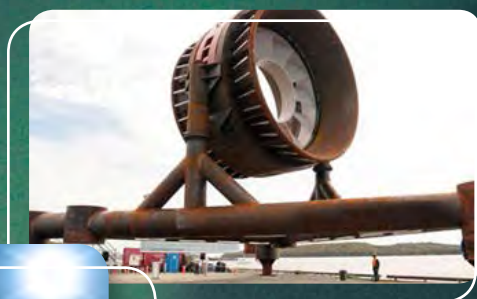




Canada – A Global Leader in Renewable Energy

Enhancing Collaboration on Renewable Energy Technologies

Energy and Mines Ministers' Conference
Yellowknife, Northwest Territories
August 2013



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Executive Summary

Over the last decade, renewable electricity generating capacity has grown at a rapid pace. This trend is expected to continue, with international organizations, governments and industry associations alike forecasting the wider deployment of renewable technologies around the globe.

In the electricity sector, hydroelectricity is the largest renewable energy source in Canada, accounting for approximately 60 percent of Canada's electricity generation. Other renewable energy sources, such as biomass, wind, tidal and solar, contribute to increasing this share to over 63 percent. When adding nuclear energy, over 77 percent of Canada's electricity generation does not emit greenhouse gases. Moreover, Canada exports large quantities of electricity to the United States, which is primarily hydroelectricity with reservoir storage. This also helps contribute to increased integration and reliability of variable renewable generation on both sides of the border.

This position of strength has been driven by concerted and collaborative actions by federal, provincial and territorial governments, through a variety of initiatives such as offset programs, procurement through requests for proposals, standard offer and feed-in tariff programs, and legislated renewable portfolio standards. As governments continue to pursue policies to spur energy innovation and encourage the deployment and integration of renewable sources of energy, Canada's reliance on electricity produced from renewable energy sources, including, hydro, wind, solar, biomass, geothermal and marine, will continue to increase.

Going forward, collaboration across jurisdictions will be necessary to ensure that Canada maintains its renewable energy advantage. Together, federal, provincial and territorial governments can have a tremendous impact on supporting reliability, electricity trade, improving system adequacy and ensuring sustainability of our electricity systems.

Introduction

As the world continues to make progress on diversifying energy supply, Canada's reliance on electricity produced from renewable energy sources, including, hydro, wind, solar, biomass, geothermal and marine, will increase. International organizations expect significant global growth in electricity generation from renewables. As an example, the International Energy Agency (IEA), in the *IEA Medium-term Renewable Energy Market Report 2013*, forecasts that the renewable energy share in global electricity generation is estimated to rise to 25 percent of gross power generation in 2018 up from 20 percent in 2011.

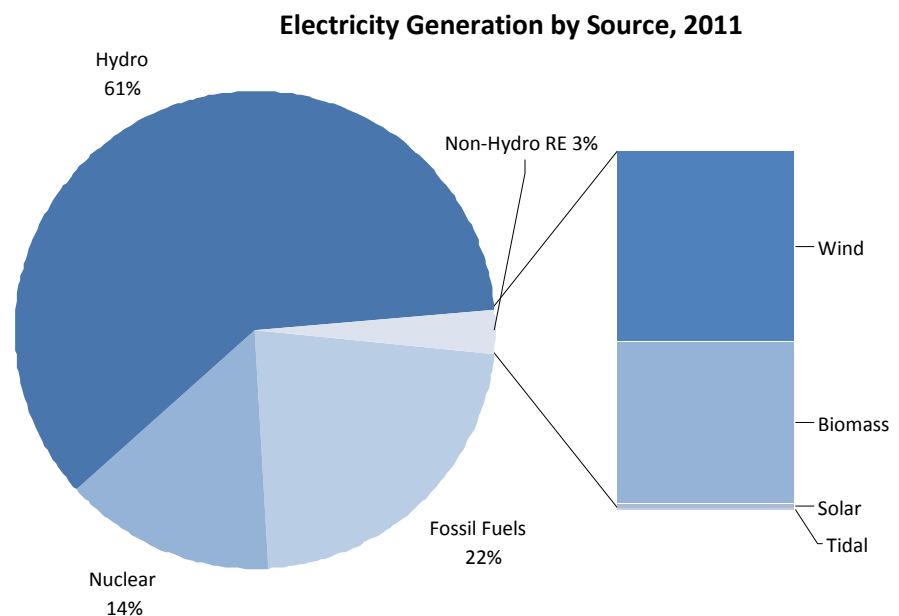
At the 2012 Energy and Mines Ministers Conference in Charlottetown, Prince Edward Island, Energy Ministers identified a need to capture opportunities across the entire energy system, examining the ways that energy is produced, transmitted and used. Energy Ministers identified energy innovation, through the sharing of knowledge and best practices and opportunities to increase commercial success and technology adoption as a key priority area for continued collaboration moving forward. The following document provides an overview of collaborative progress achieved over the past year in the area of renewable energy, and identifies potential priority action areas moving forward.

