Brock University Niagara Community Observatory

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The Story of Hydroelectric Power Generation in Niagara, 1969 to Present Day

> *A long while must elapse before the whole volume of water now passing over Niagara Falls could possibly be utilized for the production of power, but if the whole of the water were so utilized and if the lofty cliffs over which the waters now tumble, were bare, think what would then be their aspect! The face of the precipice would be covered with aquatic plants giving in summer a splendor of color which with all their watery magnificence the Falls do not now possess, while the pool below would have a quiet beauty instead of its present turbulence.*
>
> —Sir William Thomson

Introduction

The Niagara River is unique in that its most significant drop—about 100 meters total—is concentrated within a relatively short span between Chippawa and Queenston, Ontario (MacFarlane 2020). The most famous section of this decline is Niagara Falls, formed by the gradual erosion caused by water flowing over the lip of the Niagara Escarpment. Though they are not the tallest, widest, or most voluminous waterfalls in the world, their unique combination of these three things has made the region a global tourism destination. It has also made the region a hub for innovation and industry, with many hoping to harness the power of this famous waypoint between Lake Erie and Lake Ontario (MacFarlane 2020).

Towards the end of the 19th century, this combination of interest and ingenuity made Niagara a critical nexus for the development of hydroelectricity. The promise of cheap and reliable electricity drew manufacturers and other resource-intensive industries to the area. By the time that the Regional Municipality of Niagara was incorporated in 1969, over 700 chemical plants, steel and aluminum mills, oil refineries, and other such industries were operating in the area (MacFarlane 2020). In addition to driving economic growth, the expansion of hydroelectric generating capacity freed Ontario from its longstanding dependency on energy imports—predominantly coal—from the United States (Keith and Stewart 2004). The result was a close connection between hydroelectricity and economic identity that continues to shape public policy (and public opinion) within Ontario.

Though the novelty of hydroelectricity has worn off, hydro remains important both in Niagara and beyond. Generating stations along the Niagara River produce a quarter of the power used in New York State and Ontario, with hydro remaining one of the most cost-effective forms of energy production in North America (MacFarlane 2020). At the same time, regulatory changes have shifted the relationship between Niagara and hydropower in important ways, while concerns about Canada's broader energy landscape raise questions about the future of hydroelectricity. As policymakers try to find sustainable ways of meeting the expected demands of an increasingly electrified world, hydroelectricity and the Niagara region promise to remain an integral part of the conversation.

This working paper provides a snapshot of the relationship between hydroelectric power generation and economic development in Niagara. The focus of the paper is 1969 to the present day, and the evolution of hydroelectricity since the Regional Municipality of Niagara (Niagara Region) was first incorporated. The goal of the paper is not to provide an exhaustive history of hydro power, or of the intricacies of hydro policy in Ontario, both of which have been covered in more detail elsewhere (see MacFarlane 2020; Keith and Stewart 2004; Freeman 1996).

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Photo courtesy Niagara Economic Development

Rather, the goal is to focus on the position of hydroelectricity within Niagara region's broader economic landscape. With that in mind, the paper is divided into three sections: pricing, supply and demand, and green energy. Each section provides insight into the historic relationship between Niagara and hydroelectric power generation, as well as the future of hydroelectricity within the region.

Pricing

By the end of the 19th century, the Niagara region was host to several private generation and distribution companies hoping to exploit the power of the Niagara River. While generating capacity grew quickly during this time, transmitting hydroelectricity remained expensive. As a result, electricity rates were often cheaper for consumers closer to generation facilities. Combined with other locational advantages, such as proximity to the Canada-United States border, this promise of cheap electricity attracted power-intensive industries (such as chemical processors and manufacturers) to Niagara, turning both sides of the river into a hotbed of economic activity (Niagara Region 1970).

This advantage became somewhat muted with the establishment of the Hydro-Electric Power Commission of the Province of Ontario (HEPCO) in 1905.[1] Under the leadership of Adam Beck, the Commission navigated the expansion of a publicly owned distribution grid across Ontario, and the gradual flattening out of electricity rates within the province.

Originally focused on the transmission of electricity between private generating companies and municipally owned distributors, HEPCO quickly bought out its competitors and leveraged its growing influence to encourage electrification across the province (particularly in areas underserviced by the private market). By 1945, 42 per cent of Southern Ontario farms had access to electricity and, by the 1950s, most of Ontario was operating on a single integrated grid (Keith and Stewart 2004).

The Commission also began investing directly in power generation. This included the construction of the Queenston-Chippawa Generating Station in Niagara, which at the time constituted one of the largest hydroelectric facilities in the world (Keith and Stewart 2004). These investments in "public power" created close associations between hydropower generation and economic development in Ontario, solidifying Niagara's place within the broader provincial psyche (MacFarlane 2020).

