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More Hydro Power in Canada: Tapping Our Potential

by John Haffner and Jim Burpee
July, 2017

ENERGY SERIES

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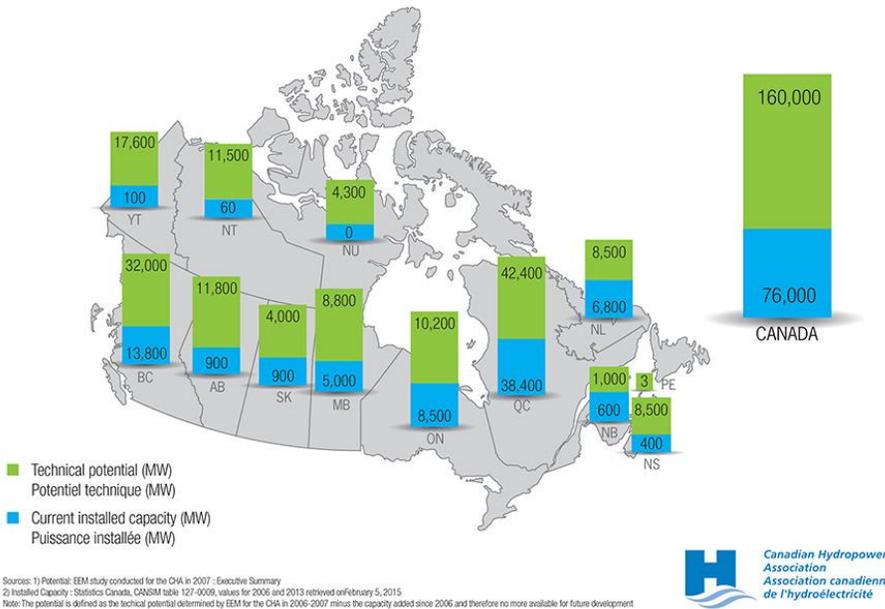
Prepared for the Canadian Global Affairs Institute
1600, 530 – 8th Avenue S.W., Calgary, AB T2P 3S8
www.cgai.ca

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ISBN:978-1-988493-46-6



Hydro power is, by far, the most significant power generation source in Canada’s electricity system. Every Canadian province except Prince Edward Island has [operating hydro power plants](#), and hydro provides [about 60 per cent](#) of the power generated across Canada. It [provides](#) about 91 per cent of the electricity generation in British Columbia, 96 per cent in Manitoba and 99 per cent in Quebec. Yet, although hydro power is already the backbone of Canadian electricity, there is still the potential to develop significant amounts of additional hydro in Canada. Canada has installed hydro capacity of 76,000 MW, and technical potential of 160,000 MW. In other words, Canada could, in theory, [more than double](#) its existing capacity:

CANADIAN HYDRO CAPACITY & POTENTIAL (MW)
L'HYDROÉLECTRICITÉ AU CANADA: PUISSANCE INSTALLÉE ET POTENTIEL (MW)



As a practical matter, some of the projects included in this estimate would face various economic, environmental or social barriers that would prevent them from proceeding. For our purposes, however, even if we were to heavily discount the estimate, the point is that Canada has very substantial untapped capacity.

Our argument here is that Canada should develop some of this additional hydro, because of its significant environmental, operational and economic advantages as a resource. The sections below are organized in two parts. First, we consider hydro power’s environmental, operational and economic advantages. Second, we consider four simple and practical ideas for advancing a hydro power agenda in Canada with these advantages in mind. More Canadians need a better



understanding of why hydro ought to grow into an even more important component of Canada's energy portfolio than it is today.

A. Hydro power's advantages

Hydro power has environmental, operational and economic advantages. These attributes distinguish hydro power from other sources of generation and reinforce its importance and value as a unique resource.

First, on the environmental front, hydro power emits almost no greenhouse gases (the initial methane emissions that sometimes occur because of flooding are close to negligible over the life of a facility). Canada has set a target of reducing economy-wide emissions by 30 per cent below 2005 levels by 2030, and it also recognizes scientific findings that global reductions of at least 80 per cent will be required by 2050 to limit climate change. As in other countries, de-carbonization of the Canadian economy will require an electricity system that is almost entirely carbon free, and one that expands electrification into other key sectors. Largely thanks to existing hydro power, Canadian electricity is already relatively low carbon, with [more than 80 per cent](#) of electricity from almost non-emitting sources. The Trottier Energy Futures Project (TEFP) has identified hydro power as an important contributor to [minimum cost](#) emissions-reduction pathways. Put differently, without replacing our remaining carbon-intensive power sources with additional hydro and without further electrification, we raise the cost of reduction efforts considerably and reduce our odds of success. With additional hydro, Canada can also sell surplus clean electricity to the United States, which has much farther to go than we do in de-carbonizing its electricity system.

Second, hydro power has unique operating benefits, including mass storage, emergency reserve, spinning reserve, load-following capacity, black start and system stability. Or in simpler terms, hydro power can store lots of energy and be turned on and off faster than any other generation source. While electricity customers often think they are just paying for electrons, what they really want are reliable electrons and a smoothly functioning electricity system.

Hydro's operational advantages have taken on greater importance with two parallel, carbon-related trends. On the one hand, Canada is phasing out coal-fired generation and also looking to reduce reliance on gas-fired generation (coal and gas have traditionally provided some of the storage and ramping flexibility alongside hydro). On the other hand, Canada is adding generation from intermittent renewables such as wind and solar, non-dispatchable forms of electricity that require complementary production from hydro power for ensuring reliable, low-carbon electricity system supply. It is also important to note that while hydro can provide back-up for wind and solar in Canada, the reverse could not happen. Since clean electricity needs to grow to meet not just future demand but also to expand its role into other sectors, and since intermittent renewables need hydro, the interests of hydro and intermittent renewable power generation sources are [aligned](#). In the big picture, growth for hydro is also good for wind and solar.