Growing Contribution of Renewable Energy in Canada's Electricity Supply Mix

Deployment of Renewable Energy

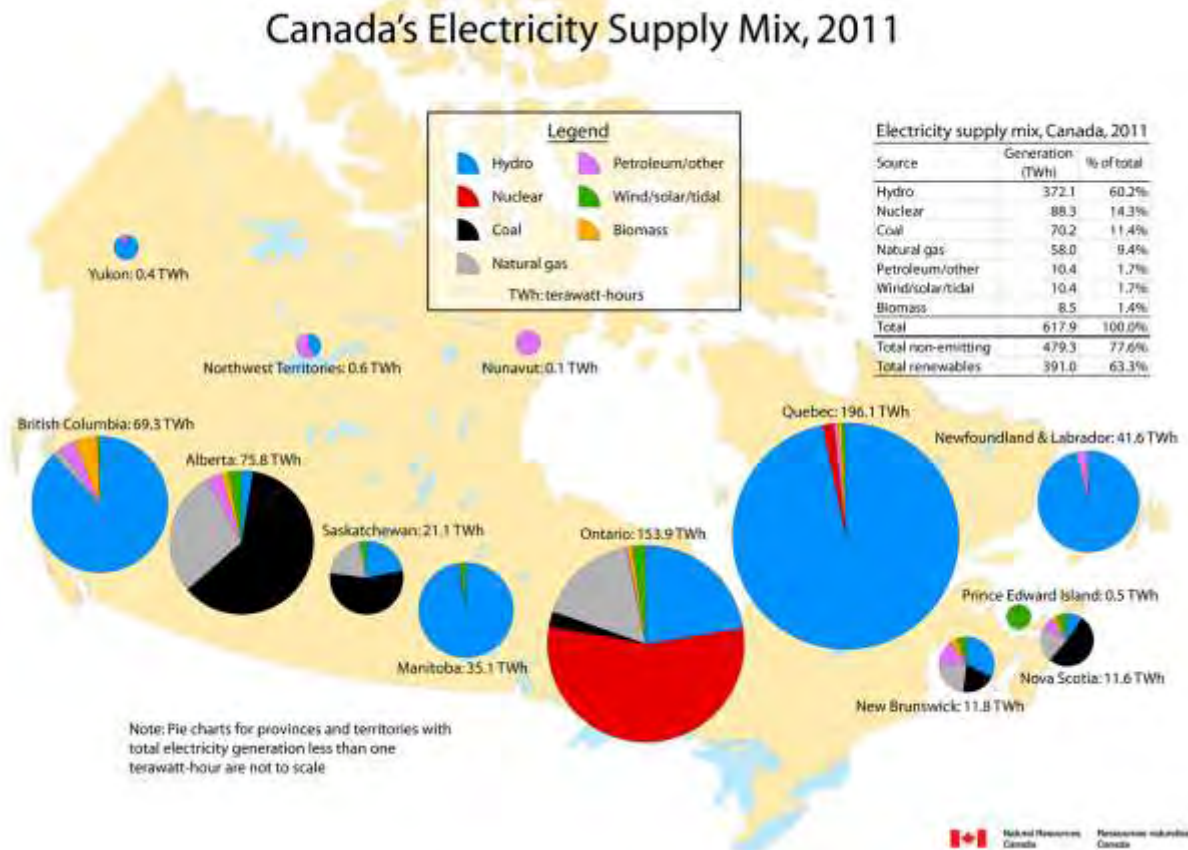
Canada is a world leader in the production and use of renewable energy, with renewable energy representing 17 percent of Canada's total primary energy supply. In the electricity sector, hydroelectricity is the largest renewable energy source in Canada, accounting for approximately 60 percent of Canada's electricity generation.