Though the expansion of a public grid eliminated a locational advantage for business in Niagara, HEPCO's commitment to providing "power at cost" meant that electricity rates in Ontario remained relatively cheap compared to other jurisdictions. In 1926, Ontario's rate to domestic consumers remained under two cents per kilowatt-hour, compared to 7.4 cents for comparable service in the United States (Keith and Stewart 2004). This commitment to cheap electricity reflected HEPCO's "promotional rate structure," based on the idea that

[1] Following its creation, the Hydro-Electric Power Commission of the Province of Ontario would be colloquially known as Ontario Hydro, and would eventually be renamed Ontario Hydro in 1974.

growth in demand for electricity could produce economic efficiencies for the Commission. As the Commission's chief engineer, T. H. Hogg, explained in 1941:

> *The basic idea behind the promotional rate structure is this: the greater the load density on an electric distribution system, the greater the economy of operation and use of materials; the larger the demand for power the greater the opportunity of developing large power resources and the greater the economies that come from generating on such a large scale. These factors lower the cost of power to consumers. (Keith and Stewart 2004)*

In this view, cheap power and economic growth went hand in hand, creating a cycle between supply and demand that would define much of the Commission's tenure in Ontario. For Niagara, the continued availability of cheap electricity allowed for locational advantages in other sectors, with export-driven manufacturers and an emerging automotive sector beginning to concentrate within the region.

By the time Niagara Region was officially incorporated in 1969, HEPCO was responsible for supplying 90 per cent of Ontario electricity (Niagara Region 1970). The Ontario Power Commissions Act of 1970 also gave HEPCO more control over the market by making all electricity rates in the province subject to HEPCO approval (Niagara Region 1970). However, investments designed to meet surging demand were beginning to undermine the Commission's promise of cheap electricity. Beginning in the 1950s, HEPCO had been investing heavily in the development of nuclear power, an expensive alternative to the cheap capital costs associated with hydroelectricity (Keith and Stewart 2004). Existing regulations, however, meant that the Commission could not pass along the cost of a new facility until it was actually producing power. The result was an interest-accumulating time-release that by the 1970s was beginning to come due, made worse by global conflict and the rising cost of oil (Keith and Stewart 2004; Gardner 1992).

For these reasons and more, electricity rates—which had been relatively stable since the turn of the century—began to increase rapidly. Between 1966 and 1970, electricity rates increased by 24.5 per cent, then by another eight per cent in 1971. In 1975, a year after being officially renamed Ontario Hydro, the Commission proposed a nearly 30-per-cent increase to electricity rates (Keith and Stewart 2004). These changes influenced the industrial make up of Ontario, favouring less energy intensive industries like transportation equipment and electrical products at the expense of basic materials industries (Gardner 1992).

After a period of stability, such sudden increases to the price of electricity fueled public backlash. In 1971, just a year after making rates subject to Commission approval, the provincial government created a task force to review the Commission's impact on projected rate increases. A few years later, in 1975, the province instigated a second review of Ontario Hydro after the organization projected further increases.

This period also saw the creation of the Niagara Basic Power Users' Association, a group of power-intensive companies who began lobbying the provincial government for more aggressive intervention (AMPCO, n.d.). Founded in the 1960s, the Niagara Basic Power Users' Association changed its name to the Association of Direct Consumers of Ontario in 1974 to reflect its expanded membership throughout the province. A year later, its name was changed again to better represent its main member base: Association of Major Power Consumers in Ontario. During this time, the group lobbied heavily against the proposed rate increases by Ontario Hydro. In particular, the organization argued that industry would be disproportionately impacted by the rising cost of electricity. Its reasoning was that since municipalities were made up of varying compositions of residential, retail, and business users, high-energy industry users who used more power but did not fluctuate or peak as badly as others, would bear the brunt of rising rates. (Association of Direct Consumers of Ontario Hydro 1974).

With electricity rates increasing rapidly, the group's efforts gained traction. On April 28, 1975, Ontario Minister of Energy D.R. Timbrell stated in a legislative assembly meeting that proposed rate increases would amount to roughly 29.7 per cent for municipalities and 29.9 per cent for direct consumers. To mitigate such increases, the Association of Major Power Consumers in Ontario advocated for improved conservation efforts, the rolling back of further development, and the cancellation of some expansion projects (Association of Major Power Consumers in Ontario 1975). Without such measures, they argued, electricity rate increases would produce inflationary pressures leading to price increases and other downstream effects (1975). Despite growing concern, rates continued to climb. Between 1976 and 1980, rates increased by approximately 80 per cent (Keith and Stewart 2004). Ontario Hydro continued to organize around ambitious growth forecasts, investing heavily in nuclear generating capacity and passing these costs along to Ontario consumers. Between 1991 and 1993, the cost of electricity increased by another 31 per cent (Keith and Stewart 2004; Daniels 1996). As a result, Ontario went from a site of relatively cheap power to one that was above the North American average.

