Canadian Electricity and the
economy

The Integrated North American Electricity Market

A Bi-National Model for Securing a Reliable Supply of Electricity

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Canadian Electricity Association

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Association canadienne de l'électricité

Executive Summary

On August 14, 2003, an estimated 50 million people in the Midwest and Northeast United States, and in Ontario, Canada experienced an electric power blackout. In a matter of seconds, U.S. and Canadian electricity customers understood first-hand how vital electricity is in our day-to-day lives. But these same customers also saw the great resiliency of the North American electricity system. Within 12 hours, over 2/3 of power generation had been restored to service. And the outage did not cause any damage to the generation or transmission facilities connected to the grid.

The North American electricity system, which interconnects Canadian and U.S. electricity markets, is among the most reliable in the world. It is a system where increasingly open markets have brought with them opportunities for new efficiencies, new technologies, and ultimately better customer service and price. However, the same system is subject to a host of pressures – aging infrastructures, lack of new build in generation and transmission to meet demand, growing regulatory pressures, to name a few – that are of such significance that reliability is threatened.

Given the interconnected nature of the system, measures taken to respond to the threat to ongoing reliability should be, wherever possible, bi-national in scope. With this paper, the Canadian Electricity Association is taking the initiative to propose seven such measures for all stakeholders to consider:

1) Support an open debate on all of the supply options available to meet the growing demand for electricity.
2) Encourage bi-national cooperation on the construction of new transmission capacity to ensure a reliable continental electricity system.
3) Explore opportunities for bi-national cooperation for both investment in advanced transmission technologies and transmission R&D.
4) Promote new generation technology and demand-side measures to relieve existing transmission constraints and reduce the need for new transmission facilities.
5) Endorse a self-governing international organization for developing and enforcing mandatory reliability standards for the evolving electricity industry.
6) Coordinate measures to promote critical infrastructure protection.
7) Harmonize U.S. and Canadian efforts to streamline or clarify regulation of electricity markets.

The reliability of the electricity system is a fundamental international concern and cannot be properly addressed without the full engagement and cooperation of both Canada and the United States. Anything less could impede future cross-border trade and, more significantly, undermine the very reliability we all seek to guarantee.

I. Electricity: A Vital Service

On August 14, 2003, an estimated 50 million people in the Midwest and Northeast United States, and in Ontario, Canada experienced an electric power blackout. In a matter of seconds, U.S. and Canadian electricity customers understood first-hand how vital electricity is in our day to day lives. But these same customers also saw the great resiliency of the North American electricity system. Within 12 hours, over 2/3 of power generation had been restored to service. And the outage did not cause any damage to the generation or transmission facilities connected to the grid.

The North American electricity system, which interconnects Canadian and U.S. electricity markets, is among the most reliable in the world. Nevertheless, reliable operation of the system is both complex and demanding. Under the best of circumstances, maintaining reliable operations is a difficult task.

Moreover, the advent of wholesale competitive markets has dramatically changed the way the system is used and operated. The system was designed to accommodate the needs of vertically-integrated electric utilities relying on their own generation or the generation of neighbouring utilities. The nature of the industry allowed for a reliable transmission grid. Competitive markets, bringing with them opportunities for new efficiencies, new technologies, and ultimately better customer service and price, have also brought pressure on a system that hasn't been expanded to meet these new demands.

Within days of the August 14th outage, the U.S.-Canada Power System Outage Task Force ("Task Force") was established to both determine the causes of the outage and to develop recommendations to reduce the possibility of future outages. The Interim Report of the Task Force identified numerous violations of NERC reliability standards as the principle reason for the August 14th outage. The Task Force Final Report is expected shortly. And it comes at a time when questions regarding the reliability of electricity supply are on the minds of both U.S. and Canadian government officials.