Other non-hydro renewable energy sources, such as biomass, wind, tidal and solar, contribute to increasing this share by 3 percent to over 63 percent. When adding nuclear energy, over 77 percent of Canada's electricity generation does not emit greenhouse gases. Canada is the world's third largest producer of hydroelectricity, and it is positioned ninth globally in



terms of wind energy installed capacity. Canada also has one of the largest tidal barrage power plants in the world – the 20-megawatt¹ (MW) Annapolis tidal power plant in Nova Scotia.

In 2011, Canada’s total electricity generation was 618 terawatt-hours (TWh) with Quebec and Ontario producing about 57 percent of the electricity generated in the country. The generation mix varies by province and territory, with many jurisdictions meeting over 90% of their electricity demand with renewable electricity as shown in the map *Canada’s Electricity Supply Mix, 2011*, while others rely on a mix of renewables, fossil fuels and nuclear generation. On a regional basis, renewable electricity generation accounts for over 52 percent of Western Canada’s generation, over 65 percent of Central Canada’s generation, and 72 percent of Atlantic Canada’s generation.

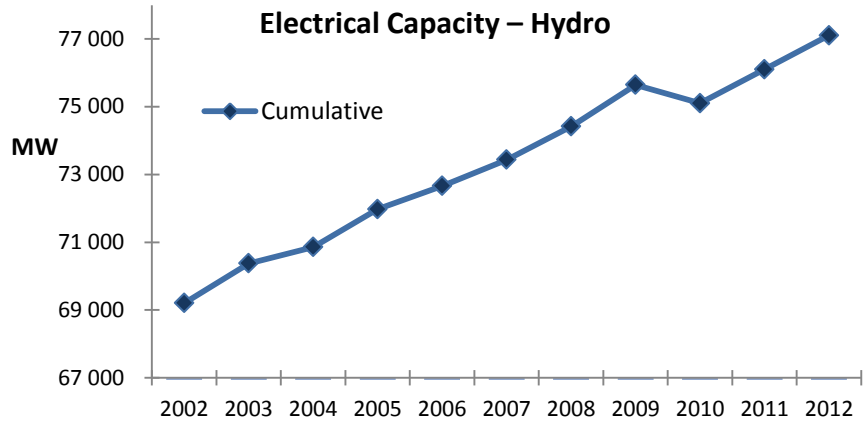


Over the last decade, renewable electricity generating capacity has grown at a rapid pace. Hydro electricity has consistently grown since 2002, adding an estimated 8000 MW of installed capacity by the end of 2012. While most of the growth occurred in Quebec, British Columbia and Ontario, all provinces have increased their hydroelectricity installed capacity by some degree. According