With electricity rates on the rise, there was some interest expressed in privatization. Under a private system, industrial consumers in particular believed they would be able to secure cheaper deals with hydroelectric companies, leaving individual consumers to rely on more expensive forms of energy production (Keith and Stewart 2004). In 1993, industrial electricity rates were between 83 and 87 per cent of residential rates, much higher than the North American average of 75 per cent (Daniels 1996). Having expanded its membership significantly through the 1970s and 1980s, the Association of Major Power Consumers in Ontario began lobbying for the privatization of Ontario's electricity grid, gaining traction with the election of Mike Harris and the Progressive Conservative Party of Ontario in 1995 (Keith and Stewart 2004).

On the back of his 'Common Sense Revolution,' Harris established an Advisory Committee on Competition in Ontario's Electricity System, which recommended privatizing existing hydroelectric and fossil-fuel plants in the province. Notably, the committee recommended the exception of generating stations in Niagara for "heritage concerns," reflecting the close association between Niagara, hydro, and provincial identity (Keith and Stewart 2004).

The first step towards privatization came in 1998 in the form of the Energy Competition Act. The Act broke Ontario Hydro into five new organizations. Ontario Power Generation took over ownership of generating stations, required by a proviso called the Market Mitigation Agreement to rebate any revenue from prices more than 3.8 cents per kilowatt-hour (a condition designed to incentivize the offloading of existing stations to the private sector) (Keith and Stewart 2004). Hydro One took over the transmission grid, buying up municipal distribution companies across Ontario. Within a couple of years, the number of municipal electric utilities was reduced from approximately 300 to fewer than 100 (Keith and Stewart 2004).[2]

The Ontario Electricity Financial Corporation took over responsibility for paying down existing debts through a 0.7 cents per kilowatt-hour surcharge added to utility bills. Rounding out the changes were the Independent Electricity Market Operator and the Electrical Safety Authority, which divided the monitoring and regulatory functions that had belonged to Ontario Hydro (Keith and Stewart 2004). With this reorganization underway, prices remained relatively stable between 1995 and 2001.

Before Harris' dream of complete privatization could be realized, however, political winds in Ontario shifted again. Rate increases following privatization in California led Ontarians to worry that a private market would produce similar rate increases in the province. These concerns were augmented by the Independent Electricity Market Operator website, which allowed visitors to track price fluctuations for electricity on the private 'spot' market. On an unexpectedly sweltering day in June 2002, visitors to the website watched the price of electricity spike from an average of $76 per megawatt-hour to almost $700 per megawatt-hour (Keith and Stewart 2004). The result was a growing skepticism of complete privatization and, after winning the 2003 election, Dalton McGuinty's Liberal Party halted plans to privatize Ontario's hydroelectric sector. The result was a pseudo-private system that survives to this day, with rates heavily controlled by a centralized Ontario Energy Board.

While the Ontario Energy Board has helped to keep rates relatively stable since the early 2000s, this has left Ontario vulnerable to more competitive strategies south of the border. In 2013, for instance, the Industrial Power Users of Niagara argued that exemptions to the Board's Global Adjustment Fee (a tool used to help stabilize rates) were allowing American distributors to buy Ontario power at discounted rates and then sell it to local businesses (IPUN 2013; Niagara Falls 2014). As a result, non-competitive rates were causing power-intensive businesses to leave Niagara for the United States (IPUN 2013). This was made worse by the proliferation of incentive programs in states like New York and Michigan, which began offering discounts designed to revive their local economies. In New York, specifically, the state-level Expansion Power program and the federal Replacement Power Program each offered discounts on electricity to businesses found within 30 miles of Niagara Falls (Niagara Falls 2014). In addition to targeting portions of the country struggling with the transition towards a post-industrial economy, such programs were designed to capitalize on the lower transmission costs and improved efficiency that proximity to Niagara provides.