North American electricity consumers expect an extraordinarily high level of reliability; the electricity industry, and regulators who govern its operations, are expected to ensure that this reliability is maintained. Citizens of Canada and the United States need assurances that the standard of living they have come to expect – a standard of living which is fundamentally dependent on electricity – can be maintained, and improved upon. That standard of living is shared across our two countries, just as the electricity system that upholds it is bi-national. To that end, measures taken to maintain and improve the system should also be bi-national, although taken in a manner that respects the sovereign jurisdiction of the United States and its States, and Canada and its Provinces.

With this paper the Canadian Electricity Association is taking the initiative to propose measures for bi-national action to maintain the reliability of electricity supply. CEA believes that the integrated North American electricity market is a testament to the extraordinarily cooperative working relationship between Canada and the United States. The Free Trade agreement in NAFTA, and its bi-national precursor, the Canada-U.S. Free Trade Agreement, had as their forerunner a free trading relationship in electrical energy dating back decades. Electricity knows no borders, and managing it in our mutual interest is a common goal.

II. The Integrated U.S./Canadian Electricity Market

A remarkable bi-lateral trading system has evolved between Canada and the United States over the last half century. What began with small tie-lines and the development of boundary waters for hydroelectricity, has evolved into extensive cooperative arrangements for managing transmission system reliability, major interties across the Canada-U.S. border coast-to-coast, and growing exports and imports.

The diversity of our systems – the different balances of the various conventional and emerging technologies in our various regional generation mixes and the differing market demands region by region over days, weeks, and seasons – has prompted a level of trade that benefits electricity consumers in every region across the continent. When linked across the national border, our diverse systems have created opportunities for efficiencies in regional systems management, reduced environmental impact, and improved reliability; these are vital achievements for all concerned.

A. Details of the Integrated Market

The map of the North American Transmission Grid below offers a clear visual indicator of the extent of current integration. Electricity trade occurs at a range of points across the Canada-U.S. border, as shown on pages 4 and 5, reflecting the largely north-south nature of the Canadian grid, as it is integrated with the more complicated web of transmission infrastructure in the U.S.

Cross-border trade enables market participants to take advantage of diversity between the Canadian and U.S. electricity systems. The diversity and complementarity of our systems is first demonstrated by the different balances of various conventional and emerging technologies in our generation mixes. These differences primarily reflect availability of resources, as different geographic regions have access to different input resources. The pie charts on page 6 show the generation mixes for Canada and the U.S.

Electricity is now established as a key and growing part of the larger energy trade between the two countries, and it

