

The North American Grid

Powering Cooperation on
Clean Energy & the Environment



Canadian
Electricity
Association

Association
canadienne
de l'électricité



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About CEA

Founded in 1891, CEA is the authoritative voice of the Canadian electricity industry, promoting electricity as a key social, economic and environmental enabler that is essential to North America's prosperity. CEA members generate, transmit, distribute and market electric energy to industrial, commercial and residential customers across Canada and into the United States every day. From vertically-integrated electric utilities, independent power producers, transmission and distribution companies, power marketers, and to the manufacturers and suppliers of materials, technology and services that keep the industry running smoothly – all are represented by this national industry association.



Nova Scotia Power's Annapolis Tidal Generating Station is one of the few tidal power plants in the world, and the only one in North America. The plant can generate approximately 80-100 megawatt hours of electricity every day, depending on the tides. Photo courtesy of Nova Scotia Power.

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1. EXECUTIVE SUMMARY

A new chapter in North America's energy story is being written. Across Canada, the United States, and Mexico, fundamental shifts in the production and consumption of energy are progressing inexorably.

In particular, each country is witnessing historic changes in the management of one of its most vital public goods – a reliable, affordable, and sustainable electricity system.

In Canada, for example, the system requires a wave of infrastructure investment and renewal on an unprecedented scale. Facing a similar challenge, the U.S. is also witnessing a lively debate about the optimal roles for centralized and distributed energy resources in the country's electricity future. Further south, Mexico's bold journey towards energy sector reforms recently reached an impressive milestone with the launch of a competitive, wholesale national electricity market.

Equally significant is that these transformations are now unfolding against the backdrop of a robust global consensus on the imperative of combating climate change. Nearly 200 countries endorsed the agreement reached at the United Nations climate conference in Paris in December 2015. Across North America, decision-makers recognize that the transition towards a more sustainable, low-carbon economy must be accelerated.

It is in this context that Canada, the U.S., and Mexico are cooperating to better position each country individually – and the continent collectively – to meet the challenges and seize the opportunities ahead. The Canadian Electricity Association (CEA) is supportive of this approach, as it is a natural extension of the deep economic integration that has propelled North America to new heights of prosperity in recent decades. It also builds upon the successful trilateral tradition of protecting our common airshed.

Recent Memoranda of Understanding (MOUs) signed by all three countries have served as timely and effective measures to expand North American cooperation in a manner responsive to the new energy landscape.ⁱ These trilateral efforts are likewise being supplemented by valuable bilateral engagement, such as the joint pledges on climate and clean energy made by Canada and the U.S. in March 2016.ⁱⁱ

However, CEA believes that the nature and pace of current transformations demand even broader and deeper action by governments. North America requires a suitable policy architecture capable of both leveraging the continent's significant energy potential and addressing the immense magnitude of climate change challenges.

“A sustainable energy future for North America will only be possible through enhanced cooperation to expand the development and deployment of innovative clean technologies, energy efficiency, and renewable integration.”

Pedro Joaquín Coldwell, Mexican Secretary of Energy



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.

CEA is therefore encouraged that the next phase of trilateral collaboration may take the form of a new, comprehensive agreement promoting clean energy development and environmental protection.

In support of this initiative, CEA has formulated a series of recommendations intended to inform the scope and substance of any potential agreement.

In order to set a proper context, this paper first highlights the interconnected nature of the Canada-U.S. relationship on electricity, and the mutual benefits thereof. For reasons of geography and physics, CEA's focus is primarily placed on the integration of the Canadian and U.S. grids. Nevertheless, many of the themes in this first segment can be applied in the U.S.-Mexico context as well – especially with numerous signs heralding much closer linkages between the two countries' power systems in the years ahead.

Honourable Sergio Marchi
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The second section then outlines ways in which a future North American clean energy and environment agreement should leverage electric integration, as well as the strategic importance of electricity as a clean energy solution. Altogether, CEA offers ten recommendations, with each accompanied by suggested actions for the consideration of policymakers in Canada, the United States, and Mexico.

CEA is confident that action on these proposals will help ensure that the next exciting chapter in North America's energy story is one of increased innovation, prosperity, security, and environmental stewardship.

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RECOMMENDATIONS

1	Increase trade in clean electricity	<ul style="list-style-type: none"> • Institutionalize existing regulatory recognition of clean electricity imported across international borders as an acceptable strategy for meeting domestic carbon reduction goals. • Modernize and align administrative procedures for authorizing international exports of electricity (or alternatively, eliminate such requirements altogether). • Eliminate cross-border electricity trade barriers and irritants.
2	Promote the electrification of transportation	<ul style="list-style-type: none"> • Ratify a North American Electric Auto Pact, which would, among other things: <ul style="list-style-type: none"> – support strategic investments in electric vehicle (EV) infrastructure; – examine where federal action can support activity at the sub-national level to electrify major inter-jurisdictional transportation corridors; and – establish targets for deployment of EVs in federal fleets and build EV charging stations in government parking lots.
3	Streamline permitting processes for cross-border transmission projects	<ul style="list-style-type: none"> • Modernize and align permitting procedures for international power lines.
4	Pursue joint innovation and research and development (R&D) projects	<ul style="list-style-type: none"> • Pool resources among government agencies, national laboratories, and other public institutions to achieve efficiencies in clean energy and climate research. • Leverage Mission Innovation as a vehicle for joint R&D. • Sustain investment in carbon capture and storage technology.
5	Support clean electrification in remote and Indigenous communities	<ul style="list-style-type: none"> • Pursue action on clean energy solutions for remote and Indigenous communities, through increased deployment of renewable resources, energy storage, and micro-grids. • Facilitate the exchange of best practices for clean energy solutions in these communities.
6	Coordinate carbon pricing mechanisms	<ul style="list-style-type: none"> • Seek consistency in national carbon pricing regimes so that pan-North American emission reductions can be maximized at the lowest cost. • Support linkages between carbon trading regimes at the sub-national level (absent a continental approach).
7	Examine climate adaptation risks and practices	<ul style="list-style-type: none"> • Make climate adaptation a core priority of the North American Energy Ministers' Working Group on Climate Change and Energy. • Focus attention on critical infrastructure vulnerabilities in cities, cross-border transmission issues, and scenarios for hydropower water use.
8	Enhance electric grid security and reliability	<ul style="list-style-type: none"> • Improve government-to-government and public-private sharing of threat information. • Affirm commitments to the existing North American electric reliability standards regime. • Recognize the need for adequate essential reliability services for the electric grid.
9	Collaborate on energy information	<ul style="list-style-type: none"> • Strengthen cooperation in collecting, analyzing, and sharing energy information, especially in relation to mapping of continental infrastructure, consistency in reporting of cross-border imports and exports, and harmonization of key terms and definitions. • Help unlock the full potential of advanced analytics to optimize electric grid operations, and maximize value and benefits for customers.
10	Ensure meaningful consultation with industry	<ul style="list-style-type: none"> • Establish a forum for governments to consult with industry on implementation at regular intervals.

2. BACKGROUND – ELECTRIC INTEGRATION IN NORTH AMERICA

This paper is focused on opportunities for forging and advancing a new continental agreement on energy and the environment, with North American electric integration serving as the ideal springboard for action.