The Industrial Power Users of Niagara argued that Ontario should offer similar incentives, proposing the creation of a "Beck Economic Cluster Pilot" that would capitalize on Niagara's historic strengths in both hydroelectric production and manufacturing (IPUN 2013). The group's efforts gained some traction among local municipalities, who saw improving energy costs as a key ingredient to economic development within Niagara. The City of Niagara Falls, for instance, argued that "if implemented, a program

[2] There are currently six local distributors in Niagara Region: Alectra Utilities, Canadian Niagara Power Company, Grimsby Power Inc., Hydro One Networks Inc., Niagara on the Lake Hydro Inc., Niagara Peninsula Energy Inc., and the Welland Hydro Electric Systems Corporation (IESO 2022).

such as this would begin to address the competitive disadvantage that Niagara Falls faces versus western New York State in terms of retaining and growing its existing industrial base and attracting new business investment in the manufacturing sector" (Niagara Falls 2014). Nevertheless, enthusiasm for the program dissipated, lost in the ebb and flow of provincial politics.

Today, the impact of electricity rates on Niagara is a mixed bag. The province has continued to enact programs designed to keep rates low, such as the Energy Consumer Protection Act (2010), the Ontario Rebate for Electricity Consumers Act (2016), and the Fair Hydro Act (2017). The province offers some incentives to industrial consumers, as well, though these are designed to encourage off-peak consumption—not necessarily competitiveness with other areas (IPUN 2013). Though the province does have some location-based incentive programs, these are directed predominantly towards northern Ontario. In 2010, for example, Ontario established the Northern Industrial Electricity Rate Program, providing discounts to businesses working on critical minerals, battery assembly, and electric vehicle manufacturing (St. Pierre 2022). The initiative was renamed the Northern Energy Advantage Program in 2022, with revised eligibility criteria and more significant rebates (St. Pierre 2022).

Given Niagara's strengths in manufacturing, and its position within emerging trade corridors, there is room to explore the development of similar incentive programs within the region. Just as access to cheap electricity laid the groundwork for the growth of local industry, such programs could help to strengthen Niagara's position in emerging supply chains for electric vehicles, semiconductors, and more. Recent investments in Thorold's new multimodal logistics hub, and improvements to the Welland Canal, signal interest among provincial and federal governments in Niagara's position along these emerging corridors (Financial Post 2022).

Accompanying these investments with incentivizing electricity rates would also align with existing programs within Niagara, such as the Niagara Gateway Economic Zone and Centre Community Improvement Plan, which encourage the development of Niagara's available employment lands (Niagara Economic Development, n.d.). As of 2016, Niagara is also Ontario's only Foreign Trade Zone, offering a wide array of tax, duty, and tariff incentives to exporters in the area (Niagara Economic Development, n.d.). Supplementing these programs with energy-related incentives would have the added benefit of reducing transmission costs, minimizing energy leakage, and capitalizing on a relatively cheap form of power generation (IPUN 2013).

Sir Adam Beck 1, Riverview. Photo courtesy Ontario Power Generation

Supply and Demand

When construction began on the Queenston-Chippawa Generating Station in 1917, many regarded its 10 generators as an excessive investment in the future of electricity. At the time, American-owned powerhouses were still exporting significant amounts of surplus electricity to the United States, reflecting a general lack of demand within Ontario (MacFarlane 2020). For proponents of hydroelectricity, however, these investments were a declaration of faith in the power of hydro—and Niagara Falls specifically—to revolutionize Canada's energy landscape.

Somewhat famously, razorblade magnate King Camp Gillette imagined a socialist utopia built above, and powered by, the Falls. "Here is a power," he declared, "which, if brought under control, is capable of keeping in continuous operation even manufacturing industry for centuries to come, and, in addition supply all the lighting, facilities, run all the elevators, and furnish the power necessary for the transportation system of the great central city" (Heal 2019). Though Gillette's utopic vision never came to pass, his belief that Niagara Falls represented a near-limitless supply of energy was not uncommon.

Demand for electricity grew significantly through the first half of the 20th century. Electrification surged following the First World War and, between 1917 and 1920, electrical generation in the United States was increased by 42 per cent to keep up (MacFarlane 2020). In Ontario, HEPCO engineers predicted that the capacity of Niagara power plants would fall short of provincial demand by 1928 (Keith and Stewart 2004). In response, the Commission began importing electricity from Quebec and invested in expanding hydroelectric generating capacity in Niagara (Keith and Stewart 2004). In early 1929, Canada and the United States also agreed to amend the Boundary Waters Treaty which governed water diversions along the Niagara River, allowing more water to be diverted for the sake of hydroelectric production (MacFarlane 2020).