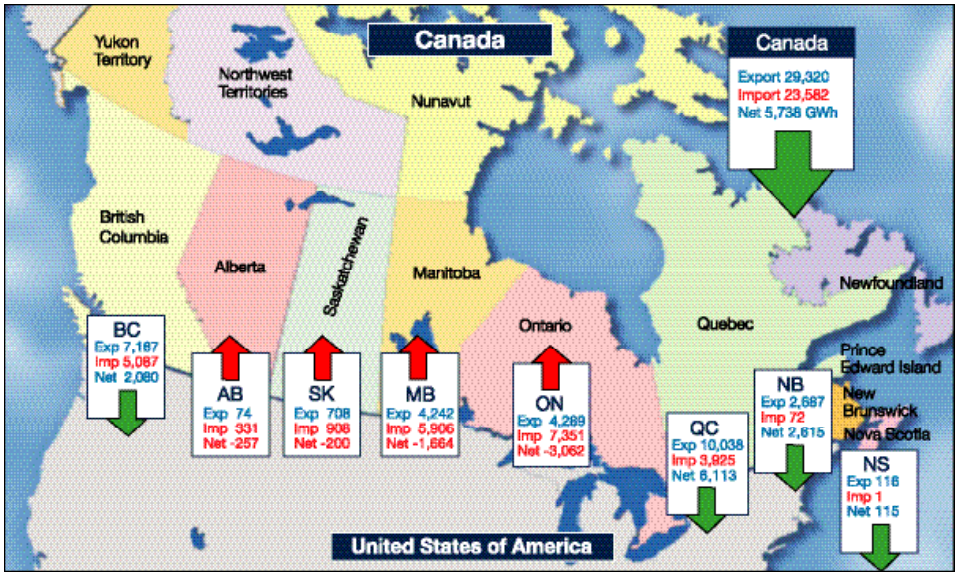
North American Transmission Grid

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

is increasingly two-way. Electricity trade between Canada and the United States stems primarily from two sources. First, generators in Canada are key suppliers to particular U.S. markets. In addition, generators in both countries take advantage of the trading relationship to optimize the performance of their respective asset portfolios, which contributes to lower electricity costs and higher overall system efficiency and reliability. The bar graph on page 6 demonstrates the extent of this two-way trading relationship.

The quantity of electricity exported from Canada has typically been 6 to 10 percent of production. Electricity export shares have varied substantially by province, sometimes as high as 25 percent. Exports in 2003 were lower than average, reflecting low water levels in some hydroelectric-producing markets, increasing domestic demand, and a higher than average electricity supply in some key U.S. markets. At the same time, electricity imports to Canada have increased significantly. The fundamental point is that the market is a borderless one, and supply meets demand north to south or south to north as that market requires, to the advantage of consumers across the continent. Robust competitive wholesale markets in both the United States and Canada rely on integrated U.S./Canadian markets. As the markets continue to open, the importance of cross-border trade will only increase.

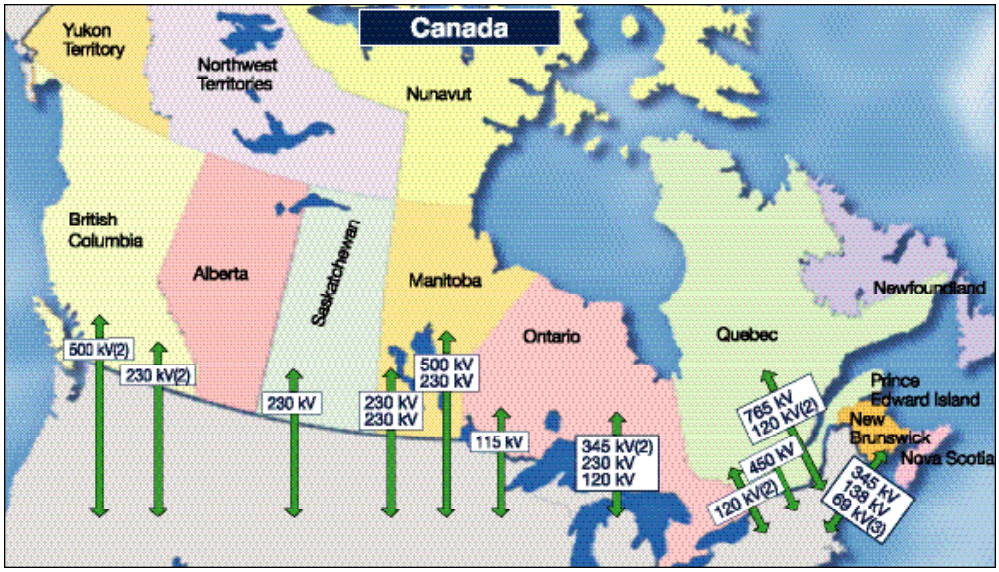
Exports and Imports between Canada and the United States, 2003



Source: NEB Electricity Exports and Imports, 2003.

Restructuring of the electricity industry remains an ongoing process in both Canada and the United States. As with states in the U.S., some provinces in Canada are pursuing a restructuring agenda at a different pace compared to others. At present, approximately 50 percent of Canadian retail customers are in open markets (although the Ontario government has capped retail electricity prices, and is in the process of reviewing its policy). The map on page 7 provides the status of market restructuring in Canada.

Major Transmission Interconnections between Canada and the U.S.



Note: The numbers indicate the voltage of the power lines from each province to the states.
If there is more than one line with a given voltage, the number of lines is indicated in parentheses.

Source: NEB, Canadian Electricity Association and Natural Resources Canada.

