

The
ONTARIO
ENERGY
REPORT

Bruce Power is helping Ontario
achieve a number of important
policy goals while simultaneously
advancing nuclear medicine and
human health.

Bruce Power is and will remain
a key contributor to keeping
Ontario's electricity system
clean, while providing low-cost
electricity rates that help
Ontario business grow and
families prosper.

ONTARIO'S SUPPLY MIX

Electricity supply in Ontario comes from a diverse mix of different fuel types: wind, solar, hydro (waterpower), natural gas, and nuclear. These fuel types have different supply characteristics, all of which are needed to meet the province's demand. Managing a balanced supply mix which is flexible, reliable, affordable, and low-emitting as possible ensures Ontario always has the electricity it needs to keep the lights on.

ONTARIO'S SUPPLY MIX INCLUDES:

- Base-load supply includes sources like nuclear and hydro. They are low-cost, reliable, Greenhouse Gas Emission (GHG)-free and supply electricity 24/7.
- Intermittent supply includes sources like wind and solar. They provide electricity when the wind is blowing and the sun is shining. This output is highly variable.
- Peaking supply sources like natural gas and peaking hydro are used when demand is at its highest. They are flexible and can come online quickly should the need arise.
- Flexible nuclear from the Bruce Power site. Bruce Power's eight-unit site adds flexible, dynamic capability.

Ontario's energy market has undergone significant transformation over the last decade. The province was the first jurisdiction in North America to lead the way in ending its use of coal-fired electricity, a milestone that was achieved in 2014. This could not have been accomplished without Ontario's nuclear industry.

Bruce Power's refurbishment of four nuclear units brought 3,000 megawatts (MW) of reliable, low-cost, and carbon-free electricity back to the grid and provided 70 per cent of the electricity needed to take coal-fired generation out of the Ontario supply stack.

With the phase out of coal in 2014, there has been a need to provide flexibility when demand in the province drops, while also ensuring availability to meet peaks given the unique nature of Ontario's energy market.

Bruce Power has made investments in all eight units on site to offer additional flexibility to Ontario's electricity market. Of the 6,400 MW of capacity from the Bruce Power site, there is the capability, which has been significantly utilized by the province, for 2,400 MW of flexible or dynamic capability. The company has achieved this by enhancements to both our operations and physical upgrades on the non-nuclear side of the plant.

Today, nuclear accounts for more than 60 per cent of Ontario's supply, with Bruce Power providing more than 30 per cent of the province's electricity at 30 per cent less than the average cost to generate residential power.

fig. 1 Ontario's Electricity Production in 2019

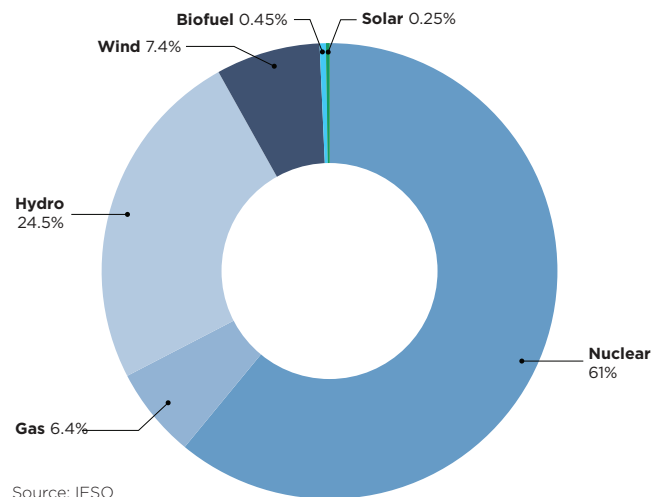


fig. 2 Ontario Generation (2007-2019)

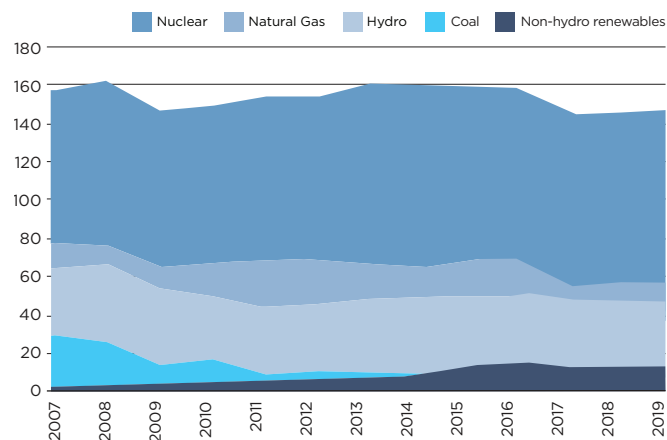
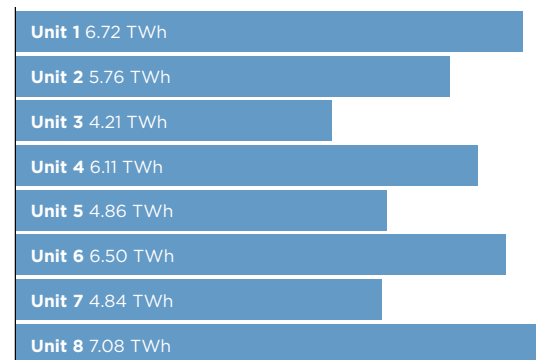


fig. 3 Bruce Power 2019 Output



Market mechanisms in Ontario help to ensure we receive power from neighbouring jurisdictions like Quebec when we need it and when it makes economic sense. The reverse is also true. Last January, Ontario provided Quebec with more than 400 GWhs to support its winter demand for power.



DEMAND

Ontario is a unique energy market from a demand perspective due to its dual peaking nature. This means that demand in Ontario is highest in the winter and in the summer. The dual-peaking nature of our energy market presents challenges which need to be managed for Ontario to be self-sufficient.

On a day-to-day basis, demand is also highly variable but, in general, peaks during the day and is lower at night. This fluctuating demand requires a unique supply mix, one which will be flexible enough to meet Ontario's highest demand days, and reliable enough to provide power 24/7.