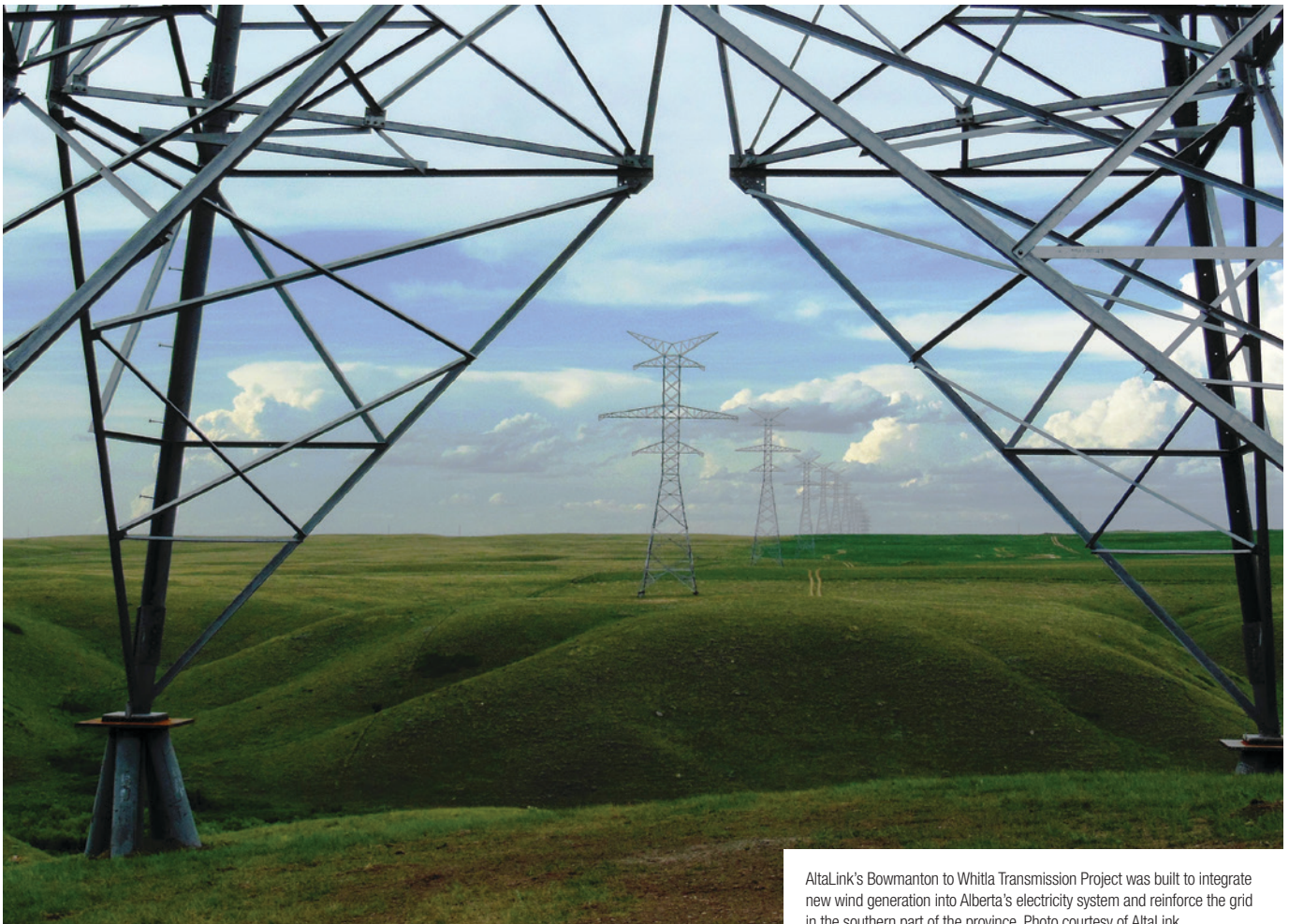
CEA is best positioned to offer initial context through the exclusive lens of Canada-U.S. linkages, as the growth of our electricity system has been inextricably and irrevocably tied with that of our southern and singular neighbour.

However, CEA is confident that much of the ensuing discussion regarding the substantial benefits of cross-border integration can likewise be applied in the U.S.-Mexico context. Although this application may be modest today, there are a host of signals foreshadowing greater electric ties between the United States and Mexico on the horizon, including the ambitious reforms being enacted in Mexico's electricity sector.

CANADA AND THE UNITED STATES – OVER A CENTURY OF INTEGRATION AND COOPERATION

CEA strongly believes that there is no better case study attesting to the significant promise and benefits of electric integration between nations than that of Canada and the United States.

This bilateral relationship has served as a model for the rest of the world on reliably planning and operating a vast, complex electricity system in a cooperative manner, while ensuring that the benefits are enjoyed by successive generations.



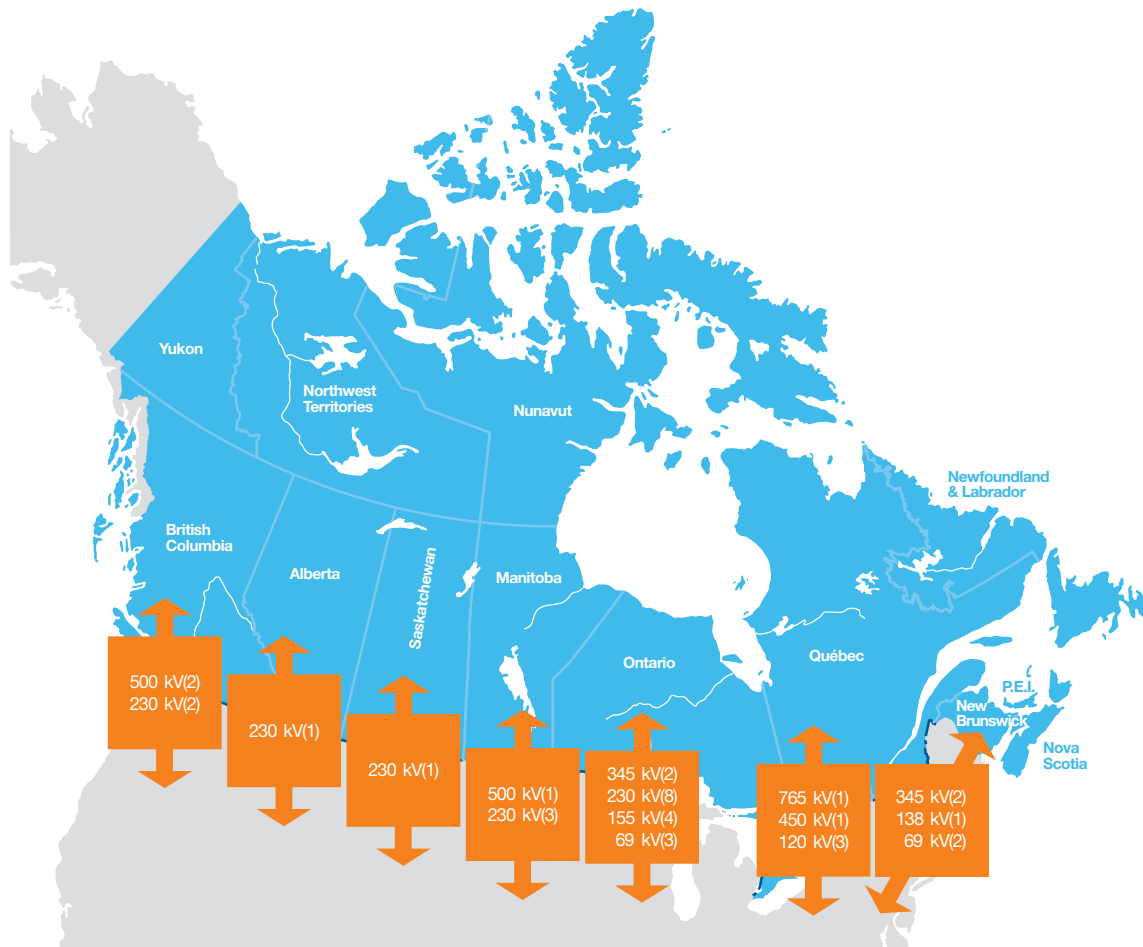
AltaLink's Bowmanton to Whitlea Transmission Project was built to integrate new wind generation into Alberta's electricity system and reinforce the grid in the southern part of the province. Photo courtesy of AltaLink.

The Integrated North American Transmission Grid

Map copyright CEA. Lines shown are 345 kilovolts (kV) and above. There are numerous interconnections between Canada and the U.S. under 345kV that do not appear on this map.



Major Transmission Interconnections Between Canada and the U.S.



Source: National Energy Board.

There are over 35 electric transmission interconnections between the Canadian and U.S. power systems, forming a highly integrated grid. It is no surprise that this immense network of power lines, generation facilities, and related communications systems is often referred to as “the world’s largest machine.”

As illustrated in the maps above, every Canadian province along the U.S. border is electrically interconnected with a neighbouring U.S. state or states, with many provinces boasting multiple (or in the case of Ontario, more than a dozen) international interties. Canada-U.S. integration is by no means a new phenomenon, with Ontario and New York

having established their first connection more than 110 years ago.ⁱⁱⁱ As discussed in greater detail below, this integration is set to continue expanding, with multiple cross-border transmission projects currently in various stages of development.

Of note, each of the proposed Canada-U.S. interconnections would unlock access to clean, non-emitting energy sources. These projects are therefore essential to maximizing North America’s clean energy potential.