B. The Economic and Environmental Benefits of an Integrated Market

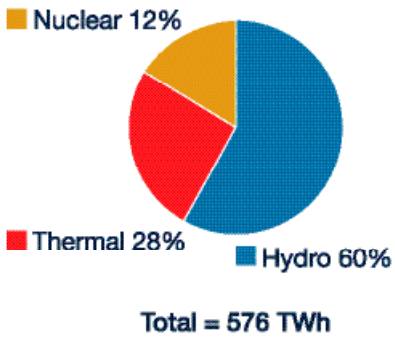
Cross-border electricity trade provides the opportunity to optimize the use of generating resources to the benefit of U.S. and Canadian market participants. For example, when linked across borders, the diversity of our systems, our climates, and our demand profiles allow for efficient power flows north or south at various times depending on market circumstances. The resulting regional market efficiency gain reduces the need for generating facilities and results in lower generation costs to consumers. Moreover, electricity companies can derive environmental benefits through such efficiencies – for instance, coordinating on exchanges between "must-run" fossil-fuel fired generation facilities and hydroelectric facilities. This involves a generator selling off-peak power to a hydro generator, allowing the latter to "bank" energy (in the form of stored water) in its reservoirs. During periods of high demand, the hydro generator releases enough water to meet its own needs and to assist in meeting the peak demand of its partner in this diversity exchange, thereby avoiding both emissions and higher costs from fossil peaking units. Such opportunities exist to a greater or lesser extent in each of the regional markets across the continent.

Efficiencies in regional systems management can also be achieved through participation in or coordination with regional transmission organizations ("RTOs"). In many cases, RTOs present an opportunity for the effective utilization of existing transmission infrastructure. In fact, some Canadian utilities are actively exploring participation in bi-national RTOs as an approach for optimizing the management of their respective transmission systems.

Moreover, the integration of the U.S./Canadian electricity markets will allow for the coordination of approaches to more effectively achieve reductions in the environmental impact of electricity facilities. No one technology is universally

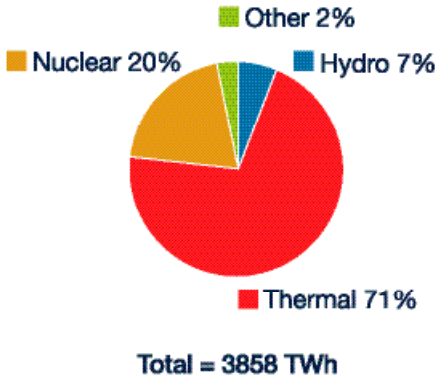
Electricity Generation by Fuel Source in Canada and the United States, 2002

Canada
Net Electricity Generation, 2002



Source: Statistics Canada
Survey 2151

United States
Net Electricity Generation, 2002

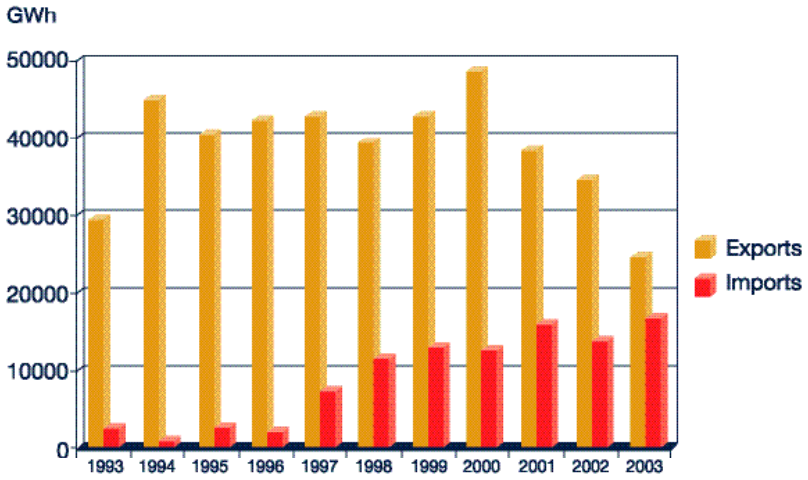


Source: Energy Information Administration.
Electricity Power Annual.

applicable across a national marketplace – resource availability, geography, and a host of other factors help determine the generation mix.