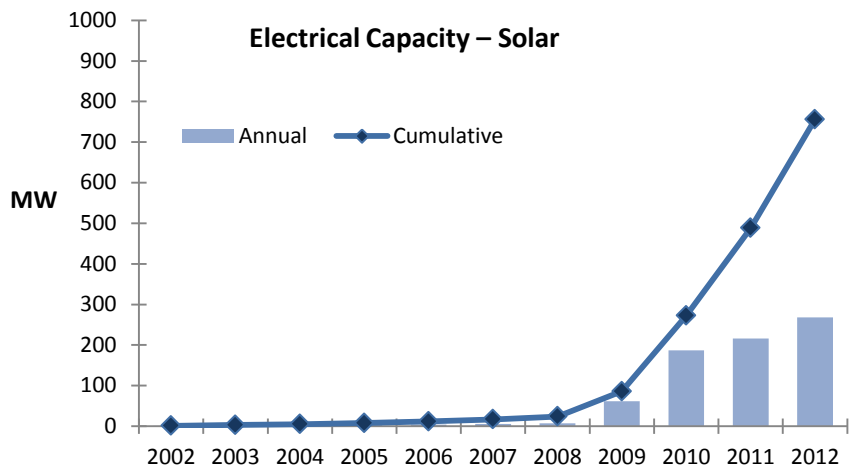
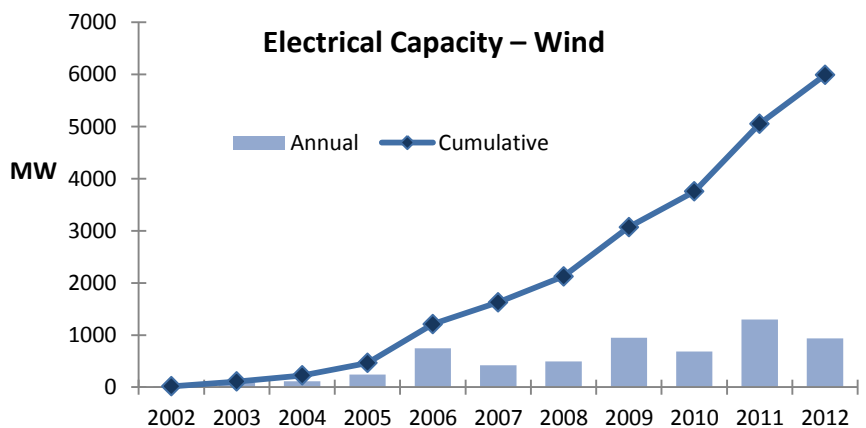
¹ The watt rating of a power plant describes the potential amount of power that could be produced if the plant were to produce at 100 percent of its potential. In this paper, megawatts are used to describe the *installed capacity* of an electrical power plant or system. A watt-hour represents the amount of energy generated from one watt of installed capacity in one hour. In this paper, terawatt-hours are used to describe the amount of electricity *generated* in a year.

to the National Energy Board, hydroelectric installed capacity is estimated at approximately 56 percent of Canada’s total capacity.

While hydroelectric capacity has grown quickly, wind and solar energy remain the fastest growing sources of electricity in Canada. The average annual growth rate for both wind and solar has approached 40 percent over the past decade, although from a much smaller base. Hydroelectricity with reservoir storage plays an important role in enabling better integration of variable renewable electricity, such as wind power.



Over the last ten years, wind power has grown thirty fold to 6201 MW in 2012, which is estimated to equal about 5 percent of total Canadian potential wind generation capacity. Currently, over 3750 wind turbines generate electricity in 170 wind farms across the country. All provinces and two territories have wind power turbines in operation, and three provinces (Ontario, Alberta and Quebec) have passed over the 1000 MW threshold of installed capacity. This is in stark contrast to Canada’s capacity in 2002, when just five provinces and one territory had a total of only 320 wind turbines in operation across 30 wind farms. In 2002, these wind farms amounted to only 231 MW in installed capacity.



Similarly, solar photovoltaic (PV) has grown substantially, reaching 765 MW in 2012 from only 10 MW in 2002. The significant growth started in 2009 with the installation of 62 MW of solar PV capacity and continued with 186 MW in 2010, 216 MW in 2011, and 268 MW in 2012. The vast majority of these installations occurred in Ontario.