Table 1 – Current U.S.-Canada International Power Line Projects

Name	Sponsor	State-Province	Length (miles)	Voltage & Capacity	Purpose	In-service Date	U.S. Presidential Permit Status
Great Northern Transmission Line	Minnesota Power (MP)	Minnesota (MN) – Manitoba (MB)	220	500 kV 750 MW, AC	Part of MP-MB Hydro PPA; supports building wind in North Dakota	June 2020 (expected)	Application filed April 2014
Lake Erie Connector	ITC	Pennsylvania (PA) – Ontario (ON)	72.4	1,000 MW, HVDC (underwater, merchant)	Deliver surplus ON renewable energy, enhance service reliability	Q4 2019	Application filed May 2015
New England Clean Power Link	TDI-New England	Vermont (VT) – Québec (QC)	154	1,000 MW, HVDC (underwater, underground, merchant)	Deliver renewable energy from QC into VT and New England	2019 (expected)	Application filed May 2014
Northern Pass	Northern Pass Transmission LLC	New Hampshire (NH) – QC	187	1,200 MW, HVDC line with 345 kV AC spur	Deliver QC hydro into NH and New England	2019 (expected)	Application filed October 2010; re-filed with new route July 2013
Soule River Hydroelectric Project	Soule Hydro, LLC	Alaska (AK) – British Columbia (BC)	10	138 kV, HVAC (underwater)	Support 77 MW hydro project in AK (sales to BC or Pacific Northwest)	TBD	Application filed March 2013

Sources: <http://energy.gov/oe/services/electricity-policy-coordination-and-implementation/international-electricity-regulation-2>; <http://www.itclakeerieconnector.com/>

The physical linkages between the Canadian and U.S. grids have also enabled steady growth in what has become a robust, continent-wide marketplace for electricity. Electricity trade occurs at a range of points both across and beyond the international border. This is a clear reflection of the largely north-south nature of the networks in Canadian provinces, as they seamlessly tie into the dense web of transmission infrastructure in the U.S.

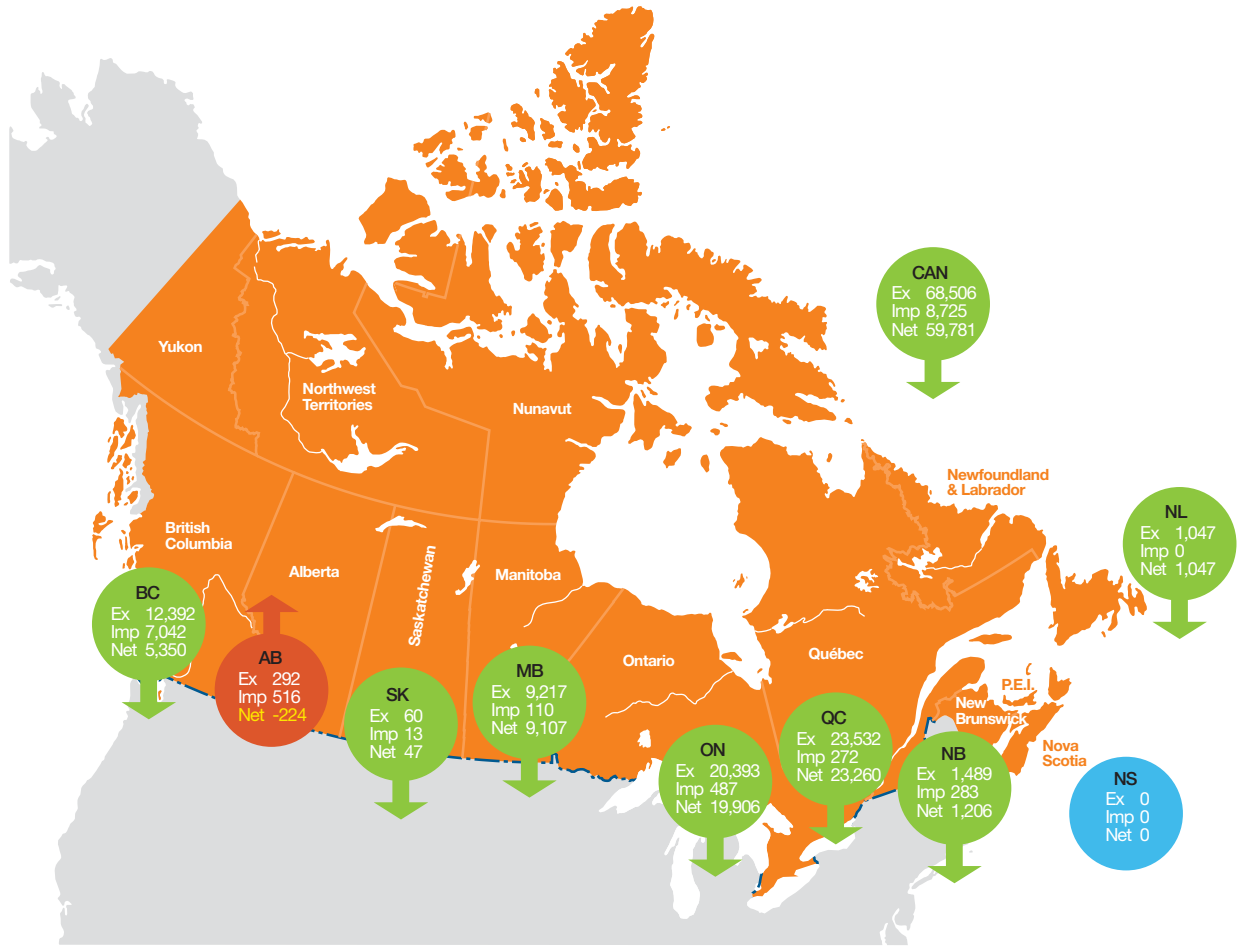
Historically, electricity exports to the U.S. have represented five to 10 percent of total electric generation in Canada. The majority of these exports involve the sale of surplus output from provinces with major hydropower resources, such as British Columbia, Manitoba, and Québec. More recently, though, export volumes from Ontario have also risen, making the province the second largest exporter for several years. In 2015, nuclear, hydropower, and wind comprised over 90% of Ontario’s supply.^{iv} New England has also recently seen an uptick in imports of nuclear energy from

New Brunswick, following the Point Lepreau Nuclear Generating Station’s return to service in 2012. Moreover, exports from Newfoundland and Labrador are set to increase, in view of new hydroelectric development. In addition, as more wind and other renewables come online in Canadian provinces, these resources are beginning to comprise a growing share of the electricity export mix.

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

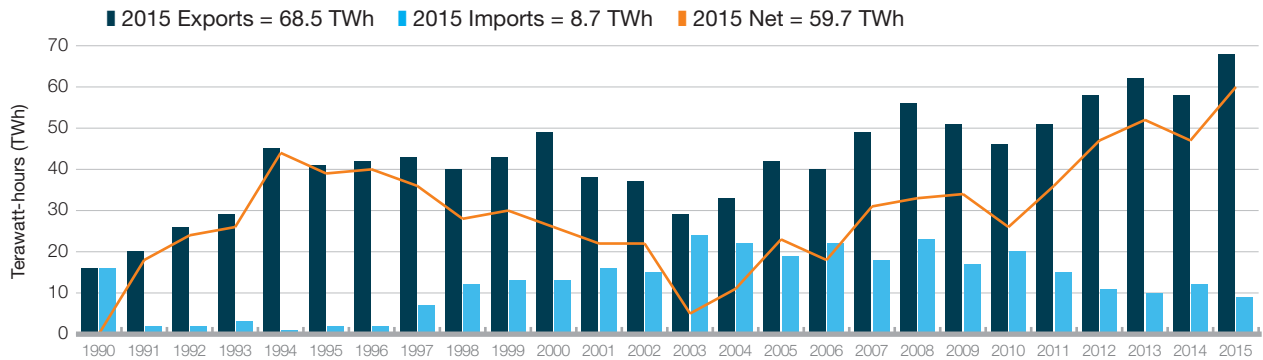
This bilateral, bidirectional movement of electricity largely goes unnoticed by the public. The home crowds cheering on the Vancouver Canucks might never contemplate that electricity generated in the U.S. could be illuminating the arena. Meanwhile, the car manufacturer in Michigan may be unaware that electricity from Canada is powering its assembly line.

Electricity Exports and Imports Between Canada and the U.S. (2015)



Data displayed are in gigawatt-hours.
 Numbers may not sum due to rounding.
 Source: National Energy Board, Electricity Exports and Imports, 2015.

Canada-U.S. Electricity Trade Volume (1990–2015)

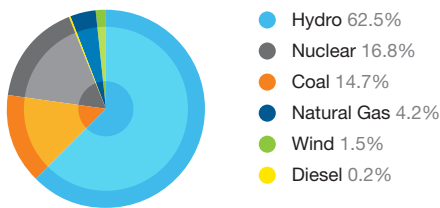


Data displayed are in terawatt-hours.
 Source: National Energy Board, Electricity Exports and Imports, 2015.