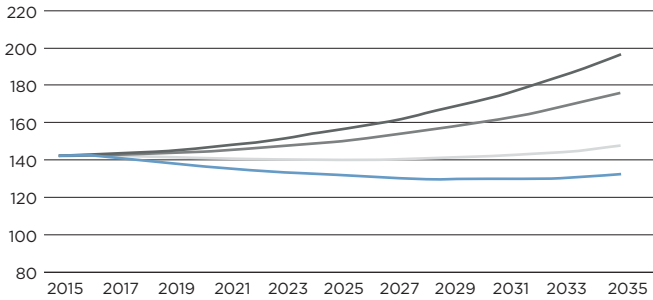
Looking forward, projecting demand must take into account factors that increase electricity demand such as population growth and economic change, as well as factors that reduce demand such as conservation and embedded generation. Through 2035, according to the Independent Electricity System Operator (IESO), annual electricity demand is projected to remain relatively flat under the most likely scenario (see figure 5). Bruce Power's Life-Extension Program will ensure Ontario families and businesses have long-term price stability.

fig.4 Demand through 2019



Source: IESO

fig.5 Ontario Net Energy Demand Across Demand Outlooks



Source: IESO, Ontario Planning Outlook (2016)



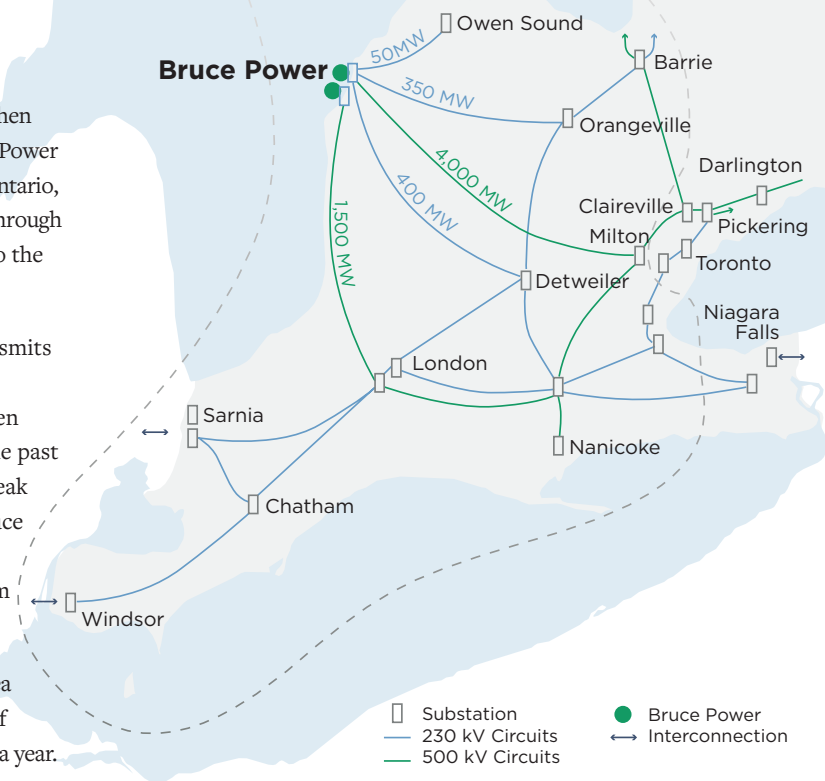
BRUCE POWER'S ROLE IN MEETING ONTARIO DEMAND

Bruce Power is the world's largest operating nuclear facility. When looking at the electricity infrastructure for the province, Bruce Power is the electricity powerhouse for virtually all of southwestern Ontario, spanning into central and northcentral Ontario. Additionally, through the Bruce-Milton transmission line, the site is a key supply to the western portion of the GTA.

The Bruce-Milton transmission line, completed in 2012, transmits electricity generated at Bruce Power to serve the northwest portion of the Greater Toronto Area (GTA). This area has seen some of the highest electrical load growth in Ontario over the past 10 years and is projected to continue rising, with a current peak demand of 1,150 MW – the equivalent electricity from 1.5 Bruce Power units. As the area grows, Bruce Power will be able to continue powering the region up to a total of 4,000 MW from the existing transmission line.

Bruce Power is an essential resource for the most populated area of the province, using existing infrastructure to deliver a third of Ontario's electricity safely and reliably, 24 hours a day, 365 days a year.

fig. 6 Key Electricity Supply Lines from Bruce Power with Typical MW Flow



There are 60 Local Distribution Companies (LDCs) in Ontario responsible for delivering electricity to the customers within a designated area. Your electricity bill is calculated and provided to you from your utility.

Utilities vary how they display charges, however, electricity bills are all broken down into the following categories:

Bill Component: Electricity (includes Global Adjustment)

Type of Charge: Consumption

This is the cost of generating the electricity you used in this period. This cost is paid to the electricity generators.

Bill Component: Delivery

Type of Charge: Demand

This is the cost of maintaining the infrastructure needed to deliver power from the generator to your home or business. The delivery charges on your bill cover the costs for a utility to build, operate and maintain infrastructure such as transmission lines, distribution lines, towers, poles, transformers substations, and other key grid infrastructure. It also covers costs of administration. The delivery charge is comprised of a fixed monthly charge, and a variable demand-based charge. Delivery rates vary from utility to utility, and are approved by the Ontario Energy Board (OEB).

Bill Component: Regulatory

Type of Charge: Consumption

This portion of the electricity bill is paid to the Independent Electricity System Operator (IESO), Ontario's grid operator and energy planner to ensure system reliability, and to the Ontario Energy Board (OEB), Ontario's independent energy regulator. The IESO manages system supply and demand to ensure there is electricity for Ontario's residents and businesses. The OEB ensures system stability, establishes rates, monitors the markets, licenses energy companies and sets policy for the province. This charge is collected by your utility and passed through to the IESO and OEB.