The objectives of reliable, affordable, environmentally preferable power require that all technologies be available. In fact, increased integration enables the larger, combined U.S. and Canadian regional electricity markets to take full advantage of various emerging technologies – like wind power, whose intermittent nature requires backup capacity, to meet our future energy needs on a larger scale.

Electricity Exports from Canada and Imports from the U.S., 1993-2003



Source: NEB Electricity Exports and Imports, Monthly Statistics, various years.

III. A North American Approach to Ensure a Reliable North American Electricity Market

As mentioned above, the electricity system in North America is an integrated one, and there is no better example of this integration than the August 14th outage. Some may suggest that the blackout could have been significantly lessened in scope if there were a clear break between our systems, and the level of integration was reduced. Such statements betray a lack of appreciation of how integration in fact prevents major blackouts from occurring.

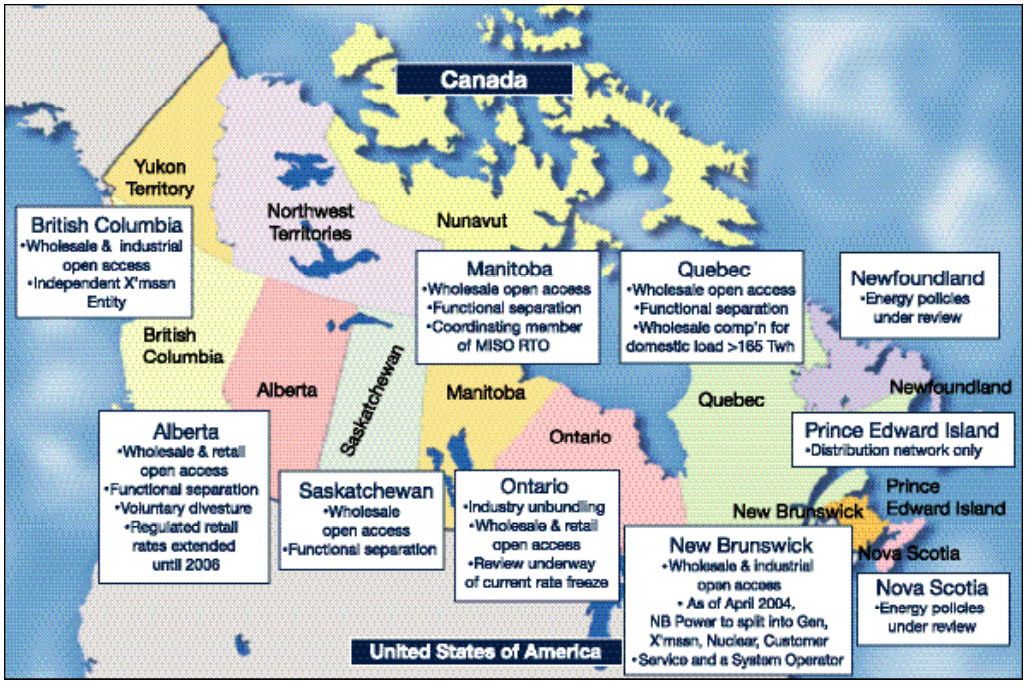
The interconnections across our border have significantly increased overall system reliability, cost effectiveness, and operational efficiency and will continue to do so. Imports and exports balance system usage and provide reliability at the various transfer points along the U.S./Canada border. Canadian electricity plays an important role in serving peak demands in a number of U.S. regional markets along the border, and even helps to secure reliable service as far south as southern California.