Electricity Generation in Canada and the U.S. by Fuel Type (2014)

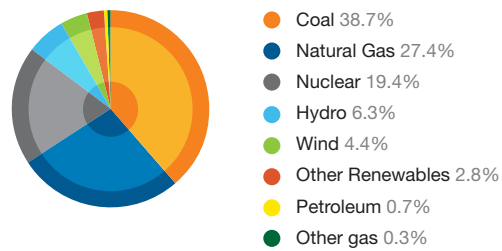
CANADA

Total Electricity Generation in 2014 = 627.68 TWh



UNITED STATES

Total Electricity Generation in 2014 = 4,093 TWh



Sources: Statistics Canada, Survey 2194, 2014; U.S. Energy Information Administration, *Electric Power Monthly*, 2014.

This is not a cause for concern, but a reflection of how routine and reliable the cross-border exchange of electricity has become. The integration of electricity markets in Canada and the U.S. means supply can fulfill demand in the most efficient, cost-effective manner possible.

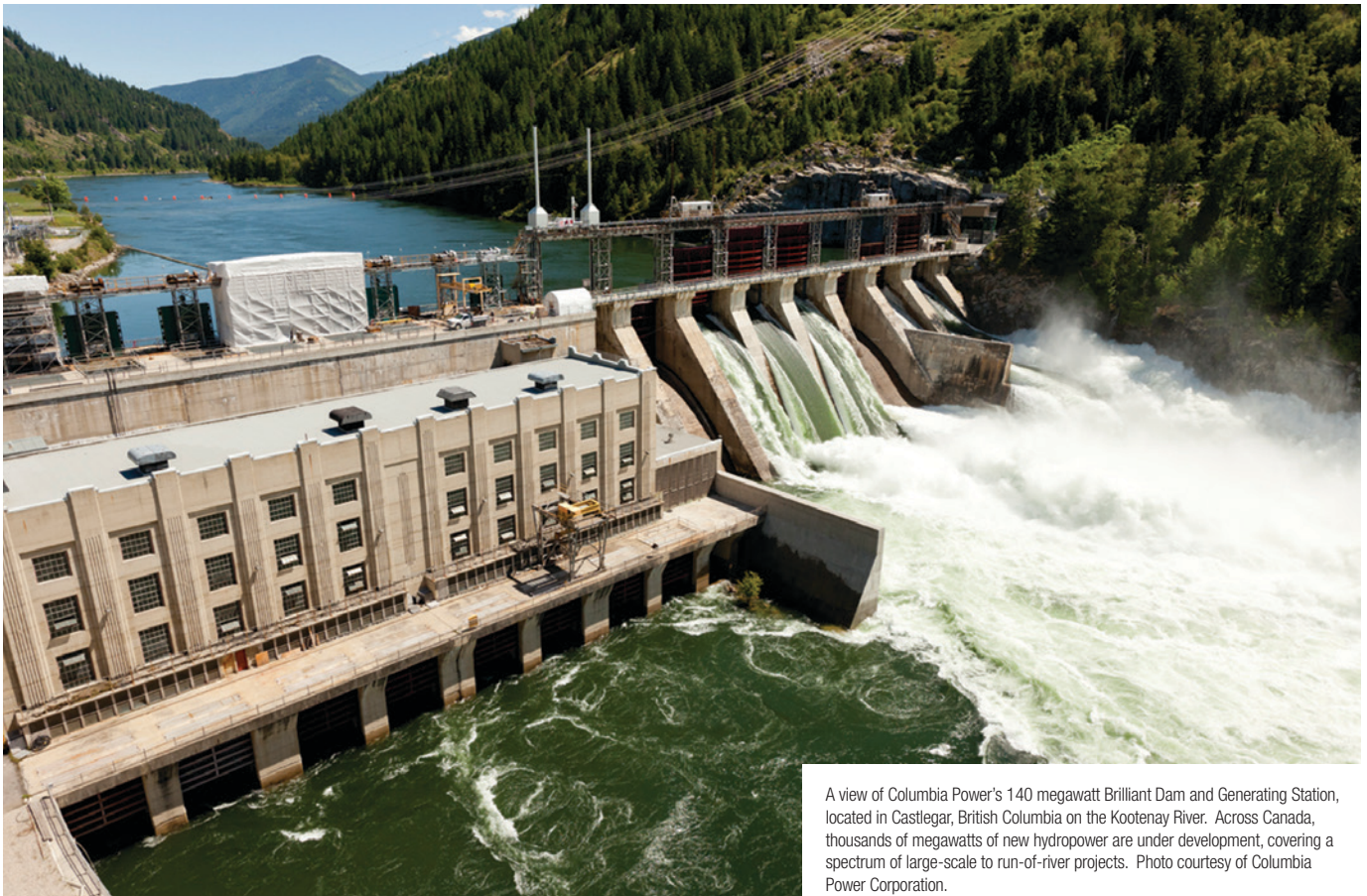
As the pie charts above illustrate, Canada and the U.S. have very different generation mixes. These differences emerge primarily from the availability of resources, as different geographic regions have access to different fuel inputs. System integration and cross-border trade enable market participants to take advantage of the supply diversity between the Canadian and U.S. segments of the larger North American grid.

In sum, Canadians and 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 BENEFITS OF INTEGRATION

The inherent advantages of Canada and the U.S. plugging into each other's networks are numerous and manifest. These include a higher level of reliable service for customers, achieved through enhanced system stability; efficiencies in system operation and fuel management; and more opportunities to use power from nearby markets to address local contingencies.

While exports of electricity from Canada represent a relatively small share of overall U.S. power consumption, these sales are nevertheless critical to the U.S. supply mix in many border regions. For example, in 2013 imports from Canada represented the following percentages of total retail sales in these jurisdictions: New England (all states), 16%; New York, 13%; Minnesota and North Dakota (combined), 12%; and Michigan, 6%.^v



A view of Columbia Power's 140 megawatt Brilliant Dam and Generating Station, located in Castlegar, British Columbia on the Kootenay River. Across Canada, thousands of megawatts of new hydropower are under development, covering a spectrum of large-scale to run-of-river projects. Photo courtesy of Columbia Power Corporation.

Table 2 – Canadian Electricity Exports as a Percentage of Total Retail Sales in U.S. States/Regions (2013)

1	New England	16%
2	New York	13%
3	Minnesota & North Dakota	12%
4	Michigan	6%
5	Washington	2%
6	California	2%

Sources: U.S. Energy Information Administration, State Electricity Profiles (2013); National Energy Board, Electricity Exports and Imports (2013)

Likewise, integration between neighbours helps improve affordability of supply, as more efficient price signals and larger markets help to keep downward pressure on costs and expand access to competitively-priced resources.

Finally, linkages between the Canadian and U.S. power systems facilitate greater reductions in greenhouse gas (GHG) emissions – in particular, with clean Canadian exports helping to displace GHGs in the U.S. generation fleet. An integrated system helps maximize opportunities for developing renewable resources. As illustrated above in Table 1 and discussed further below, there are pending international transmission projects all across the shared border that will enable investments in new non-emitting resources. The completion of these projects will mark yet another important phase in the bilateral legacy of playing to our integrated strengths to optimize environmental performance.

3. RECOMMENDATIONS FOR A NORTH AMERICAN AGREEMENT ON CLEAN ENERGY AND THE ENVIRONMENT

The first section of this paper surveyed the attributes and the advantages of cross-border electric integration in a specific North American setting. In turn, this next section will establish a policy platform upon which governments in Canada, the U.S., and Mexico can launch a new era of cooperation and action in developing clean energy resources and protecting the environment.

RECOMMENDATION 1 – INCREASE TRADE IN CLEAN ELECTRICITY

As the common framework governing trade and investment across the continent, the North American Free Trade Agreement (NAFTA) has successfully helped to increase cross-border energy trade, including in electricity. The shared benefits which have accrued to Canadian, U.S., and Mexican energy customers as a result have been significant.

CEA strongly believes that the next phase of joint action amongst the three countries should aim to employ and re-invigorate the principles of NAFTA, in the service of expanding the volume of continental electricity trade. As detailed above, the electricity trading relationship cultivated by Canada and the U.S. is robust, with the total value of trade revenue in 2015 exceeding C\$3.4 billion.^{vi} Similarly, U.S.-Mexico electricity trade has been trending steadily upwards.^{vii}

There is room for increased growth in this area, through fidelity to NAFTA's principle of non-discrimination, with doors open to all forms of clean electricity regardless of their geographic origin.

This can easily be achieved, for example, by upholding precedents recently established in Canadian and U.S. emission rules for fossil fuel generation. The regulatory impact analysis performed for Canada's GHG performance

standards for coal-fired power plants assumes an increase in electricity imports from the U.S. in several affected provinces.^{viii} Meanwhile, the U.S. Clean Power Plan (CPP) recognizes international electricity imports as an acceptable CO₂-reduction strategy to assist U.S. states in meeting their emission reduction targets.^{ix} One study has suggested that, under the CPP, exports of clean electricity from Canada to the U.S. could triple.^x Analogous examples also exist at the sub-national level, with northeastern U.S. states increasingly opening the doors to Canadian electricity imports in their coordinated clean energy procurement plans.^{xi} CEA believes that it is essential for these underlying premises of recent regulatory action to be reflected in any future North American agreement.