Bill Component: HST

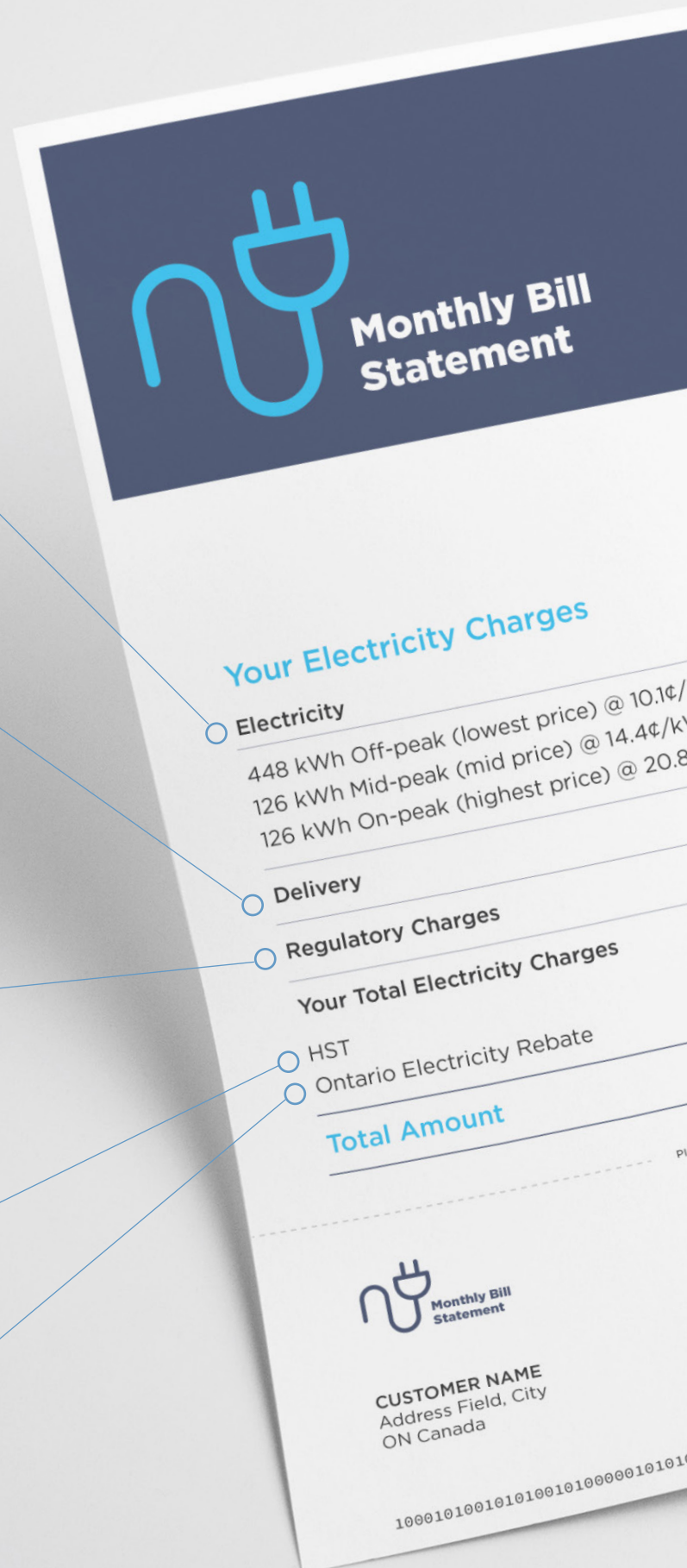
Type of Charge: Entire Bill (percentage based)

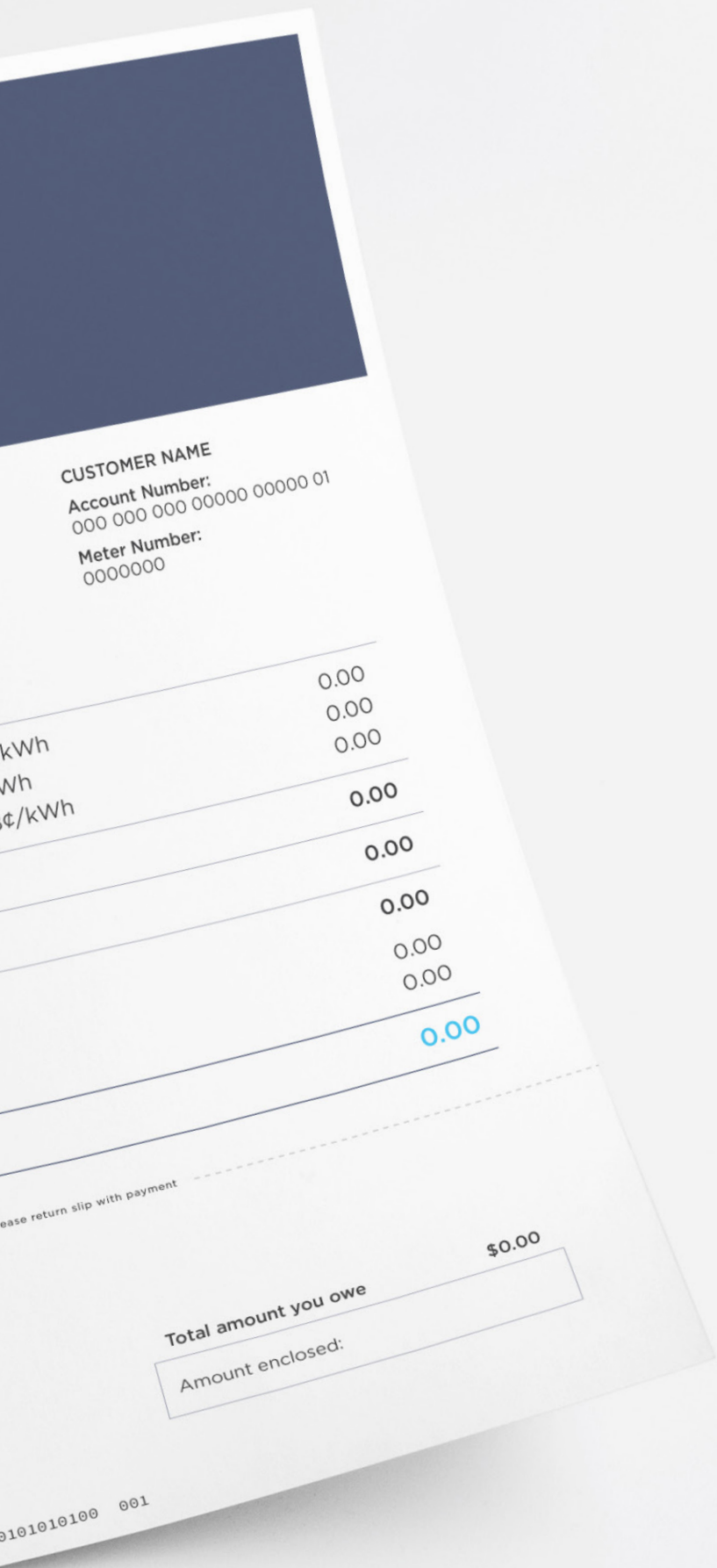
Provincial and Federal tax, paid to the government. A portion of this tax is refunded through the Ontario Energy Rebate.