Cross-Border Electricity Trade

Renewables are important in Canada's electricity trade with the United States. Provinces that have significant hydroelectric resources are the major net exporters of electricity. In 2011, Quebec and British Columbia exported over 10 percent of electricity production to neighbouring US states. In recent years, Manitoba has exported more than a quarter of its electricity production into the US Midwest. In addition to meeting demand, hydro projects have flexibility attributes and water storage capabilities which help meet the demand profile of export recipients. Exports of electricity into US markets generate revenues on the order of \$2 billion per year. Canadian-produced hydro is critically important for meeting demand and maintaining reliability in a number of US states. In June 2013, five New England States launched a regional initiative to expand imports of large hydro into the region, which will begin with a proposal to the New England States Committee on Electricity. Hydro is already helping states like Vermont and Wisconsin meet their renewable energy objectives. In the Midwest, it will help balance wind that is being added to the grid in states like North Dakota.

The use of variable, non-hydro renewable electricity generation is growing on both sides of the border, and hydroelectricity with reservoir storage complements these resources well. Increasing two-way electricity trade with neighbouring markets can help to integrate growing levels of variable generation and contribute to improving reliability.

Federal Provincial, and Territorial Measures to promote Renewable Energy Growth

The growth in the use of renewable energy for electricity generation is a result of a number of targeted, complementary policy initiatives undertaken by federal and provincial governments. The federal government launched the \$324-million Wind Power Production Incentive program in 2002 and the \$1.4-billion ecoENERGY for Renewable Power program in 2007.

Both programs provided an incentive of 1¢/kilowatt-hour to qualified renewable energy projects, such as small hydro, biomass, wind, and solar, during the first ten years of their operation.

Canada's Tax Measures

In 2006, as part of its tax measures, the Government of Canada extended to 2020 the Accelerated Capital Cost Allowance under Class 43.2 of the Income Tax Act, Annex II for renewable energy equipment, and successively expanded its eligibility to new renewable energy equipment. Start-up expenses may also qualify as Canadian Renewable and Conservation Expenses and be fully deductible in the year they are incurred, carried forward for deduction in later years or can be renounced to shareholders through a flow-through share agreement.

Across Canada, all provinces have been promoting the use of renewable energy through a number of initiatives, including offset programs, procurement through requests for proposals, standard offer and feed-in tariff programs, and legislated renewable portfolio standards. For example, requests for proposals have been used in all provinces with the exception of Alberta, which has an offset program in place. Renewable portfolio standards are legislated in Nova Scotia, New Brunswick and Prince Edward Island, while standard offer and feed-in tariff programs are used in Ontario, Nova Scotia, Prince Edward Island and British Columbia.

Provincial and Territorial Renewable Energy Policies

British Columbia	<ul style="list-style-type: none"> • Directed BC Hydro to create Standing Offer Program for clean and renewable resources of up to 15 MW • 2006 and 2008 Clean Power Calls as well as targeted Bioenergy Calls based on competitive bidding processes encouraged incremental clean and renewable development
Alberta	<ul style="list-style-type: none"> • Support for renewable energy projects through the Climate Change and Emissions Management Fund • Support for biomass-based electricity from Alberta's Bioenergy Programs (Bioenergy Producer Credit Program, Biorefining and Commercialization and Market Development Grant, and Infrastructure Development Grant Program • Support for renewable energy projects through Alberta Innovates – Energy and Environment Solutions • Net billing for micro-generation • Alberta carbon offset program
Saskatchewan	<ul style="list-style-type: none"> • Target of doubling wind power capacity by 2017 to 9% of total generating capacity • Net metering for small producers • Financial assistance for renewable energy projects • Request for proposals – wind
Manitoba	<ul style="list-style-type: none"> • 1000 MW of wind power
Ontario	<ul style="list-style-type: none"> • 10 700 MW of renewable energy capacity, excluding hydroelectric, by 2018 • Renewable Energy Standard Offer Program • Feed-in tariff program for smaller projects • Competitive program for larger projects • Net metering for small producers
Quebec	<ul style="list-style-type: none"> • 4000 MW of wind power installed capacity by 2015 • Requests for proposals for 800 MW of wind power • Net metering for small producers
New Brunswick	<ul style="list-style-type: none"> • Legislated renewable portfolio standard of 10% 2016 • Policy commitment to increase renewable portfolio standard to 40% by 2020 • Net metering and embedded generation feed-in tariff programs for micro and small generators • Request for proposals – wind
Nova Scotia	<ul style="list-style-type: none"> • Legislated renewable portfolio standard of 40% renewable generation by 2020 • Enhanced net metering for distribution connected customers • Community feed-in tariff program for distribution connected projects • Request for proposals for large-scale, transmission connected projects
Prince Edward Island	<ul style="list-style-type: none"> • Policy target of 30% of renewable energy by 2013 • Net metering for small energy producers • Feed-in tariff for wind