CEA also maintains support for reforming existing permitting regimes in North America for cross-border electricity exports. To begin, these procedures have not been updated in decades. As a result, they neither reflect recent evolutions in power markets nor the establishment of mandatory North American reliability standards. In addition, given the integrated nature of the markets they help regulate, national permitting processes should be more aligned. Improvements could include aligning the information requested



from applicants and the length of permit terms. Moreover, the statutory language underpinning these permits reflects an outdated scarcity mindset by implicitly assuming that exporting electricity carries an inherent risk of impairing domestic supply. It also remains unclear whether these permits in fact govern anything that is not already addressed through other market or regulatory mechanisms. For these reasons, CEA continues to question the need for international electricity export permits.

Finally, CEA hopes that any new North American agreement will apply the principles of NAFTA in eliminating lingering barriers and irritants to the movement of electricity across international borders.

Fortunately, at present the number of entrenched impediments to the seamless, unrestricted exchange of electrons are few. However, those that do exist can pose significant burdens.

In certain competitive electricity markets, for example, specific market rules seem to expressly or implicitly give undue preference to internal sources of capacity and energy, while discriminating against external resources. Similarly, a common trend in past years at the sub-national level has been the adoption of restrictive renewable electricity production or purchase obligations. In some jurisdictions, these programs were configured to exclude specific non-emitting resources, on account of their size or geographic origin.

While these approaches look set to be superseded by recent policies such as the federal regulatory precedents cited above, CEA nevertheless encourages all three governments to exercise vigilance in maintaining open, inclusive cross-border trading regimes.

POLICY ACTIONS

- Institutionalize existing regulatory recognition of clean electricity imported across international borders as an acceptable strategy for meeting domestic carbon reduction goals.
- Modernize and align administrative procedures for authorizing international exports of electricity (or alternatively, eliminate such requirements altogether).
- Eliminate cross-border electricity trade barriers and irritants.



Pictured is one of the electric vehicles (EVs) in BC Hydro's fleet. The province is partnering with Washington, Oregon, and California to pave the way for an EV corridor from Whistler, British Columbia to San Diego, California. Photo courtesy of BC Hydro and Power Authority.

RECOMMENDATION 2 – PROMOTE THE ELECTRIFICATION OF TRANSPORTATION

According to a 2015 report entitled *Pathways to Deep Decarbonization in Canada*, “fuel switching to decarbonized electricity is the single most significant pathway toward achieving deep emissions reduction globally.”^{xii} Decarbonize the electricity system, the strategy goes, and then electrify everything.

In assessing the relative priority and feasibility of electrification in other sectors, the evidence overwhelmingly favours starting with transportation. First, North America boasts one of the most integrated automotive supply chains in the world. Next, transportation is the second-largest source of GHG emissions in all three countries.^{xiii}

Lastly, there is a rich, mature policy foundation to build upon. This includes an assortment of commitments to deploy electric vehicles (EVs) in government fleets and to build EV charging stations in government parking lots. It also includes exemplary sub-national partnerships, such as the Pacific Coast Collaborative, which is planning an EV corridor from British Columbia to California.^{xiv} (No doubt there is opportunity to extend this corridor into Mexico as well).

Considering the importance of the North American auto sector to the integrated economy, as well as the need for massive reductions in carbon emissions,

CEA contends that assertive government action is warranted. **Accordingly, CEA strongly encourages the three countries to ratify a North American Electric Auto Pact.** Alongside a renewed vision for cooperation on energy and climate, such action would have a galvanizing effect on the automotive industry and place it in the pole position for accelerating the transition to a low-carbon future.^{xv}

Core pieces of any trilateral “EV pact” should include strategic investments in EV infrastructure, procurement of EVs in federal fleets, and support for – as well as coordination with – state and provincial initiatives like the Pacific Coast Collaborative. Carbon pricing, which would send a clear, unadulterated price signal, is arguably the most efficient and elegant way to stimulate EV growth, shift the rate of infrastructure build-out, and propel EV adoption into high gear.

Finally, electrification of transportation is perhaps the greatest example of where the electricity sector can play a strategic role in multiplying clean energy solutions, while simultaneously enabling broader social and economic gains. For example, there is great potential for EVs to help optimize operation of the larger electricity network. By offering storage capacity to the grid, EVs can facilitate integration of intermittent renewable sources like wind and solar. Likewise, North America’s dependence on fossil fuels – and on the geopolitical adversaries who often supply them – will be significantly diminished, resulting in enhanced energy security. And of course, greater deployment of EVs will mean greater demand for clean electricity as fuel, which will in turn provide assistance in fulfilling commitments on climate change.

POLICY ACTION

- Ratify a North American Electric Auto Pact, which would, among other things:
 - support strategic investments in EV infrastructure;
 - examine where federal action can support activity at the sub-national level to electrify major inter-jurisdictional transportation corridors; and
 - establish targets for deployment of EVs in federal fleets and build EV charging stations in government parking lots.

RECOMMENDATION 3 – STREAMLINE PERMITTING PROCESSES FOR CROSS-BORDER TRANSMISSION PROJECTS

As discussed in detail above, the electric power systems in North America are highly interwoven. Between Canada and the United States alone, there are approximately three dozen physical transmission interconnections. A handful of lines connect the U.S. and Mexico as well, with potentially greater integration to come.

These interconnections are the electric bridges linking the transmission superhighways crisscrossing the continent. They serve as stabilizers of the larger network and vital conduits for two-way flows in electricity trade. Where appropriate, they can be key solutions for reducing transmission congestion, improving reliability, and unlocking new sources of renewable energy.

In view of the inherent benefits in this cross-border infrastructure, it is not surprising that there remains significant interest in further expansion. For example, along the Canada-U.S. border, there are numerous interconnection projects in various stages of development.^{xvi} (See Table 1 above). One strategically important unifying feature of each project is that it would help bring online new sources of clean, non-emitting energy in all three countries. These projects are therefore critical to ensuring that North America's clean energy potential is maximized, rather than left stranded.

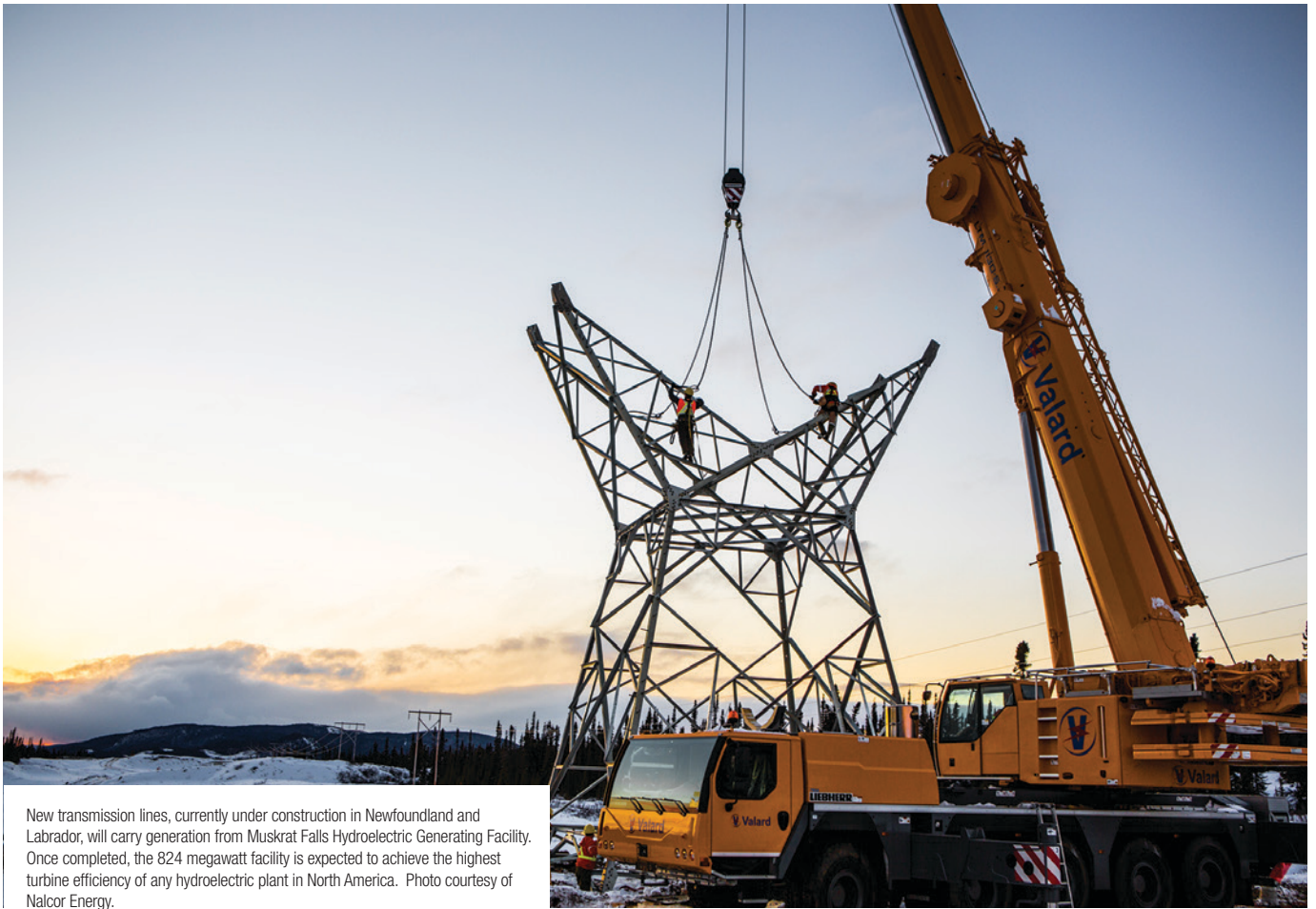
In recent years, however, numerous projects have suffered setbacks in their timelines. Many of these are attributable to ill-defined and out-of-date parameters around project reviews and scoping periods (particularly under the U.S. framework). Inconsistencies and undue delays in these processes inject uncertainty and risk into development plans, and deprive consumers of such benefits as enhanced reliability, affordability, and diversity of supply. And arguably, any barrier to expanding cross-border infrastructure is likewise a barrier to greater trade.