Bill Component: Ontario Electricity Rebate

Type of Charge: Consumption

The Ontario Electricity Rebate is applied to bills for most residential consumers, farms, and some small businesses. It is a rebate provided by the Ontario government of 31.8% of the base invoice amount, and replaces previous rebate programs.





Electricity Charges

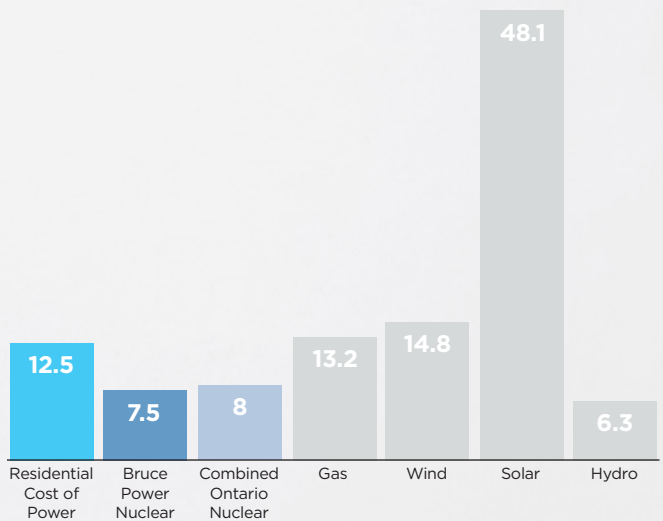
Off-peak (lowest price) @ 10.1¢/kWh
 Mid-peak (mid price) @ 14.4¢/kWh
 On-peak (highest price) @ 20.8¢/kWh

Residential and small business customers pay time-of-use rates. These fixed-rate tiers recover total system costs for generating the electricity of residential customers.

On a volume-weighted average basis, residential electricity customers pay 12.5 cents per kWh in electricity costs.

The electricity costs go to paying generators for producing electricity. Some generators, like Bruce Power and Hydroelectric, cost less to generate electricity per kWh than others, such as solar and wind.

fig. 7 2019 Ontario Energy Board Total Unit Supply Cost (cents/kWh)

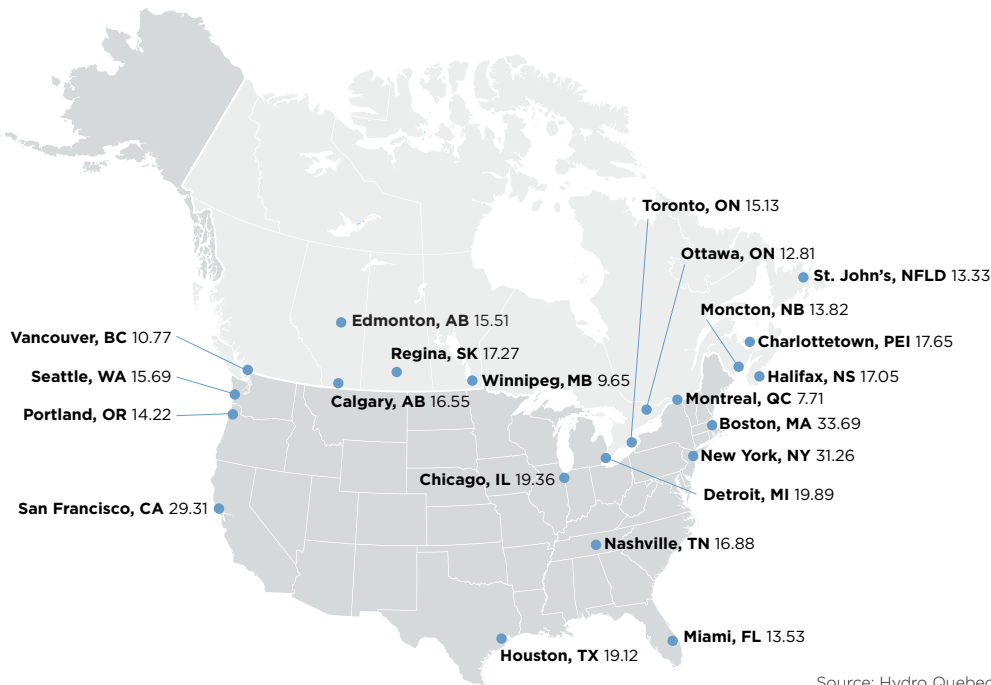


ELECTRICITY RATE COMPARISON

Ontario's electricity rates are competitive and in-line with rates across other Canadian and North American cities. The average residential ratepayer in Ontario will pay an all-in rate which is lower than most other major North American cities.