A second surge in demand followed the Second World War, with electricity use continuing to rise through the post-war boom (MacFarlane 2020). At least in part, this growth was being driven by HEPCO itself, which used increasing demand to justify the "promotional rate structure" outlined above. In 1938, despite projecting shortfalls just a decade earlier, the Commission created a Department of Sales Promotion whose mandate was to encourage electrification across the province (Keith and Stewart 2004). In 1950, it also began construction on a second Queenston-Chippawa Generating Station, renaming both stations after the Commission's original chairperson, Adam Beck. MacFarlane (2020) has explored the gradual remaking of Niagara Falls

itself during this period, and the unique effort that went into ensuring the Niagara River could be maximized for both tourism and hydroelectric power generation. By the mid-point of the 20th century, Ontario had developed 40 per cent of its hydro capacity (compared to 22 per cent across Canada) (MacFarlane and Watson 2018). This period likewise saw HEPCO invest significantly in the expansion of nuclear power. Together, these projects created a reliable supply and alleviated any concerns about meeting demand. HEPCO began encouraging further electrification to justify the significant investments that it had made, restarting a supply-demand cycle that saw the Commission stretching its finances increasingly thin (Keith and Stewart 2004).

By the time that Niagara Region was incorporated in 1969, electricity was an everyday reality for most Canadians. In turn, the electrification of household appliances and other services meant that demand for electricity was becoming increasingly disconnected from economic productivity. In 1958, Ontario was producing more than $3 worth of goods and services for every kilowatt-hour of electricity being consumed. By 1974, this had fallen to $2.35 (Keith and Stewart 2 004). Nevertheless, demand for electricity continued to grow. Between 1960 and 1978, Canada's energy demands increased an average of 5.3 per cent per year (Niagara Region 1979). Local records reveal similar trends in Niagara.

Though hydroelectricity remained a significant part of Ontario's energy landscape, the amount of water that could be diverted from the Niagara River was already heavily regulated, particularly during the day when tourists flocked to the waterfalls (MacFarlane 2020). To keep pace with an increasingly electrified world, HEPCO therefore began investing heavily in nuclear power generation. In 1973, the Commission predicted that nuclear power's contribution to the provincial grid would rise from nine per cent to between 60 and 70 per cent by 1990 (Keith and Stewart 2004). However, unlike hydroelectricity, which remained relatively cheap to produce, nuclear facilities required a significant upfront cost and often ran into unexpected delays (Keith and Stewart 2004). These rising costs had a dampening effect on energy use in Ontario. Whereas total energy use grew at an average rate of five per cent between 1962 and 1972, demand remained virtually the same between 1973 and 1984 (Gardner 1992).

Nuclear power was also more controversial than hydroelectricity. In 1979, a nuclear station at Three Mile Island in Pennsylvania came dangerously close to a radiation leak and in 1986 an explosion at Chernobyl left the safety and environmental risks of nuclear energy in question (Keith and Stewart 2004). Protests quickly sprung up around nuclear projects in Ontario, with many becoming increasingly hesitant about heavy investments in this relatively recent technology.

With the future of nuclear energy uncertain, concerns again emerged around the sustainability of Ontario's energy grid. In 1989, the Annual Report of the St. Catharines Hydro-Electric Commission projected that the province would exceed its electricity supply by 1995. Rather than investing more into supply, however, emphasis shifted towards conservation. Ontario Hydro's Marketing Branch was renamed the Energy Management Branch and, in 1989, the company launched a conservation campaign across the province (Keith and Stewart 2004).

By 1991, Ontario Hydro was investing $179 million in conservation. By 1992, cumulative savings from conservation programs since 1988 were reducing customer bills by about $260 million and saving enough power annually to run a midsized city (Keith and Stewart 2004). This despite the fact that other economic challenges during this period made it difficult for new energy-efficient technologies to penetrate the market (Gardner 1992).