Newfoundland and Labrador	<ul style="list-style-type: none"> • Through development of hydroelectricity resources at Muskrat Falls, over 98% of electricity for the province will come from renewable sources • Continue to support and study potential for hydro and wind development in isolated areas with the view to developing renewable resources as a means of replacing diesel generation • Support research and development initiatives to reduce greenhouse gases emissions by promoting renewable energy development • Provincial Government committed to utilize revenues from non-renewable energy resources to further support clean energy development
Northwest Territories	<ul style="list-style-type: none"> • Hydro, biomass and solar energy strategies to promote the use of renewable energy technologies • Renewable Energy Fund to subsidize renewable energy generation
Nunavut	<ul style="list-style-type: none"> • Implementing Ikummatit, a territorial energy strategy that focuses on alternative energy sources and efficient use of energy
Yukon	<ul style="list-style-type: none"> • Through its Energy Strategy, a commitment to increase the supply and use of renewable energy, including a 20% increase in renewable energy supply by 2020

Canada participates in the IEA's Implementing Agreement on Renewable Energy Technology Deployment (IEA-RETD) to facilitate the development and sharing of information on topical policy issues surrounding the deployment of renewable power, and to ensure the access to best practices policies and initiatives in world-leading countries. The IEA-RETD is a policy-focused, technology cross-cutting platform of OECD countries aimed at accelerating the deployment of renewable energy technologies.

Future Growth

Canadian governments and industry associations project that the growth in deploying renewable electricity capacity will continue. Based on existing federal, provincial and territorial policies and initiatives, the IEA estimates that Canada's wind power installed capacity could reach 12 000 MW by 2015 (approximately 8 percent of Canada's forecasted total installed capacity), while Canada's solar PV capacity could continue to grow to almost 3000 MW by 2016 (approximately 2 percent of Canada's forecasted total installed capacity). An additional 5000 MW of hydroelectric capacity could come on line by 2020. New, emerging renewable energy technologies projects, such as wave, in-stream tidal and geothermal, are being developed. Approximately 60 MW of ocean energy is expected to be commissioned by the end of 2016. As well, governments are looking to increase the use of renewable electricity, smart grid technologies, and grid connections to supply off-grid communities with cleaner electricity.

The 2012 IEA World Energy Outlook

The IEA forecasts that in 2035, hydropower will represent about half of the total amount of global renewable electricity generation, wind power about 25 percent and solar PV almost 8 percent.

Development and Demonstration of Renewable Energy Technologies

While some renewable energy technologies are becoming mainstream and other emerging technologies are showing great potential, the federal government has focused on the development and demonstration of new, promising technologies and approaches to produce and use electricity more efficiently, while creating the market conditions for further deployment.

The federal government – through initiatives such as Natural Resources Canada’s Clean Energy Fund and the eco-ENERGY for Innovation Initiative, and Sustainable Development Technology Canada’s SD Tech Fund – has supported the development and demonstration of renewable energy, smart grid and energy storage technologies that will facilitate greater use and integration of renewable energy technologies.

In an effort to promote regulatory efficiency and market certainty, the federal government is developing a policy framework for administering marine renewable energy (i.e. in-stream tidal, wave and offshore wind) activities in offshore areas of federal jurisdiction. While numerous federal laws currently govern the offshore, this policy framework, currently under development, represents an opportunity to recommend a management regime best suited for marine renewable energy.

Federal, Provincial and Territorial Joint Action on Maintaining Reliable, Cleaner Electricity Supply

The rapid increase in the share of wind power and solar PV is transforming power systems globally and this trend is likely to intensify. Some renewable energy sources, such as wind and solar PV, produce electricity when the resource is available and thus electricity generation from these sources is variable and increasingly predictable with use of improved forecasting methods.