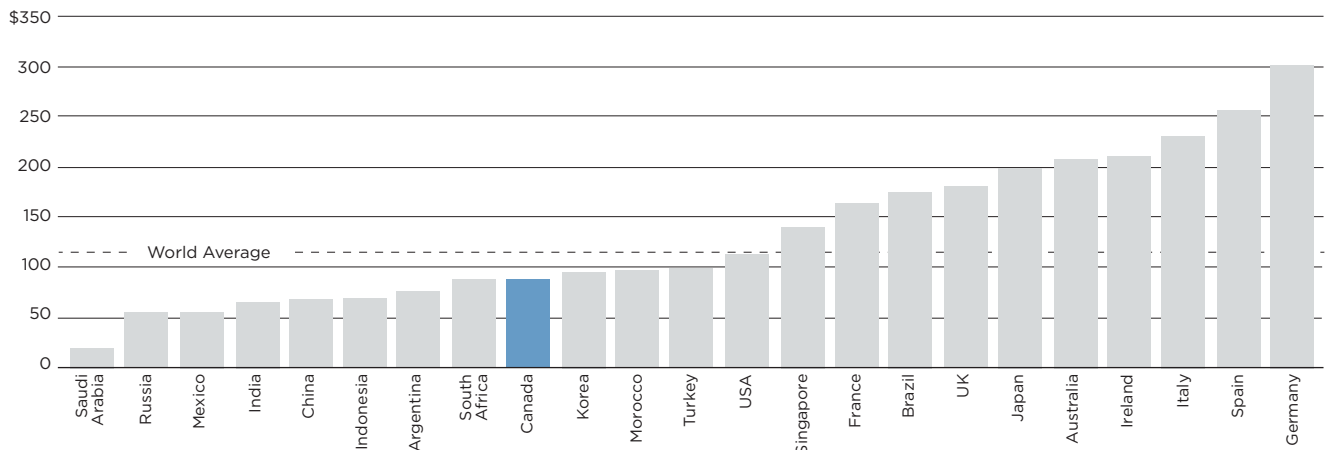
Compared to major global countries, Ontario's residential electricity rates rank among the lowest in developed countries and almost 30 per cent below the 2018 world average of 17.33 cents/kWh. This is largely due to Ontario's nuclear fleet, which is a key contributor for keeping prices down in Ontario.

fig. 8 Average prices for residential customers in major North American cities (cents/kWh)



Source: Hydro Quebec, Comparison of Electricity Prices (2019)

fig. 9 Residential electricity prices in selected economies, 2017 (CAD as of 2019)



Source: IEA, World Energy Prices (2019)

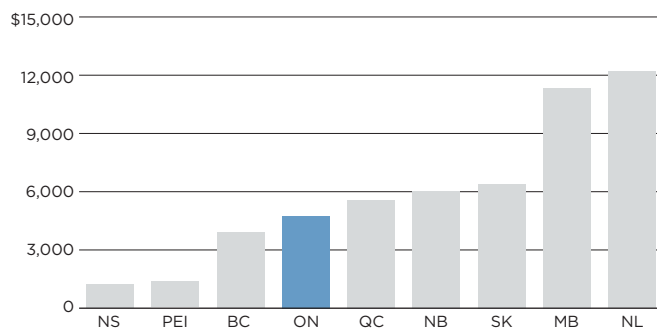


PROVINCIAL SYSTEM DEBT PER CAPITA

The electricity system, like any other long-lived infrastructure investment, requires long term financing options that spread the costs over the life of the investment. All jurisdictions make use of long term debt to finance building new projects or ongoing maintenance of their electricity systems.

Ontario's provincial long-term debt associated to electricity infrastructure is lower per capita than many neighbouring jurisdictions and helps Ontario remain competitive while maintaining a reliable, stable and diverse supply mix.

fig. 10 Long-term debt per capita for electric utilities



BRUCE POWER'S ROLE IN LOW COST POWER IN ONTARIO

Bruce Power produces 30 per cent of Ontario's power at 30 per cent less than the average cost to produce residential power. Bruce Power is the source of half of Ontario's nuclear generation, and the lowest cost source of nuclear energy in the province.

In January 2019, Bruce Power announced it will be contributing more than \$200 million to reduce electricity system costs from 2019-2021. These efficiency payments will benefit Ontario's electricity consumers, and are a result of Bruce Power's focus on innovation, simplification and continuous improvement in our operations.

According to a 2017 report written by Ontario's Financial Accountability Office (FAO) on the life extension of the province's nuclear fleet, "There is currently no portfolio of alternative low emissions generation which could replace nuclear generation at a comparable cost."

The FAO estimates that the Bruce Power Refurbishment Plan will result in nuclear generation supplying a significant proportion of Ontario electricity demand from 2016 to 2064 at an average price of \$80.7/MWh in 2017 dollars.

EMISSIONS

Ontario's electricity is supplied by a diverse group of clean generation resources. More than 90 per cent of Ontario's electricity is generated by non-emitting sources such as nuclear, hydroelectric and, to a lesser extent, renewables such as wind and solar. The province has become the example other jurisdictions in North America look to for guidance on clean energy policy, and Bruce Power is proud of the role it plays in keeping Ontario's air clean.

NUCLEAR UP, COAL DOWN

Between 2003 and 2012, Bruce Power brought four nuclear reactors back to life. This revitalization generated 70 per cent of the energy needed to phase out coal in Ontario and allowed the province to shut down all coal plants.

Closing coal-fired power plants represents one of the largest greenhouse gas reduction initiatives in North America. Phasing out coal from our generation stack has eliminated more than 30 mega tonnes of annual GHG emissions, equivalent to taking seven million vehicles off our roads. Emissions of oxides of Sulphur, which are predominantly a byproduct of coal combustion, have also shown a marked decrease with the phase out of coal-fired electricity.

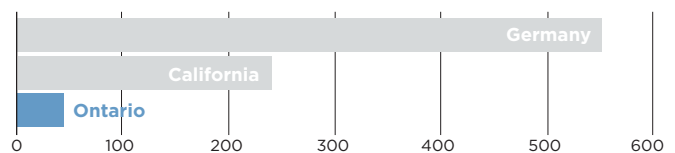
Phasing out coal is not only beneficial to the environment and the air we breathe – decreasing smog days from 53 in 2005 to zero in 2019 – but also positively impacts the health of Ontario residents. A study by the Ministry of Energy found that phasing out coal

can limit emergency room visits, illness and hospital admissions, resulting in a financial benefit of \$2.6 billion annually.

Ontario's off-coal program is a model for other jurisdictions in the fight to lower emissions from the electricity sector.