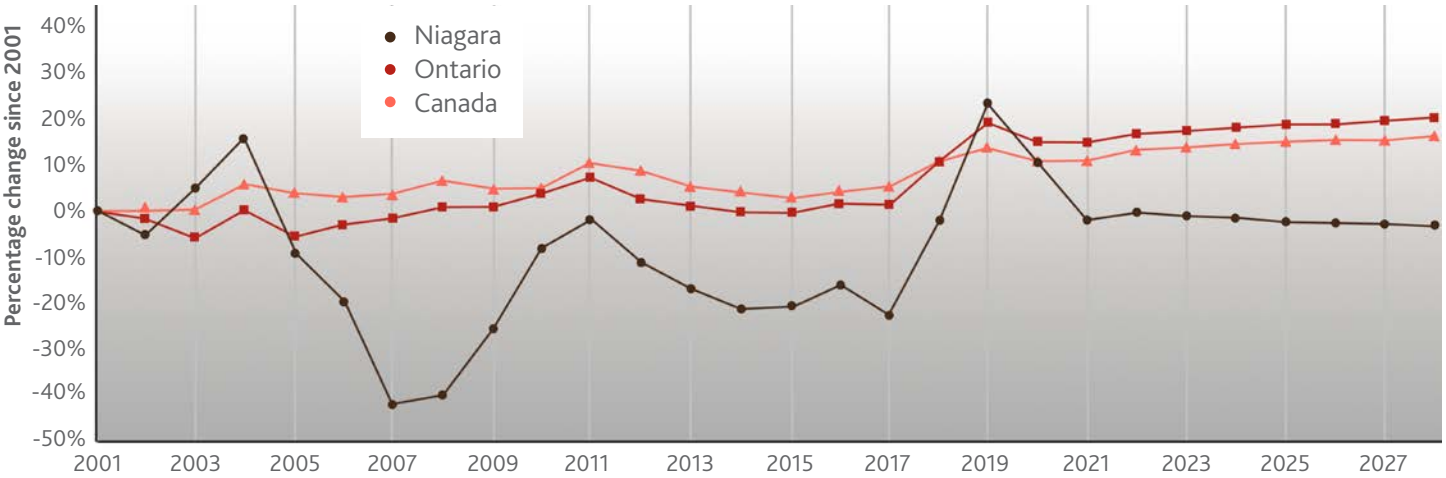
While Ontario Hydro was tempering its demand forecasts, however, it was not eliminating them entirely. Conservation efforts quickly gave way to the more growth-friendly notion of "sustainable development" and, by 1994, Ontario Hydro's spending on energy-efficiency had been reduced to $94 million—half of what it was in 1991 (Keith and Stewart 2004). Though this period saw demand forecasts slightly reduced, the assumption that demand for electricity would continue to grow remained constant.

As the contribution of nuclear energy to the grid became more stable, concerns about Ontario's electricity supply began to dissipate. In 1989, the margin between installed capacity and peak demand was 28.1 per cent. By 1993, the margin had increased to 64.8 per cent (Daniels 1996). During this period, nuclear replaced hydro as the primary contributor to Ontario's power supply, and generating capacity became more distributed across the province. We can see this change reflected in jobs data from this period. Between 2001 and 2022, for example, jobs in electric power generation[3] increased by 16 per cent in Ontario (Table 1). In Niagara, however, the number of jobs in the sector decreased by one per cent during this same period. The decline in the sector was most steep between 2004 and 2007, when sector growth in Ontario began to outpace Niagara's. (Figure 1). Though this steep decline has been largely offset since then, these changes reflect broader shifts in Ontario's energy landscape and the declining significance of hydro to the province's energy supply.

Table 1: Change in electric power generation jobs, 2001–2022; Niagara, Ontario and Canada compared

Region	2001 Jobs	2022 Jobs	Change	Percentage change
Niagara	863	859	(5)	(1%)
Ontario	34,973	40,725	5,752	16%
Canada	87,661	99,283	11,622	13%

Figure 1: Industry job growth in electric power generation, 2001–2022; Niagara, Ontario and Canada compared



While nuclear has replaced hydro as the primary contributor to Ontario's power supply, investments in generating and distribution technologies have kept hydroelectricity a relevant and low-cost player in Ontario's energy landscape. In 2013, for example, a new underground water supply tunnel was opened in Niagara Falls, carrying water under the city to Sir Adam Beck Hydroelectric Generating Station 2 (Ontario Power Generation, n.d.). In 2022, after a century of operation, the station also upgraded two of its generating units, further increasing the capacity of the station (Spiteri 2022). As a result of these and other investments, hydroelectricity has remained critical in supporting Ontario's continued growth. Hydroelectric power accounts for 24 per cent of Ontario's installed generation capacity, while oil/gas account for 27 per cent and nuclear accounts for 34 per cent (IESO 2023). In terms of actual energy output, hydro likewise accounts for 24 per cent of Ontario's yearly energy output, second only to nuclear (58 per cent) (IESO, n.d.).

Understanding the position of hydro within Ontario's broader energy ecosystem is important given that demand for electricity is once again on the rise. The IMO's successor, the Independent Electricity Systems Operator (IESO), expects an average growth in electricity demand in Ontario of about 1.7 per cent a year between 2023 and 2024 (IESO, 2021). During this time, the IESO predicts that electricity demand in Ontario will increase from below 150TWh to almost 225TWh. The report identifies changes in the agriculture sector, growth in the mining and steel sectors, and the transition towards electric vehicles as key factors driving these increases. Demand from the electrification of transportation in Ontario is projected to grow an average of 20 per cent a year during this same period (IESO 2021). Already, the Independent Electricity Systems Operator is expecting shortfalls in supply, and the need to import electricity from other jurisdictions (IESO 2023).

