INTEGRATED SUSTAINABILITY STRATEGIES FOR THE GREAT LAKES REGION

By Samiba Tahseen and Bryan Karney, PhD, P.Eng.

MANY OF TODAY’S pressing challenges are complex. These problems often go beyond the capacity of a single organization, sector or nation to understand and respond to, and require collaboration across both internal and external boundaries to engage all stakeholders. The resolution of such critical issues often involves significant technical, as well as economic, legal and political components. As technical approaches are frequently intertwined with distinct political concerns, application of relevant scientific and technological factors is necessary for the most effective policy. Recognizing this, effective policy-making these days combines engineering study with policy analysis to address problems where technical details are critical to decision making. One such example is presented here through a case study of the Niagara River.

The Niagara River, an integral part of the Great Lakes Basin, hosts world-renowned and breathtaking waterfalls. The word Niagara, which has an aboriginal root, first appears in the form of Onguiaahra, presumed to refer to the “neck” connecting the two lakes. The river is about 58 kms long, extending between Lake Erie and Lake Ontario, and carries, on average, about 5660 m³/s of water between the lakes.

Each year, Niagara Falls attracts 12 to 14 million tourists, generating 57 per cent annual occupancy for the Niagara accommodation market. Tourism revenue from Niagara has a significant impact on the regional, as well as national, economy, as it is responsible for 11 per cent of hotel room night occupancy in Ontario, according to the 2009 Ontario Tourism Investment Attraction Research Study (www.mtc.gov.on.ca/en/publications/publications.shtml).

Apart from being a tourism resource, the elevation difference provides the much-required head for hydropower installation on both sides of the Canada-US border. At present, the Niagara River provides the driving force for almost 5500 MW of renewable power shared by both jurisdictions. Moreover, the river has long held its strategic importance as an international waterway, not only contributing to the growth of the region but also serving recreational purposes. Balancing the competing demands of Niagara for recreational, commercial and industrial uses has proven to be a challenge.

Looking at the falls, it’s hard to imagine the human ingenuity just below the surface. The remedial works of 1941 are considered to be a milestone protecting the falls from erosion while making hydropower from Niagara a reality. At present, its generation capacity is subject to bilateral regulations in the form of the 1950 Niagara River Water Diversion Treaty. The treaty identifies the “unbroken crest-line” as the most significant feature of the falls and establishes diversion limits aimed at securing it. These limits, commonly known as scenic flow restrictions, establish that during the period from April 1 to September 15, no less than 100,000 cfs (2832 m³/s) of water must go over the falls between 8:00 a.m. and 10:00 p.m. The same flow restrictions are in effect between 8:00 a.m. and 8:00 p.m. from September 16 to October 31. At all other times, a minimum of 50,000 cfs (1416 m³/s) of water must go over the falls unless additional water is necessary (1950 Niagara treaty, www.treaty-accord.gc.ca/texte.aspx?id=100418). The present-day flow control strictly adheres to this stipulation, which limits the flow diverted for hydropower.

But there are issues that pose impending threats to the Niagara resource system. One such concern is the growing number of over-misting events at the falls, which is believed to be influenced by an increased air-water temperature difference (Case). The Niagara Parks Commission has reported an increase in these events–68 in 2003 compared to 29 in 1996 (Bins). With the 4.4 C projected temperature increase for Ontario by 2040-2049 (SENES Consultants Ltd.), these excessive misting events may escalate and thus have a negative impact on Niagara’s tourism industry by discouraging tourists from a future visit. However, it’s difficult for such a prerogative to be backed by sound statistics, due to a lack of a consistent data set that would make such analysis possible. Another crucial issue is the gradual retreat of the Niagara escarpment. Although the rate has been greatly reduced by flow control and remedial works, erosion continues at a rate of 0.3 m each year.
Despite having enormous prospects, the hydropower potential of the Great Lakes region is still partly untapped, primarily due to a policy constraint of the Niagara water diversion treaty. However, the current flow restrictions may not be the absolute minimum to achieve the scenic spectacle of Niagara. The crestline remains unbroken even at the current lowest flow rate of 50,000 cfs (1416 m³/s) (Friesen and Day). An additional 50,000 cfs of water flowing over the falls during the tourist season represents 1.6 million MWh of hydropower capacity for Ontario, which translates into $52 million annually, considering Ontario’s recent average electricity price (Sedoff et al.).

Again, the merits of additional diversion extend far beyond price. Hydropower, particularly with pumped storage, can be an effective means of permitting demand variability. This special attribute of hydropower, along with its trivial emission and negligible fuel dependency, makes it indispensable to Ontario’s commitment to reduce CO₂ emissions. As the province is expecting significant proliferation and deployment of such intermittent renewables as wind and solar, the increased hydropower capacity at Niagara could prove to be a valuable backup. In addition, a reduction of flow over the falls is likely to improve the excessive misting conditions at Niagara, since flow rate is positively correlated with plume height (Case). Additional flow diversion, apart from extending the hydropower potential at Niagara, can also slow down further erosion at the falls. Furthermore, the third Niagara tunnel, inaugurated in 2013 at a cost of $1.6 billion, increases Ontario’s intake capacity by 25 per cent. However, the scenic flow provisions of the 1950 treaty would restrict this new tunnel from being utilized to its potential.

In 2000, the treaty, which acts as a major policy constraint, expired and is being extended year by year. The expiration of the treaty opens the door for renegotiation, which may permit additional hydropower generation along with a reduction in both the erosion rate and occurrence of heavy misting, without compromising the beauty of the falls. Any treaty revision should focus on the fact that the agreement, when signed in 1950, represents an era not struggling with carbon emission and the urgency of generating clean, sustainable energy.

Moreover, the Chicago Area Waterway System has been identified as a potential threat by the Great Lakes Fishery Commission for protecting the Great Lake ecosystem from Asian carp, an invasive species. The possible discontinuation of the Chicago diversion, currently being disputed in the US courts, has the potential to enhance available flow through the Niagara River and thus increase the potential for greater diversion for hydropower generation.

Hydroelectric power has long fueled the economic growth in Ontario. Generating nearly 8 per cent of Ontario’s electricity, the Sir Adam Beck (SAB) complex, located on the Niagara River, hosts the only pumped storage station in Ontario. Even with limited storage capacity, this pumped storage station, known as SAB PGS, plays a valuable role in balancing the grid by providing much-needed ancillary services. The strategic placement of the reservoir also limits the hydraulic constraints on SAB I and SAB II, the two conventional, run-of-the-river hydro plants, and helps to use the full capacity. Additional flow diversion has the potential to redefine the role of the SAB PGS, which runs below its capacity for more than 70 per cent of the year. The key question is, of course, to assess the risks and possible rewards of a renewed negotiation. It requires the adoption of an integrated management approach to formulate policies that involve all three dimensions of sustainability—social, environmental and economic. The solution will draw experience from the field of engineering and business, as well as social science.

This article does not attempt to influence any decisions, but rather attempts to integrate the disparate and currently unconnected aspects of energy, tourism and policy, and to draw attention to the need for further research to promote sustainable development of the incredible resource system present at Niagara.

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REFERENCES