Internationally, several countries now have penetration levels of variable generation sources of electricity in excess of 15 percent of their total electricity generation. A domestic example is P.E.I., where over 99% of the electricity generated in the province comes from wind, accounting for about 20% of the island’s total electricity demand. With these increasing levels of variable renewable electricity generation, jurisdictions around the world have begun developing and modifying grid planning and operations practices to improve the reliable operation of their electricity grids that were designed in an era of large and centralized conventional power plants.

A changing resource mix with higher penetration levels of variable renewable electricity has implications for reliability of grid operations, power market design and infrastructure needs.

Federal, provincial, and territorial governments are working together to address these integration issues resulting from raising levels of renewable energy that is being incorporated into the electricity grid. In May 2012, the Federal-Provincial-Territorial Electricity Working Group held a workshop on the integration of renewables, which explored the challenges with, and potential

solutions to, accommodating increased amounts of intermittent renewable power on electric systems, while ensuring reliability of the electrical supply.

As part of its 2013 work-plan, the Federal, Provincial, Territorial Electricity Working Group (FPT EWG) has undertaken a project to examine cases where hydroelectric facilities with storage capabilities are being used to back up variable renewable electricity, such as wind power and solar PV, with a particular focus on regional and international examples.

Using four cases studies from Denmark, United States and Canada, the report concludes that:

- Hydro facilities with storage capabilities are well suited for integrating the variable electricity into the electrical grid. However, the type and amount of support that a hydro project can provide to the operation of the electrical grid depends on the amount of storage available.
- Hydro projects with storage capabilities could reduce the costs associated with integrating variable renewable electricity in the case where these projects are not otherwise committed to provide other more valuable services. Furthermore, expanding the number of hydro storage projects can reduce the cost of such services through competition.
- Electricity markets designs and system operating procedures can also enhance the effectiveness and reduce the costs of integrating variable renewable electricity with the aid of hydro storage projects.
- Electricity transmission arrangements can have a significant impact on the ability of hydro projects with storage capabilities to integrate variable renewable electricity. The expansion of transmission interconnections with other markets is also a key element of the strategy to integrate increasing amounts of variable renewable electricity.

This study, which benefitted from the input of the federal, provincial, territorial electricity group, suggests that jurisdictions in Canada can collaborate in order to manage the increased system variability associated with new renewable electricity as it is incorporated into the North American grid and the reliability standards regime.

The FPT EWG continues its work on advancing the Canadian position regarding reliability and security of the North American electricity sector through briefings, dialogues, and conferences with key groups, in particular with the Federal Energy Regulatory Commission and the North American Electric Reliability Corporation.

To this end, the recently created Monitoring and Enforcement Sub-Group (MESG) has been established as a peer forum for enforcement agencies and regulators in Canada to focus on matters of compliance and enforcement of North American electric reliability standards in Canada.

Moving Forward: Opportunities for Future Collaboration

Going forward, all jurisdictions in Canada could benefit from continued collaboration and exchange of information towards the development, demonstration and deployment of renewable energy. Together, federal, provincial and territorial collaborative efforts will have tremendous impact on supporting reliability, electricity trade, improving system adequacy and ensuring sustainability of our electricity systems.

The federal government will continue to ensure information sharing from its research, development and demonstration projects supported through the Clean Energy Fund and the ecoENERGY for Innovation Initiative with the provinces and territories to maximize potential for future uptake of these technologies and practices with the ultimate objective of developing a reliable electricity grid that delivers a cleaner energy supply.

There is also an opportunity to maximize the exchange of information on policy matters which is resulting from Canada's participation in IEA-RETD activities related to policy and economic analysis associated with the continuing large-scale deployment of renewable energy technologies. As these IEA-RETD projects focus on topical issues, such as integration of variable electricity and innovation supply chain, they could provide great opportunities for sharing of international best practices, while increasing the visibility of Canadian solutions for promoting and deploying renewable energy technologies.