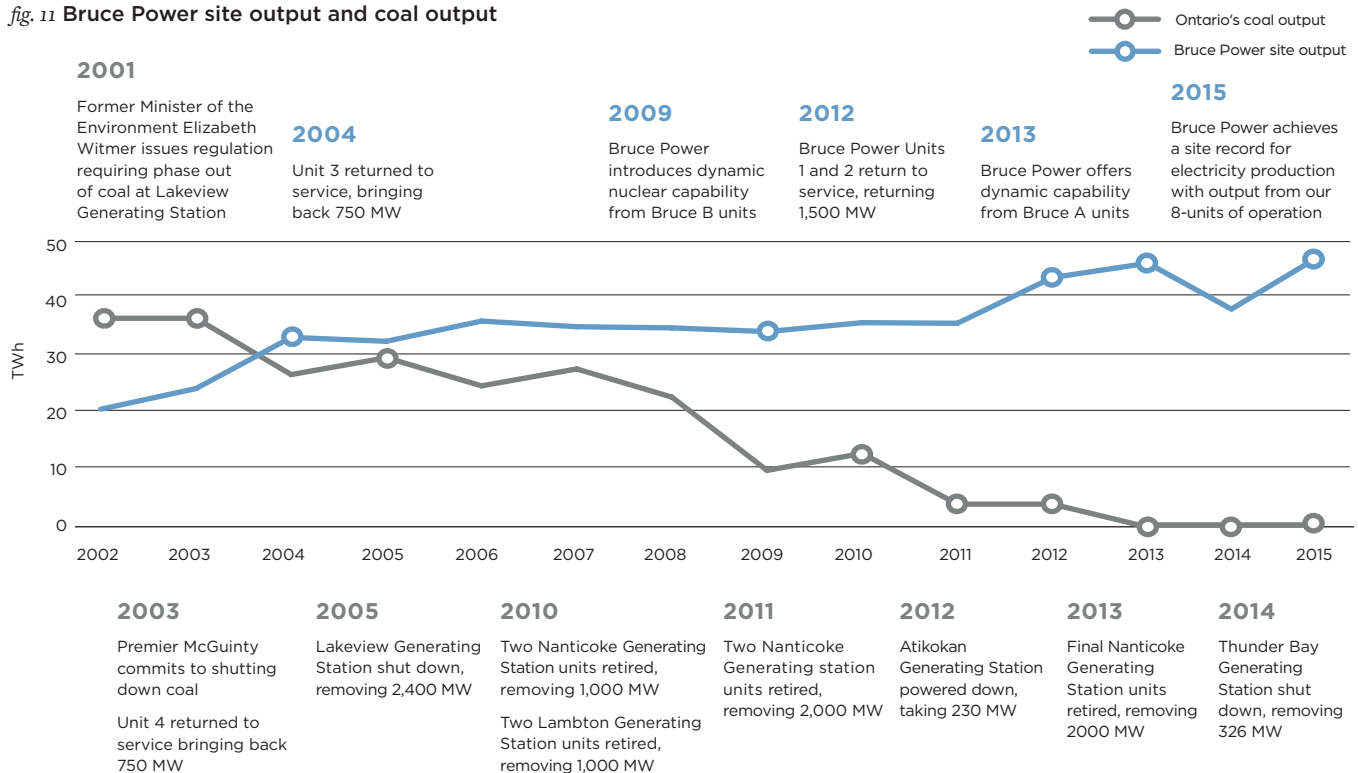
In 2017, Germany generated 37 per cent of its electricity from non-carbon sources. Germany has made massive investments in altering its grid by removing nuclear power in favour of large scale renewables, investing upwards of \$580 billion in renewable energy and storage by 2025.

fig. 12 Emission intensity from the electricity sector by jurisdiction (gCO₂e/kWh)



Despite these investments, Germany's current emission intensity has not improved since the program began, however household prices have tripled over the same timeframe. Germany's emission intensity is almost 10 times higher than Ontario's. Because of the reliable electricity output and low-emissions of the nuclear industry, Ontario has been able to cut emissions from the electricity sector while also maintaining a low-cost system for consumers.

fig. 11 Bruce Power site output and coal output



Bruce Power

POWERING HOSPITALS, KEEPING MEDICAL EQUIPMENT CLEAN AND SAFE, AND PROVIDING LIFE-SAVING ALTERNATIVE CANCER TREATMENTS

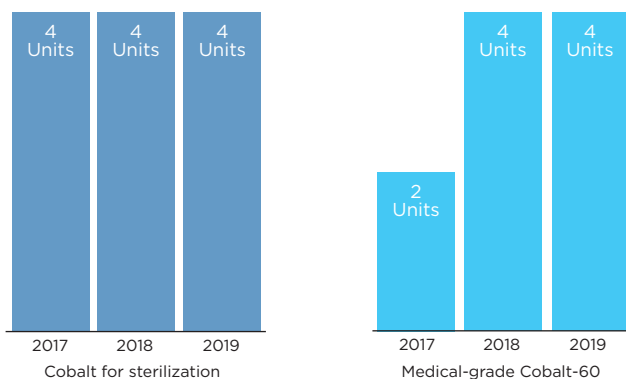
Bruce Power positively impacts millions of people. Aside from providing carbon-free electricity for the consumers of Ontario, it also benefits the world's health care system through the production of medical isotopes.

For more than 30 years, Bruce Power has been a reliable supplier of Cobalt-60 for Nordion, an Ottawa-based company. Bruce Power's Cobalt-60 is used to sterilize 40 per cent of the world's single-use medical devices and equipment such as syringes, gloves, implantable devices, surgical gowns and masks.

Cobalt-60 irradiation technology is also increasingly being used to preserve food – spices, grains, fruit, vegetables and meat. Using Cobalt-60 as a preservative avoids the use of potentially harmful chemical fumigants and insecticides. Gamma prevents food-borne illnesses caused by micro-organisms such as E.coli and salmonella, without affecting the taste or nutrient levels of the food.

In 2019, Bruce Power began harvesting High Specific Activity (HSA) Cobalt-60, or medical-grade Cobalt-60, which will benefit cancer patients in Canada and around the world. This medical-grade Cobalt is used worldwide for alternative treatments to traditional brain surgery and radiation therapy for the precise treatment of brain tumors and complex brain conditions, while limiting damage to the surrounding healthy tissue and organs.

fig. 13 Isotope production at Bruce Power



Bruce Power's commitment to supply HSA will ensure that Canada will continue to be a leader in the global manufacture of this critical isotope.