To their credit, authorities in both Canada and the United States have recognized for some time the need for reform and are beginning to take action to update their respective requirements. Nevertheless, CEA would respectfully observe that the pace of these efforts has been quite slow, with little traction gained and the final timeline for completion unclear.

Accordingly, **CEA continues to urge greater government-to-government cooperation in modernizing and streamlining the permitting processes governing these projects.** A joint approach to permitting reform will help maximize effectiveness and efficiencies between the respective national authorities' efforts. In addition, similar to the discussion on electricity trade above, CEA encourages the alignment of permitting requirements for cross-border transmission projects, with an eye towards instilling greater certainty and stability into the process.

POLICY ACTION

- Modernize and align permitting procedures for international power lines.



New transmission lines, currently under construction in Newfoundland and Labrador, will carry generation from Muskrat Falls Hydroelectric Generating Facility. Once completed, the 824 megawatt facility is expected to achieve the highest turbine efficiency of any hydroelectric plant in North America. Photo courtesy of Nalcor Energy.

“The sense of urgency and spirit of cooperation demonstrated by Canada, Mexico, and the United States serve as an example as the rest of the world takes urgent action on climate.”

Dr. Ernest Moniz, U.S. Secretary of Energy

RECOMMENDATION 4 – PURSUE JOINT INNOVATION AND RESEARCH AND DEVELOPMENT (R&D) PROJECTS

There is a growing push across North America for electricity providers to offer a range of energy services through a data-driven, customer-centric operations platform. Four key drivers, in particular, are influencing action: reducing GHG emissions; increasing system resiliency to climate change and extreme weather events; empowering customers to play a more central role in shaping the system; and containing costs to be able to do more with less.

Ultimately, the electricity sector's success in this regard will require movement well beyond incremental productivity improvements. All of this makes technological innovation central to the modern electric utility mission.

Too often, however, funding to develop, test, and deploy experimental pilot projects and innovative technologies is deemed by utility regulators to be discretionary spending and is cut from rate-recovery budgets. Regulators have tended to focus on immediate costs and needs in order to keep consumers' rates as low as possible. In practice, this results in repeated deferral of investment and R&D into projects aimed at transforming electricity generation, transmission, and distribution.

When it comes to transformational innovation projects, the electricity sector can, should, and wants to do more. However, partnerships with government are needed to enable adequate funding, mitigate risks, and distribute rewards. CEA strongly believes that there is space for meaningful contributions to innovation in the context of any renewed agenda for trilateral cooperation.

As a general matter, CEA encourages all three countries to pool resources – where appropriate – among relevant government agencies, national laboratories, and other public institutions to achieve efficiencies in clean energy and climate research.

Possibilities abound for joint action – whether through exploration of alternative supply technologies, integration of distributed energy resources and EVs, energy storage, grid monitoring and modelling, or next-generation power transformers, to name a few. In addition, while the North American electricity sector is marching to a steady beat of decarbonization, fossil fuels will remain part of the power generation mix for decades to come, especially in the U.S. and Mexico. **Sustained support for carbon capture and storage technology is therefore imperative.**



An aerial view of SaskPower's Boundary Dam Power Station. In 2014, Boundary Dam became the world's first commercial-scale, fully-integrated carbon capture and storage system. Photo courtesy of SaskPower.

A potential vehicle for action is Mission Innovation. Launched on the margins of the UN climate conference in Paris, this initiative holds significant promise for coupling government support for and spurring private sector investment in clean energy technology. As all three countries are founding members of this global partnership, CEA recommends that synergies be leveraged between Mission Innovation and any action contemplated through new trilateral agreements.

An animating principle of this effort should be incentivizing electricity providers to serve as the real-world test-bed in which transformational technology can be tested and refined. Successful projects can then be marketed externally as high-margin, knowledge-economy products and services.

POLICY ACTIONS

- Pool resources among government agencies, national laboratories, and other public institutions to achieve efficiencies in clean energy and climate research.
- Leverage Mission Innovation as a vehicle for joint R&D.
- Sustain investment in carbon capture and storage technology.



A Nalcor Energy employee on the job. Nalcor has built one of the world's first integrated hydro, wind, and diesel energy systems in a remote, off-grid island community. Photo courtesy of Nalcor Energy.

Electricity Innovation in Action

The following five projects provide a coast-to-coast snapshot of the world class innovation led by Canadian electricity companies:

1. **BC Hydro** is leading a smart infrastructure initiative, working with partners to deliver a public network of EV charging stations.
2. **SaskPower's** Boundary Dam power station in Saskatchewan is home to the most advanced power station carbon capture and storage system on the planet.
3. **Ontario Power Generation** is converting shuttered coal plants to biomass. Its Atikokan Generating Station is the largest 100 per cent biomass-fueled electricity plant in North America.
4. **New Brunswick Power** is partnering with Siemens on several pioneering Smart Grid projects. One involves Canada's first "energy internet" enabling communication between customers and the grid; the other, a platform for local firms to test and adapt Smart Grid products and services.
5. **Nalcor Energy** has built one of the world's first energy systems to integrate generation from wind, hydro, and diesel. The project is located in the remote off-grid community of Ramea Island.



The 2013 participants from the Island Falls Hydroelectric Station High School Graduate Program. Pictured from left to right: Corey Bear, Clorissa Morin, Marianne McCallum, Reina McCallum. Photo courtesy of SaskPower.

RECOMMENDATION 5 – SUPPORT CLEAN ELECTRIFICATION IN REMOTE AND INDIGENOUS COMMUNITIES

While Canada, the United States, and Mexico have very different geographies, they are all home to communities in remote, isolated areas. In many instances, these are communities of Indigenous peoples who often live in challenging circumstances.

Another unfortunate consequence of innovation funding gaps discussed previously has been persistent challenges in extending electricity service to areas with insufficient ratepayer critical mass. This has left many remote communities reliant on high-emitting diesel fuel to keep the lights on.

CEA firmly believes that remote and Indigenous communities must not be left behind in North America's transition to a cleaner energy future. Our fellow citizens in these areas are no less deserving of the benefits of a low-carbon lifestyle and economy than the rest of us.

CEA therefore strongly encourages Canada, the U.S., and Mexico to ensure that action on clean energy solutions for remote and Indigenous communities features prominently in the next phase of trilateral cooperation. Potential steps could include greater deployment of low-emitting and renewable resources, energy storage technologies, and the creation of micro grids. **In addition, the exchange of best practices on such efforts should be promoted.**

To be sure, there are promising initiatives underway. These include projects being spearheaded by utility companies in northern Canada. For years, Yukon Energy has been testing the viability of wind generation to augment hydropower and offset diesel during periods of peak demand, while assessing challenges for wind turbine design related to permafrost in Arctic bedrock.^{xvii} Similarly, in the remote community of Colville Lake (population 150), Northwest Territories Power Corporation has developed a system of solar energy and battery storage to supplement diesel generation, which should enable the community to rely exclusively on sunlight for power during the summer.^{xviii}

Notwithstanding individual success stories, there is still much more work to do in achieving widespread clean electrification in remote communities. Sustained support from governments is critical to making such transformational investments possible.