Such linkages, however, also mean we share the challenges of ensuring the reliability of an interconnected international electricity network, and we need to address these challenges cooperatively. Such cooperative action is particularly important now, when markets on both sides of the border are facing uncertainties in the face of aging infrastructure, the need for new generation and transmission, growing environmental and other regulatory pressures, natural gas price volatility, and other issues. In the following, CEA proposes seven measures for cooperative action to promote a reliable supply of electricity.

A. Adequacy of Supply

In 2001, CEA developed a "Bird's-Eye View" (BEV) of the supply and demand situation in Canada. The BEV was based on a review of data from the last several decades, a composite of the commonly

Status of Market Restructuring in Canada, 2004



used existing outlook models and a survey of CEA members to update, correct and validate what is in those outlooks. The BEV concluded that by 2020, demand will be about 670 TWh, with 205 TWh coming from new plants that represent 35% of year 2000 production. New demand, plant replacements and exports require new investment of over 20,000 MW per decade to 2020. Interestingly, in June 2003, The National Energy Board (NEB) of Canada released new demand projections that suggested that demand would grow more quickly than the CEA's BEV projection. The NEB projected that demand would reach 817 TWh in 2020, a 21% increase over the BEV projection.

The trend for electricity demand growth in Canada (and the U.S.) continues to show a consistent slow decline in the electricity intensity of the economy. While this suggests that demand growth will continue at a pace less than that of GDP as we continue to be more efficient in our use of electricity, it also means that we still need more electricity year over year. CEAbelieves it is reasonable to project demand growth between 1 to 1.5% per year for the foreseeable future. This means significant investment is required to meet that demand, and to meet it reliably. The right signals need to be in place to stimulate new investment in generation, transmission, and distribution infrastructure – up to $150 billion (Canadian) worth in Canada over the next two decades. At the same time, efforts need to be undertaken to make demand more efficient.

The situation is similar in the United States (where demand growth is projected to hold at about 1.8% per year), and there is a need to bring stakeholders together in our two countries to identify how best to address this for the continental market. The supply of energy has deeper security concerns for the North American marketplace, in a world where energy security is fundamentally tied in to geopolitical questions. The availability of a range of supply options – different fuels, different technologies – is fundamental to a cost-effective, reliable and secure system. North American markets have options, but choosing amongst them is not a simple task. It has to be done in an environmentally sound, economically prudent, security conscious manner.

B. Development of New Transmission Facilities

In 2002, the Department of Energy identified the absence of adequate transmission capacity as a key cause of transmission constraints throughout the North American transmission grid. In its National Transmission Grid Study, the Department of Energy determined that the transmission system in the United States has become congested because growth in electricity demand and investment in new generation facilities have not been matched by investment in new transmission facilities. The U.S. Department of Energy has reported that the construction of high-voltage transmission facilities is expected to increase by only 6 percent during the next 10 years, in contrast to an expected 20 percent increase in electricity demand and generation capacity. Similar disparities between generation and transmission investment have occurred in Canada. And the North American Electric Reliability Council projects that transmission investment will continue to lag behind generation investment, resulting in still greater congestion on the North American transmission grid.

While the integrated U.S./Canadian electricity market enjoys the benefits of cross-border trade, constraints along the border and within large regional markets continue to inhibit further trading. Several examples exist of supply potentially available to constrained regions that cannot move because of transmission congestion. For example, the constraints in the Pacific Northwest coupled with the lack of direct interties between Alberta and the United States limits the opportunities for cross-border trade between these jurisdictions. Constraints within the Northwest and Northeast regions constrain economic flows beyond the border. Enhanced

transmission capacity between Manitoba and its bordering states will allow for increased exports from Manitoba.

A bi-national cooperative approach to encouraging the construction of new transmission capacity should help to ensure a reliable electricity system for Canadian and U.S. ratepayers. First, CEA believes that the evolving regional transmission organizations ("RTOs") can achieve effective regional and cross-border planning only by ensuring effective participation by Canadian entities and provincial authorities in the planning process. Given the reality of international regional markets and the interconnected nature of the North American transmission system, an RTO that includes transmission facilities that connect with or cross the U.S./Canadian border will be able to identify both the constraints along the border and the necessary transmission facilities to address such constraints.