HOW COBALT-60 IS PRODUCED BY BRUCE POWER:

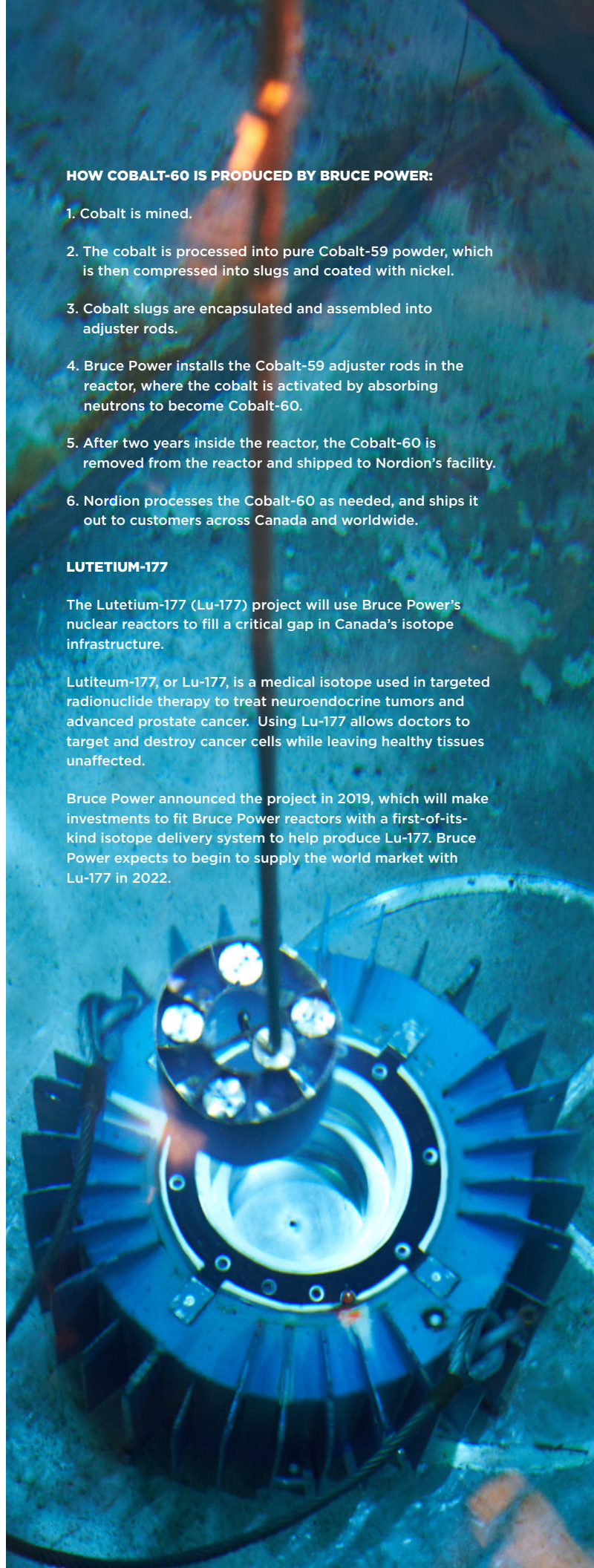
1. Cobalt is mined.
2. The cobalt is processed into pure Cobalt-59 powder, which is then compressed into slugs and coated with nickel.
3. Cobalt slugs are encapsulated and assembled into adjuster rods.
4. Bruce Power installs the Cobalt-59 adjuster rods in the reactor, where the cobalt is activated by absorbing neutrons to become Cobalt-60.
5. After two years inside the reactor, the Cobalt-60 is removed from the reactor and shipped to Nordion's facility.
6. Nordion processes the Cobalt-60 as needed, and ships it out to customers across Canada and worldwide.

LUTETIUM-177

The Lutetium-177 (Lu-177) project will use Bruce Power's nuclear reactors to fill a critical gap in Canada's isotope infrastructure.

Lutetium-177, or Lu-177, is a medical isotope used in targeted radionuclide therapy to treat neuroendocrine tumors and advanced prostate cancer. Using Lu-177 allows doctors to target and destroy cancer cells while leaving healthy tissues unaffected.

Bruce Power announced the project in 2019, which will make investments to fit Bruce Power reactors with a first-of-its-kind isotope delivery system to help produce Lu-177. Bruce Power expects to begin to supply the world market with Lu-177 in 2022.





ECONOMIC IMPACT

Bruce Power's operations support 22,000 direct and indirect jobs annually, contributing \$4 billion through the direct and indirect spending in operational equipment, supplies, materials and labour income in Ontario. Approximately 480 companies directly do business with Bruce Power and these organizations in turn work with hundreds of sub-suppliers.

Over the next 20 years, as Bruce Power refurbishes its fleet through its Life-Extension and Major Component Replacement (MCR) project, it will add an incremental 5,000 direct and indirect jobs, and an incremental \$2 billion in annual direct and indirect spending.

More than 90 per cent of Bruce Power's capital and resource costs are spent in Ontario, and the company's supply chain supports hundreds of businesses throughout the province.