[3] Jobs by industry in electric power generation consist of only one industry within the NAICS code classification system, namely: "Electric power generation, transmission and distribution."

It is important to note that for this study, we used the geographical area of the St. Catharines-Niagara CMA, which does not include Grimsby and West Lincoln. This was necessary to be able to compare the local sector to other CMAs (the geographic unit of economic analysis) in Ontario. You can read that analysis in working papers by Charles Conteh.

Though meeting this demand will be a global challenge, it is being felt in acute ways within Niagara. In Niagara-on-the-Lake, for instance, concerns are being raised about the impact that electric vehicles and at-home charging stations will place on the local grid. As one representative from the municipality's local distribution company put it, "If everyone plugs in their car when they arrive home from work, then what is already the peak demand at around 5 to 6 pm will get much worse" (Curtis 2023). A recent report by the Independent Electricity Systems Operator (2022) also outlines needed upgrades to Niagara's distribution system, with many transmission stations either at, or forecasted to meet, existing capacity (IESO 2022).

As Ontario works to meet this demand, hydroelectricity will likely be an important part of the picture. Hydroelectric power generation is more consistent than other forms of renewable and alternative energy production, and storage pools provide added flexibility to hydropower. Several nuclear facilities in Ontario are also preparing for either retirement or refurbishment, which will affect electricity availability over the next decade (Crawley 2023). Though the Ontario government has signaled interest in expanding gas production facilities, hydro can provide a lower-cost and more environmentally friendly alternative (Crawley 2023).

Indeed, while a recent IESO report concluded that the province will be unable to meet its electricity needs without adding gas-fired capacity, Crawley (2023) notes that this was before the federal government announced further investment tax credits for new wind, solar, hydro, tidal, and nuclear projects (totalling $6.3 billion). At the same time, the report highlighted the need to think critically about both efficiency and conservation, finding new ways to maximize the tremendous power that the Niagara River provides. While electrification is critical to improving the sustainability of Ontario's transportation system, for instance, many have argued the need for improved public and active transportation alternatives, as well.

Photo courtesy Ontario Power Generation

Innovation and Green Energy

The allure of the Niagara River has made the region a hotbed for innovation in the hydroelectricity sector. At the beginning of the 20th century, for example, Niagara was host to early conflict over the value of direct versus alternating current electricity, drawing prominent figures like Thomas Edison and Nikola Tesla to the region (MacFarlane 2020). The proliferation of generating facilities at Niagara also helped the rapid evolution of high-voltage and multi-phase transmission infrastructures, making it possible to send electricity from Niagara to Buffalo and beyond (MacFarlane 2020).

With demand for electricity increasing significantly through the first half of the 20th century, investments in generating capacity were funnelled towards the construction of bigger and more efficient generators. Since then, Niagara has been home to some of the largest hydroelectric generators in the world (MacFarlane 2020). The advance of hydroelectric power generation in Niagara has also depended on the careful diversion of water from the Niagara River, and the innovative technologies used to model and complete these diversions since the start of the 20th century (MacFarlane 2020).

While demand for electricity has remained on a relatively stable upward trajectory, the question of how best to meet this demand has been answered differently over time. In the 1950s and 1960s, nuclear energy emerged as another potentially limitless—and cleaner—alternative to coal and fossil fuels (Keith and Stewart 2004). Compared to hydro, however,

Photo courtesy Ontario Power Generation

nuclear facilities needed a much higher upfront investment. By the time that HEPCO's Pickering A station began generating at full capacity in 1974, for example, the project was $218 million over budget, costing the company a total of $746 million (Keith and Stewart 2004). Nuclear power is also more controversial. Construction sites often attracted protestors, worried about the perceived environmental risks of nuclear energy (Keith and Stewart 2004).

Against this backdrop, hydroelectric power generation has been a relative constant for those hoping to meet increased demand in a sustainable and cost-effective way. In 1980, for example, the recently renamed Ontario Hydro launched a Dual Energy Program that offered grants to houses willing to switch to hydro heating for spring, summer, and fall (oil would continue to be used in the winter). Such efforts to encourage the supply of more sustainable energies coincided with other conservation initiatives in the 1990s and early 2000s. In 2002, for instance, Ontario passed the Electricity Pricing, Conservation, and Supply Act, which provided tax exemptions to municipal properties (including schools) if they added generating capacity that is renewable or alternative (i.e., solar, wind, etc.).