Opportunities to ease transmission congestion need to be identified and actions taken to ensure adequate returns and reduce siting delays. One approach for encouraging the construction of transmission facilities across the border, as well as within states and provinces, is streamlining the process for siting transmission lines. Speeding the process for transmission siting would allow for increased construction of necessary transmission facilities within the North American transmission system.

Rates of return on capital invested in transmission facilities are too low, and serve to discourage investment in such facilities. Instead, capital is invested in facilities that offer higher returns, such as generation facilities. Last year, FERC issued a proposed transmission policy statement that recognized the need for increased rates of return to encourage transmission investment. CEA believes that regulatory approaches that increase rates of return for transmission facilities would encourage greater investment in such facilities. Similarly on the fiscal side, tax measures that would facilitate more investment in the development of new transmission infrastructure at key bottlenecks across the continental marketplace could be implemented. For example, improved capital cost allowance rates based on useful life would encourage greater investment.

C. Investment in Emerging Transmission Technologies

CEA recognizes that the challenges to the construction of new transmission facilities will likely continue in the future. Accordingly, while efforts are taken to provide new facilities where possible, at the same time there is a need to, wherever possible, provide alternative methods for adding transmission capacity or alleviating transmission constraints.

Advancements have been made in technologies both to reinforce and to improve the management of the grid. Reinforcements have been utilized in regions where new construction is politically or logistically infeasible. Improvements to grid management, such as the utilization of real-time data, have allowed for the more efficient use of the existing transmission infrastructure. Unfortunately, the absence of direct benefits from such improvements to the transmission grid, as well as the absence of near-term profits from many transmission projects, may serve to discourage both investments in such projects and the necessary research and development to pursue advanced transmission technologies. Opportunities for bi-national cooperation for both investment in advanced transmission technologies and transmission R&D – either through government programs, industry support, or government-industry partnerships – should be explored to take advantage of the bi-national interest in a reliable and efficient transmission system.

D. Promote New Generation Technology and Demand-Side Measures

Adequate generation and transmission capacity are critical to ensuring a reliable electricity market. But focusing solely on the supply side of the grid misses opportunities for employing demand-side measures to improve reliability. Distributed generation and demand-side measures, can help to

relieve existing transmission constraints by reducing reliance on the transmission grid. Demand-side measures have been implemented both in Canada and the United States in response to various policy directives.

Distributed generation in Canada accounts for 11 percent of total generation, while distributed generation in the United States accounts for approximately 8 percent of total generation. The prospects for additional distributed generation development remain significant in both the United States and Canada. For example, the U.S. Department of Energy has estimated that 20 percent of all new generation could be distributed generation by 2010.

Such measures will help to reduce reliance on the existing electricity system – generation and transmission – as well as reduce the need for the construction of new facilities in that system.

Measures to relieve transmission constraints can often occur in places other than where the constraint exists. Accordingly, with respect to transmission constraints along the U.S./Canada border, demand-side measures can be deployed in a bi-national cooperative manner notwithstanding the presence of the border. For example, transmission constraints in the United States may be relieved through distributed generation or efficiency measures taken in Canada. Similarly, energy efficiency measures in the United States could help to relieve transmission constraints in Canada. Bi-national coordination in the planning and deployment of demand-side measures could thus prove an effective means of addressing transmission constraints on the international grid.

E. Mandatory Reliability Standards

The Joint Canada/U.S. Task Force has issued preliminary conclusions that point to the failure of some parties to follow NERC's voluntary reliability standards. CEA agrees that the present system of voluntary reliability standards must change, particularly as electricity markets continue to evolve. However, because the transmission grid is international in scope, the focus must be on solutions that are international as well.