For projects of this nature, a fresh mindset is required – one that recognizes the strategic value of clean electricity investments in advancing a host of larger public policy interests. The upshot of deploying clean energy in remote and Indigenous communities is not limited just to reducing harmful diesel emissions. It will also unlock new possibilities for economic prosperity, as new electric infrastructure corridors help facilitate natural resource and industrial development.

Here again, electricity can serve as a strategic and positive force for advancing the public good. CEA urges policymakers to take full advantage of this opportunity as a new North American agreement on clean energy and the environment is contemplated and crafted.

POLICY ACTIONS

- Pursue action on clean energy solutions for remote and Indigenous communities, through increased deployment of renewable resources, energy storage, and micro-grids.
- Facilitate the exchange of best practices for clean energy solutions in these communities.



An aerial view of the Haeckel Hill wind facility outside of Yukon's capital city, Whitehorse. Yukon Energy is testing the viability of wind generation to augment hydropower and offset diesel during periods of peak demand. Photo courtesy of Yukon Energy.

RECOMMENDATION 6 – COORDINATE CARBON PRICING MECHANISMS



Capital Power's 40 megawatt Kingsbridge 1 facility located near Goderich, Ontario. Photo courtesy of Capital Power.

The global drive to price carbon emissions continues to grow. In October 2015, for example, the World Bank, the International Monetary Fund, and the Organization for Economic Cooperation and Development launched the Carbon Pricing Panel, which encourages all nations to set up carbon markets or tax emissions.^{xix}

In Canada, there has been significant policy movement in step with this crystallizing consensus. In 2008, British Columbia became the first jurisdiction in North America to impose a carbon tax, widely acknowledged as among the

most successful approaches to carbon pricing worldwide. Subsequent action elsewhere in the country has meant that, pending the implementation of cap-and-trade programs in two provinces, approximately 90% of Canadians will live in a province with a carbon pricing system. What's more, in early March 2016, federal, provincial, and territorial leaders in Canada agreed to identify avenues for additional action on carbon pricing. This effort is part of a pan-Canadian framework on clean growth and climate change aimed at meeting or exceeding the country's emission targets under the Paris Agreement.^{xx}

It remains CEA's view that a carbon price applied economy-wide across North America will allow for much greater emission reductions at a much lower cost, when compared to sector-specific regulation. Any carbon pricing mechanisms in Canada, the U.S., and Mexico ought to work in a coordinated fashion, especially to prevent emissions leakage from one jurisdiction to another.

Carbon pricing holds great promise for effective action on mitigating climate change. CEA appreciates that individual jurisdictions may wish to tailor carbon reduction policies, depending on their specific circumstances or needs (e.g. carbon tax, emissions trading, or a hard cap on emissions). CEA also fully recognizes the political, social, and economic challenges associated with putting a price on carbon in any jurisdiction (let alone in three sovereign countries). Nevertheless, CEA hopes that the next phase of trilateral cooperation on clean energy and the environment will signal interest and aspiration on this front.

Absent coordinated action at the continental- or national-level, governments should continue acknowledging and encouraging developments at the sub-national level. Jurisdictions like British Columbia, California, and Québec have demonstrated the promise and effectiveness of these approaches (the latter two through a pioneering joint carbon trading regime). **With carbon markets set to continue expanding in numerous states and provinces, federal governments in North America have a crucial role to play in promoting opportunities for greater carbon market linkages at the sub-national level.**

POLICY ACTIONS

- Seek consistency in national carbon pricing regimes so that pan-North American emission reductions can be maximized at the lowest cost.
- Support linkages between carbon markets at the sub-national level (absent continental or national approaches).



An AltaLink transmission line in Canmore, Alberta during one of the worst floods in the province's history. Total damages were estimated at more than \$6 billion. Photo courtesy of AltaLink.

RECOMMENDATION 7 – EXAMINE CLIMATE ADAPTATION RISKS AND PRACTICES

The preceding discussion on carbon pricing touches a core area of focus for climate policy – mitigation. Quite simply, mitigation in the context of climate change pertains to capping and ultimately reducing carbon emissions. Traditionally, the broader dialogue around climate change has dwelled on mitigation efforts.^{xxi}

In recent years, however, much greater attention has been paid to the other core component of action on climate change – adaptation. In short, the need to adapt to and prepare for the now unavoidable effects of climate change has become an increasingly apparent reality.

CEA urges policymakers in Canada, the United States, and Mexico to incorporate the reality of climate adaptation into subsequent plans for trilateral action, including the

prospect of a new continental agreement on clean energy and the environment. CEA applauds the identification of climate adaptation as an area for collaboration, both in the May 2015 formation of a Ministerial-level working group on climate change and energy^{xxii}, and in the February 2016 MOU on enhanced cooperation. **CEA strongly encourages Ministers to grant this issue the importance it deserves and adopt it as a core priority for their working group.**

With the aim of helping to inform and advance the broader discourse on climate adaptation, CEA recently released a report entitled *Adapting to Climate Change: State of Play and Recommendations for the Electricity Sector in Canada*.^{xxiii} This document represents the first national-level discussion in Canada on climate adaptation in the

electricity sector. The chief objectives of the report include communicating the importance of climate adaptation as a critical issue for the electricity sector, providing an overview of current adaptation perspectives and practices among electricity companies, and recommending actions to advance adaptation efforts in the sector and with key stakeholders.

In brief, the report stresses that greater clarity in climate change data and modelling methods, as well as the development of corporate governance tools and structures, is needed to successfully incorporate adaptation considerations into planning and investment decisions. The report also calls for greater collaboration amongst the stakeholders responsible for ensuring the resilience of electricity networks, including federal and sub-national governments.

Of note, the paper finds that a substantial (and growing) body of evidence confirms the business case for adaptation investments, and that the cost of these investments will be vastly exceeded by the cost of inaction.

Based on the findings and recommendations in the paper, CEA recommends that any North American agreement on clean energy and the environment focus its attention on the following key areas of shared concern:

- Critical infrastructure vulnerabilities in cities (especially in the context of temperature increases exacerbated by the urban heat island effect).
- Cross-border transmission issues (recognizing the critical reliability benefits provided by Canada-U.S. interconnections and the numerous risks posed to such infrastructure by climate effects like wildfires, ice storms, and changes in ground conditions).
- Scenarios for hydropower water use (recognizing that changes in water availability in one country may impact generators in the other country, as well as the overall electricity trade balance).

Climate change presents a wide range of risks and vulnerabilities for the electricity sector. With the effects of climate change becoming less predictable, the sector needs assistance in preparing for a more dynamic and uncertain landscape. Through joint leadership and action, the Canadian, U.S., and Mexican governments could offer much value to this effort.

POLICY ACTIONS

- Make climate adaptation a core priority of the North American Energy Ministers' Working Group on Climate Change and Energy.
- Focus attention on critical infrastructure vulnerabilities in cities, cross-border transmission issues, and scenarios for hydropower water use.

“Secretary Moniz, Secretary Joaquín Coldwell and I want to build on North America’s strength as one of the world’s most dynamic and influential regions for secure and sustainable energy.”

The Honourable James Carr, Canadian Minister of Natural Resources

RECOMMENDATION 8 – ENHANCE ELECTRIC GRID SECURITY AND RELIABILITY

Clean energy deployment and enhanced environmental protections are indispensable steps in the transition to a low-carbon future. However, these activities will be in vain if they are not matched with an unfailing commitment to the security and reliability of electric power supply and delivery.

Accordingly, while the issues fall slightly outside the customary contours of dialogue on clean energy and the environment, CEA believes that grid security and reliability warrant attention in the context of this broader agreement being contemplated by North American leaders.

The threat landscape facing the energy and electricity sectors is increasingly serious. Regrettably, the power grid remains a popular target of foreign adversaries. The December 2015 cyber event which led to a prolonged power outage in Ukraine is just one of many examples illustrating the gravity of threats currently facing critical infrastructure sectors.

It would be naïve for governments and industry to assert that it is possible to mitigate every possible threat looming in cyberspace and elsewhere. However, certain measures to shore-up the security of critical energy systems are within our control.