The Corporations Tax Act, passed shortly thereafter, incentivized similar adoption in the corporate sector. Around the same time, the Ontario Energy Board Act was also amended, allowing the Minister of Energy to issue directives on energy conservation, efficiency, sustainability, and cleanliness. These programs reflected growing concern over the environmental impact of Ontario's energy supply, which had been brought to a head in 1998 when a report by the Ontario Medical Association found that smog was killing 1,900 people per year in Ontario (Keith and Stewart 2004).

Such efforts continued through the start of the new millennium. In 2009, Ontario passed the Green Energy Act with guiding principles regarding greenhouse gas reporting, energy usage, green energy investments, and energy efficiency in government facilities. The Act also established the Renewable Energy Facilitation Office, which focused on the development of renewable energy projects.

While these efforts further entrenched the importance of hydroelectricity to Ontario's energy supply, they also set the stage for the continued expansion of alternative energies like wind and solar. By 2013, for instance, Canada had become the fifth-largest single wind market in terms of new builds, with a significant portion of installed wind capacity concentrated in Ontario (Niagara Falls 2014b). Interest in energy storage also grew during this time. In 2014, the Ontario Power Authority and the Independent Electricity Systems Operator submitted a joint report to the Minister of Energy for an energy storage procurement framework (Niagara Falls 2014b). Around the same time, the City of Niagara Falls published a report anticipating that the advanced energy storage systems market would grow 70 per cent (3,200kWh) by 2023 (Niagara Falls 2014b).

Though pumped hydro storage would remain most prominent, the report also noted investments in other forms of storage like compressed air energy storage, batteries, supercapacitors, fuel cell and flywheel technologies. The report highlighted emerging technologies like hydrogen storage, super magnets, and synthetic gas, as well, positioning these new technologies as opportunities for further investment (Niagara Falls 2014b). Given Niagara's historic concentration of expertise and capital in energy production, storage, and transmission, the report argued, efforts should be made to attract these emerging industries to the region.

A decade later, this argument has proved prescient. Niagara's legacy in hydroelectric power generation and transmission has made it an attractive destination for the development of renewable and alternative energy projects. In 2022, the same year that the Ontario government published a new hydrogen strategy, Atura Power (a subsidiary of Ontario Power Generation) selected Niagara Falls as the site of their new production and storage project (Atura 2022). That same year, the federal government announced a $1.5m investment to support CHAR Technologies' Renewable Natural Gas and Biocarbon Project in Thorold (Niagara Economic Development 2022). Others have speculated about the future of offshore wind farms in Lake Ontario, and the role that such technologies could play in reducing Ontario's dependence on fossil fuels (McGrath 2023).

While these projects are subject to evolving federal and provincial priorities, the concentration of expertise in these sectors has made Niagara an attractive destination for businesses interested in energy conservation and efficiency. The region is host to companies like ES Fox Ltd. and EnerDynamic Hybrid Technologies, for example, whose products are being used to improve energy efficiency in industrial warehouses (and refurbished nuclear facilities) across the province (Niagara Falls 2018). Recognizing these strengths, municipalities in Niagara have begun to think critically about recruitment and development in these emerging energy sectors, including the prospect of creating a research and innovation centre in Niagara Falls (Niagara Falls 2018). Together, such efforts have turned Niagara into one of Canada's largest green energy hubs, the bedrock of which continues to be hydroelectric power.

Conclusion

Those who visit Niagara today will find a unique blend of history and innovation. Located just upstream of the actual Falls, the Rankine Generating Station, once one of the largest producers of hydroelectricity in the world, has been converted into a museum, showcasing the long and storied history of hydroelectricity in Niagara. The first Sir Adam Beck station has also shut down production, and the City of Niagara Falls is grappling with how best to reimagine the historic properties that it finds in its possession (Niagara Falls 2018). Attentive visitors to Niagara Falls can likewise look out at the Niagara River and see remnants of the many structures that have been used to divert water for the sake of hydroelectric power since the beginning of the 20th century (MacFarlane 2020).

It would be a mistake to assume that Niagara's strengths in hydroelectric power generation are a thing of the past, however. The Niagara River continues to be a significant source of power within Ontario and beyond. Recent efforts to increase generating capacity in Niagara signal the important role that hydro will play in meeting increasing demand for sustainable power. At the same time, the balance between supply and demand is a delicate one, and there is room to think critically about the demands that new technologies are placing on local infrastructures.

As interest in more environmentally sensitive forms of power generation grows, Niagara's historic strength in hydroelectric power generation has made it an attractive site for the development of new technologies. This is reflected in public and private investment in the area, as well as the economic development materials of local municipalities. With the provincial government considering how best to meet the demand associated with electric vehicles, critical mineral supply chains, and more, the storied role that Niagara has played in the electrification of Ontario should be top of mind.

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