CEA supports the enactment of the reliability standards language contained in the U.S. energy bill. That language would allow for the creation of an Electric Reliability Organization ("ERO") that, properly constituted, could provide solutions that are applicable and acceptable to all parties across the continent. The ERO model ensures a balance of interests that protects the organization from being unduly subject to any one stakeholder or government, while respecting the sovereign right of regulators in each country to assure themselves that the interests of their citizens are provided for through oversight and remand functions. And because only the ERO – as opposed to individual regulatory or legislative bodies – can develop reliability standards, the reliability system can be run effectively on an international basis. Nevertheless, Canadian entities will review the proposed ERO to ensure that it fully represents their interests and jurisdiction.

CEA recognizes that, until such time as legislation passes in the U.S. Congress, the Federal Energy Regulatory Commission may consider other options to address reliability. In either case, the underlying reality remains the same: the reliability of the bulk-power system is by its very nature an international concern, and cannot therefore be properly addressed without full engagement of and cooperation with Canada. Anything less could impede future cross-border trade and, more significantly, undermine the very reliability we all seek to see guaranteed.

F. Critical Infrastructure Protection

Since the terrorist attacks in the United States on September 11th, 2001, the electricity industry is better prepared for both physical and cyber attacks on the electricity infrastructure. However, the frequency of cyber attacks is on the increase. Such an increase is particularly troubling given the electricity industry's growing dependence

on e-commerce and electronic controls. Moreover, the potential for physical threats to the electric infrastructure remains a reality.

In January 2000, following the successful Y2K transition, CEA members formed the Critical Infrastructure Protection Working Group in order to coordinate activities, share best practices, and interface with the federal government. In its first year-and-a-half of activities it had established an effective information sharing Intranet site, implemented methods for coordinating activities with the North American Electric Reliability Council ("NERC") and other partners, developed and implemented an Early Warning System for threats to electricity infrastructure, and worked closely with the federal government. The Early Warning System developed by the Working Group is a model being looked at by other sectors as a fast and efficient method of communicating information in times of high alert.

The integrated market enables Canadian and U.S. participants to effectively work together to safeguard the North American electric grid against physical and electronic cyber threats. The North American electric power industry is currently working through NERC to develop further approaches for safeguarding the North American bulk electric power system. By working through NERC, Canadian and U.S. utilities and other market participants are able to coordinate responsibilities to ensure effective critical infrastructure protection of the electric power sector. Such bi-national cooperation provides for an effective and cost-efficient approach to ensuring the protection of the North American electricity infrastructure. A North American approach to critical infrastructure protection serves as an effective model for protecting the electricity industry's critical assets, and accordingly should be supported and built upon.

G. Regulatory Efficiency

A significant effort is under way by the Government of Canada to review the federal regulatory framework. The object of the "Smart Regulation" project is to ensure that in the application of the high standards that Canadians have come to expect from those subject to federal regulation under a range of pieces of legislation – environmental, health, safety, etc. – government is operating in the most efficient and effective way possible.

The electricity industry is monitoring this process keenly. In CEA's opinion, the initiative is a timely one, as regulatory certainty, clarity, consistency, and efficiency are fundamental factors in the determination of whether or not new project development should go ahead.

This smart regulation initiative could be harmonized with efforts in the United States to streamline or clarify regulation. For example, initiatives by the U.S. Department of Energy to streamline processes under its cross-border transmission facility program could be coordinated with similar efforts in Canada. Similarly, Canadian and U.S. regulators could work together to harmonize approaches in regulating electricity markets. Through such coordination, regulators on both sides of the border would be able to maximize regulatory efficiency across the North American marketplace.

Conclusion

The integration between Canada and the United States will only increase as energy demand and trade continue to grow. This makes close cooperation between our countries a necessity. At the same time, the market, regulatory and administrative systems are different in each country. These differences will necessitate flexibility in any regime for the common administration of transmission, in order to ensure regional solutions. The reliability of the bulk-power system is by its very nature an international concern, and cannot therefore be properly addressed without the full engagement of and cooperation of both parties, Canada and the United States. Anything less could impede future cross-border trade and, more significantly, undermine the very reliability we all seek to guarantee.