Along with colleagues in the energy and other sectors around the world, CEA strongly believes that greater sharing of threat information – between and among sectors and governments – is our first line of defence towards securing the integrity of our systems. **CEA encourages the Canadian, U.S., and Mexican governments to improve government-to-government and public-private sharing of critical, timely, and actionable threat information.**

Valuable steps forward in this regard could include increased funding and capacity for the national computer emergency readiness teams (or CERTs) in each country;



An employee monitors conditions on the grid in Ontario at the control room of the Independent Electricity System Operator. Photo courtesy of Independent Electricity System Operator.

development of integrated, cross-border incident response plans for cyber and physical security threats of national significance; deployment of standardized, automated platforms for machine-to-machine information sharing; and robust government interface with the electricity sector's official information sharing and analysis center (E-ISAC).^{xxiv}

There is a host of fertile ground upon which to build. For example, the Government of Canada has announced plans to launch a review of federal cyber policy.^{xxv} CEA hopes that this exercise will emphasize the need for strengthened international partnerships, including trilateral cooperation in North America. In addition, U.S. legislation passed in December 2015 included provisions for electric grid emergency consultation and information sharing between the U.S. government and its Canadian and Mexican counterparts.^{xxvi} CEA applauds these measures and believes that it would be entirely appropriate for their implementation to be incorporated into a North American energy and environment agreement.

Finally, all three governments should renew their commitment to the integrity and longevity of our current international electric reliability model, as embodied in the North American Electric Reliability Corporation (NERC). NERC is an exceptional success story for transboundary cooperation on standardizing electric grid planning and operations. This story is set to become even more compelling, as Mexico is further integrated into the fold.

What's more, NERC is in the midst of extremely valuable technical work on the implications of the changing electricity resource mix in North America. In December 2015, for example, NERC issued a detailed report examining those services and operational characteristics which are essential for maintaining grid reliability.^{xxvii} This analysis is a must-read for all federal and sub-national policymakers whose decisions can have a direct influence on the composition of the power supply mix. **As Canada, the U.S., and Mexico look to integrate more clean energy onto the system, a proper recognition and understanding of these essential services will be a primary determinant of ultimate success.**

POLICY ACTIONS

- Improve government-to-government and public-private sharing of threat information.
- Affirm commitments to the existing North American electric reliability standards regime.
- Recognize the need for adequate essential reliability services for the electric grid.



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.

RECOMMENDATION 9 – COLLABORATE ON ENERGY INFORMATION

“Knowledge is power.” These words, originally coined by Sir Francis Bacon in 1597, still ring true today as loudly as they did over 400 years ago. And in a delightful twist of linguistic irony particular to CEA’s industry, this maxim is also a fitting tribute to the incredible potential of “big data” to transform the supply, delivery, and management of electric power.

It is a truism that informed public policy is not possible without information. And yet, there is growing recognition across North American policymaking circles that, when it comes to energy, the data at their disposal is quite literally all over the map. Canadian, U.S., and Mexican energy ministers have discovered that their respective data inventories for energy commodities, infrastructure, and

trade flows are often not congruent, nor do they consistently employ the same terminology. The end result frustrates efforts to perform research and analysis on continental energy trends, as well as to anchor sound policy proposals on a firm, evidence-based footing.

To their credit, North American energy ministers have acknowledged these gaps and have committed to plugging them. The MOUs established in recent years have included provisions promoting enhanced cooperation in collecting, analyzing, and sharing energy data.^{xxviii} **CEA applauds these efforts and encourages a strengthening thereof in any new North American energy and environment agreement.** In CEA’s view, it would be profoundly regrettable if the fulfillment of common objectives was impeded by the

lack of a common language and line of sight on energy data.

Specific areas where CEA welcomes improvement include mapping of continental infrastructure, consistency in reporting of cross-border imports and exports, and harmonization of key terms and definitions for energy products and flows.

In addition, CEA urges ongoing government support for unlocking the full potential of “big data” and advanced analytics to optimize electric grid operations and, in turn, maximize value and benefits for customers. Across Canada, CEA members are continuing to develop and deploy new applications for data analytics, ranging from enhanced customer control over energy usage, detection of security threats, integration of distributed energy resources, and real-time monitoring of system performance.

Notwithstanding these forward strides, there are still new frontiers to discover. However, exploring the vast range of known and unknown opportunities is well beyond the reach of any one actor or set of actors. Partnerships between government, industry, academia, and other institutions are therefore essential.

Policymakers in Canada, the U.S., and Mexico possess some unique tools, whether it be the ability to convene a collaborative process involving numerous stakeholders or to provide seed funding for promising new ventures. CEA hopes that the next phase of trilateral cooperation on clean energy and the environment will leverage these tools, thus enabling knowledge to transform the future of electric power.

POLICY ACTIONS

- Strengthen cooperation in collecting, analyzing, and sharing energy information, especially in relation to mapping of continental infrastructure, consistency in reporting of cross-border imports and exports, and harmonization of key terms and definitions.
- Help unlock the full potential of advanced analytics to optimize electric grid operations, and maximize value and benefits for customers.

RECOMMENDATION 10 – ENSURE MEANINGFUL CONSULTATION WITH INDUSTRY



Newfoundland Power employees at the company's headquarters in St. John's, Newfoundland. Photo courtesy of Newfoundland Power.

The preceding recommendations are intended to serve as constructive ideas for North American policymakers to consider in the potential development of a new trilateral agreement on clean energy and the environment. Having addressed issues of substance through these proposals, CEA wishes to offer a brief word related to process.

With the post-Paris Agreement era now upon us, CEA strongly believes that sustaining a balanced dialogue and partnership between governments and industry will be critical to the success of subsequent action. For both parties, the roles and responsibilities are clear. Governments will set the ambition and the policy framework. Industry meanwhile, will be on the front lines of implementing our way to a low-carbon future. These are two sides of the same energy and climate coin.

Many observers believe that the Paris Agreement represents a watershed moment for the international community – one which will launch an intense and higher-threshold period of work for all countries. If true, this will represent a momentous political and business challenge.

In support of impending and ongoing work in the Canadian context, CEA has called for the creation of a new, permanent consultation forum. CEA envisions this forum helping governments build common ground and foster consensus in an effort to craft and execute a coherent, cohesive, continuously-evolving climate strategy.

For similar reasons, CEA believes that any trilateral agreement should have a provision for regular consultation with industry. Transparent, inclusive processes empower real change. They provide industry with the policy and regulatory certainty required to pursue business model adjustments, ground-breaking innovation, and transformational investments.

Likewise, these processes offer governments a continual feedback loop around their plans and aspirations. As this paper illustrates, the electricity sector is keen to engage and to inform an ambitious, yet realistic vision of what can be achieved.

Accordingly, CEA requests that any new trilateral agreement establish a forum for governments to consult with industry on implementation at regular intervals.

CEA recognizes there are numerous factors to evaluate in determining how best to convene governments, industry, and other stakeholders (e.g. non-governmental organizations, Indigenous peoples, and public interest groups) in pursuit of common ground on energy and environmental solutions. In addition, there may be several different models for consultation that policymakers may wish to consider for this purpose.

Nevertheless, CEA respectfully contends that the prospects for successfully implementing a new North American agreement will be maximized if a provision for regular consultation with industry is built in at the onset, rather than bolted on at a later stage.

POLICY ACTION

- Establish a forum for governments to consult with industry on implementation at regular intervals.

4. CONCLUSION

The continental energy landscape is being transformed and the global consensus on combatting climate change is strengthening. Against these backdrops, CEA believes that there are significant opportunities for leveraging North American electric integration and the strategic importance of electricity as a clean energy solution.

These opportunities will be more achievable and numerous when Canada, the U.S., and Mexico pursue them together, rather than in isolation. This fundamental premise was recognized more than 20 years ago with the sealing of an historic free trade agreement, which bound together all three countries in a common quest for enhanced prosperity, security, and environmental performance.

CEA is encouraged that a kindred vision is guiding today's decision-makers in North America, as they consider another historic step – a new agreement on clean energy and environmental protection. An agreement of this nature holds great promise for anchoring the next phase of North America's economic growth in clean development and driving low-carbon innovation.

In support of such an approach, this paper has recommended ten specific opportunities for pursuit and progress in the trilateral arena.

CEA looks forward to working with all three governments, along with our private sector counterparts in the U.S. and Mexico, to take maximum advantage of these opportunities. Indeed, collaboration and consultation between government and the private sector will be instrumental to the success of this effort. CEA trusts that the February 2016 MOU's appeal for all three governments to engage with outside stakeholders "wherever possible" will likewise serve as a fundamental guiding principle for subsequent activity on this new proposal.

CEA urges decision-makers to seize the opportunities afforded by this period of transformation in the energy and climate landscape. Success in this enterprise will help ensure that the corresponding economic, social, and environmental benefits are shared across the continent, by all the peoples of North America, in the fullest possible measure.

For North America, a new energy story awaits.

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