Finally, hydro power has significant economic advantages. Although it has a significant upfront capital cost, hydro subsequently provides a stable, long-term source of electricity with very low



operating costs. In North America, the cities with the lowest cost of electricity all benefit from hydro power.

Hydro power also provides substantial socioeconomic benefits – ones that have recently been quantified in an ambitious study in Europe. Advisory firm DNV GL conducted a macroeconomic study of hydro power in the 28 EU member states, alongside Norway, Switzerland and Turkey. The study [found](#) that hydro power's contribution in Europe per annum was around 38 billion euros, an amount similar to Slovenia's GDP, and that this amount was projected to grow to around 75 to 90 billion euros by 2030. In the Canadian context, "hydro power project development" could [generate](#), over the next two decades, "over \$125 billion in investments and a million jobs." Canadian hydroelectric expertise can also be applied to global markets, as [highlighted](#) in a recent study by McKinsey & Company. Manitoba Hydro and BC Hydro have international divisions, but Canadian companies could do more to leverage the country's deep hydroelectric knowledge to support projects abroad and electrification and low-carbon pathways in emerging economies.

B. How to advance a hydro power agenda in Canada

Canada is fortunate to have such a resource in abundance. Given its environmental, operational and economic advantages, developing additional hydro potential ought to be a key component of Canada's energy strategy. However, in the contest among competing stakeholder interests and sophisticated advocacy groups, this outcome is far from certain. The following four ideas would help strengthen an agenda for developing more hydro power in Canada. All ideas involve advancing the public interest, and would benefit hydro only insofar as it contributes to the public good:

1. Add a reliability factor in evaluating costs of future generating options

It is common for different electricity generation technologies to be compared by using average energy costs (c/kwh) or initial capital costs (\$/MW). But these numbers only present part of the picture. From a system-planning perspective it is important to have a high level of confidence that customer demand can be met second by second throughout the year – their interest is dependable capacity. To compare properly large-storage hydro to, say, wind or solar, the cost of storage or demand-response programs to make the intermittent resource dependable needs to be added to the cost of energy.

2. Push for a North American carbon price

While the Trump administration represents an unfortunate reversal of global momentum towards climate action following the Paris COP agreement, climate science is a bigger story. Canada should dig in and engage with U.S. counterparts in their federal and state governments, universities and civil society who also support climate action. We should aim and push for a North American carbon-pricing regime. If we had one, the value of hydro power's emission-free generation would be obvious and reflected in market activity.



3. Include de-carbonization contribution as part of project assessments

Many debates in Canada about the merits of specific proposed hydro projects are framed too narrowly. When projects are being considered, there ought to be a discussion of how they could support electrification of other sectors and allow Canada as a whole to achieve lower emissions. This approach will require a broader discussion of costs and benefits than has traditionally been the case. As part of this expansion, First Nations communities should not only be consulted in good faith about the potential impacts of local projects and invited to partner on projects, they should also be partners in the choices Canada will need to make in achieving its greenhouse gas reduction targets. If First Nations communities can support the development of significant additional capacity in hydro, they are also helping Canada to do its part to avert the climate crisis.

4. Strengthen low-carbon electricity co-operation across jurisdictions

From the standpoint of electricity planning, Canada's provinces often treat their borders as fences. We could do much more to improve interprovincial electricity in pursuit of optimal ways to use clean electrons to reduce emissions. The same applies between Canada and the United States. We have an interconnected North American grid with multiple interties, and as mentioned earlier, the U.S.'s electricity system is much more emissions-intensive than the Canadian system. Additional Canadian hydro can be built to serve not only Canadian de-carbonization efforts, but also those in the United States. U.S. states should be able to include imported clean electrons from Canada as part of their emissions reductions, and evidence of future U.S. demand should support the business case for new hydro projects in Canada. Minnesota Power and Manitoba Hydro recently signed an agreement that will take effect in 2020 and enable Minnesota Power [to store](#) some of the wind power it generates in Manitoba Hydro's hydro stations. Many more projects along these lines should be developed between the two countries. The challenge, however, will be to figure out how to value the cross-border GHG reductions appropriately so that, for instance, British Columbia ratepayers are not paying for an Alberta or California benefit. Our electricity market interactions do not capture these benefits appropriately today.

Conclusion

Tapping significant additional hydroelectric resources will require policy-makers to develop a committed, long-term, interdisciplinary cross-border vision. Climate change is happening. In integrating scientific understanding with operational and economic considerations in energy planning, Canada will be well positioned to optimize its preparations for, and participation in, the low-carbon economy of the future, with hydro playing a critical role.

► About the Authors

John Haffner is a consultant with extensive experience in the cleantech, energy and infrastructure sectors. As President of Haffner Group, a Toronto- and Hong Kong-based company he founded in 2011, he provides advisory and execution services for clients in Canada and Asia. Haffner has more than 15 years' experience working on energy and environmental issues, including major projects for Ontario Power Generation and the Canadian Electricity Association. He is a 2008 Yale World Fellow, and in 2011 was nominated as an Asia 21 Young Leader by Asia Society. He is also a lecturer in Climate Change and Energy Law at McGill University's Faculty of Law.

Jim Burpee has been working in the electricity sector on a provincial, federal, North American and global level for 40 years. He has worked as a senior executive for much of that time (Ontario Hydro/ Ontario Power Generation) including six years at the CEO level (Bridge Renewable Energy Technologies, Canadian Electricity Association). He still writes, speaks and consults on issues of high level corporate strategy and public policy with respect to electricity.

► **Canadian Global Affairs Institute**

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