More than

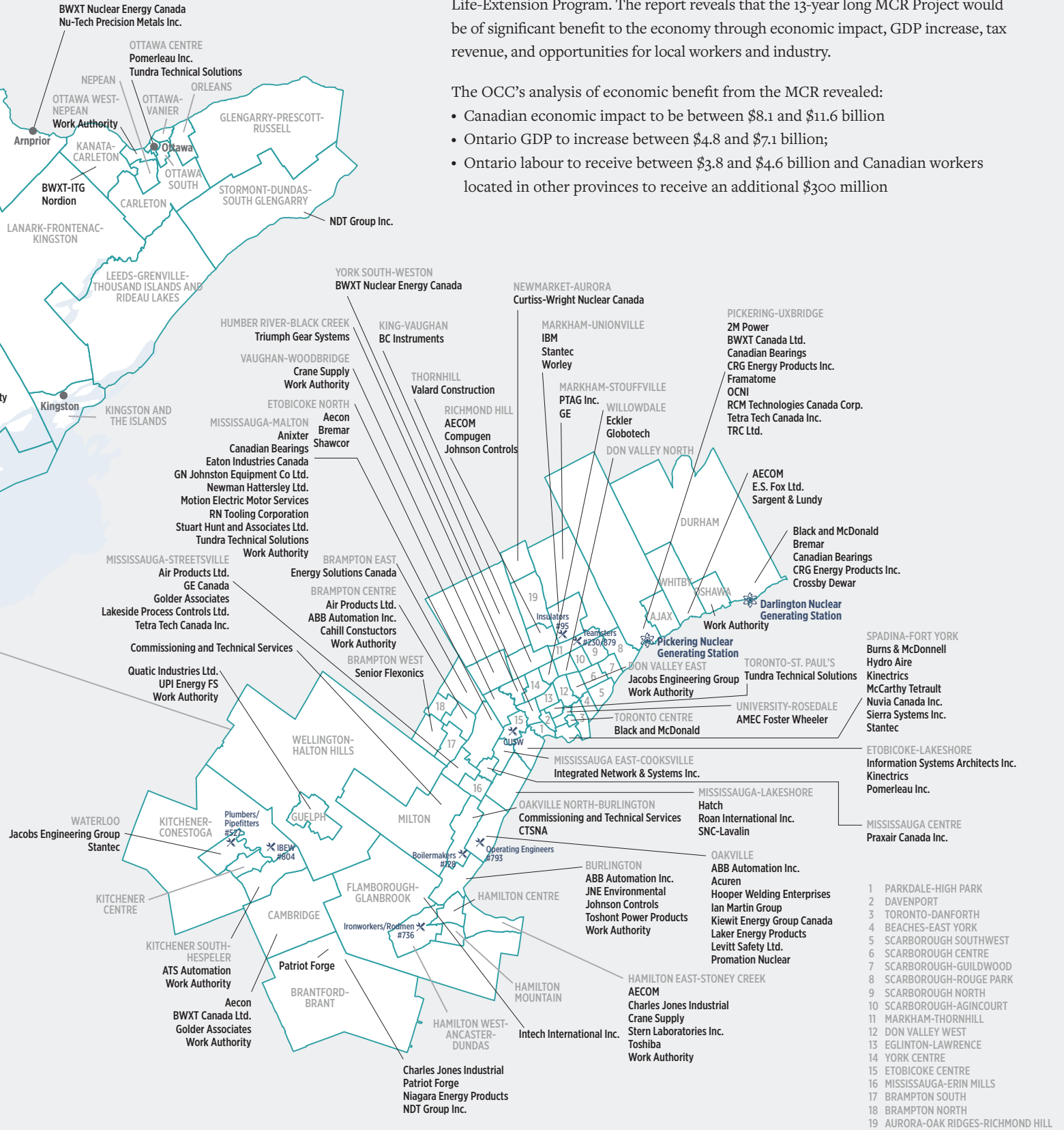
90%

of Bruce Power's capital and resource costs are spent in Ontario.

The Ontario Chamber of Commerce (OCC) released a report outlining an impartial economic impact assessment of the MCR project undertaken as a part of Bruce Power's Life-Extension Program. The report reveals that the 13-year long MCR Project would be of significant benefit to the economy through economic impact, GDP increase, tax revenue, and opportunities for local workers and industry.

The OCC's analysis of economic benefit from the MCR revealed:

- Canadian economic impact to be between \$8.1 and \$11.6 billion
- Ontario GDP to increase between \$4.8 and \$7.1 billion;
- Ontario labour to receive between \$3.8 and \$4.6 billion and Canadian workers located in other provinces to receive an additional \$300 million



- 1 PARKDALE-HIGH PARK
- 2 DAVENPORT
- 3 TORONTO-DANFORTH
- 4 BEACHES-EAST YORK
- 5 SCARBOROUGH SOUTHWEST
- 6 SCARBOROUGH CENTRE
- 7 SCARBOROUGH-GUILDWOOD
- 8 SCARBOROUGH-ROUGE PARK
- 9 SCARBOROUGH NORTH
- 10 SCARBOROUGH-AGINCOURT
- 11 MARKHAM-THORNHILL
- 12 DON VALLEY WEST
- 13 EGLINTON-LAWRENCE
- 14 YORK CENTRE
- 15 ETOBICOKE CENTRE
- 16 MISSISSAUGA-ERIN MILLS
- 17 BRAMPTON SOUTH
- 18 BRAMPTON NORTH
- 19 AURORA-OAK RIDGES-RICHMOND HILL

PUBLIC OPINION

Bruce Power relies on the support and commitment of surrounding communities. In a phone survey of 605 randomly selected Ontario residents in December 2019, voters identified cost of living, healthcare and the environment as their top three concerns. We asked Ontarians what they think about nuclear power, its role in climate change, research and innovation and medical isotopes.

80%
of residents support the Life-Extension at Bruce Power

As an emissions-free generator, Bruce Power is an integral component to helping Ontario meet its climate change objectives, while simultaneously creating jobs, driving Ontario economic growth and supporting innovation. Our poll found:

73%
of Ontarians agree nuclear energy is a critical part of the global climate change solution

75%
agree that investment in nuclear will strengthen Canadian research and innovation

73%
agree that nuclear provides economic opportunities for Canada

Ontarians rely on Bruce Power every day to power their homes and businesses with low cost affordable electricity. Our poll found that:

68%
of Ontarians agree that nuclear energy helps keep electricity prices stable

77%
of Ontarians remain committed to Ontario being energy independent and agree that Ontario must prioritize generating enough energy to meet its needs rather than importing from other jurisdictions such as Quebec

Bruce Power is playing a pivotal role in the world's supply of life-saving medical isotopes, which are being used by health-care practitioners worldwide to treat cancer patients in novel, non-invasive ways.

66%
of Canadians are concerned about ceding their leadership position in isotope production and research and development

63%
of Canadians support the development of a national strategy for isotopes to ensure Canada remains at the forefront of the isotope sector



BrucePower[®]

Innovation at work

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