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City of Pickering
**Economic and financial impact
of the retirement of Pickering
Nuclear Generating Station**

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June 18, 2015

FINAL REPORT

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Executive Summary

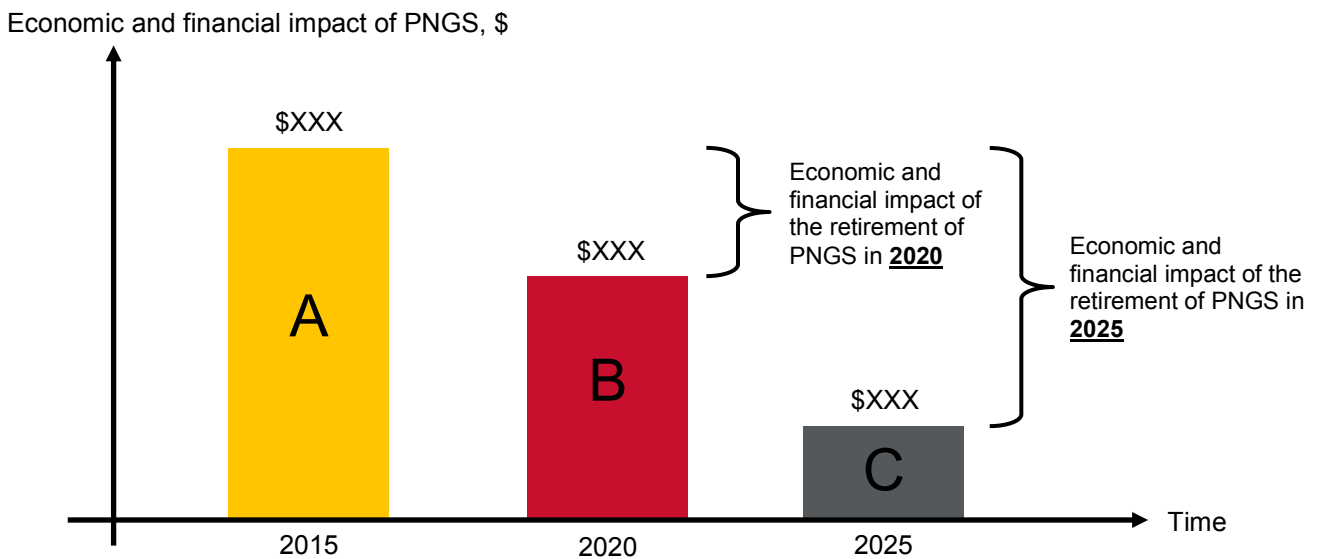
Study objectives

The Pickering Nuclear Generation Station (“PNGS”) has nearly reached its useful life and is slated for decommissioning. Given that PNGS is the largest employer in the City of Pickering, the municipality engaged HDR Corporation (“HDR”) to assess and estimate the economic and financial impact to Pickering and specifically Pickering residents and the Corporation of the City of Pickering of the retirement of PNGS on an objective, transparent and credible basis over the 2015 to 2025 period.

How to interpret the results?

Economic and financial impacts associated with the retirement of PNGS are estimated relative to the baseline which for the purposes of this study is the economic and financial contribution of PNGS in 2015. The figure below illustrates how the economic and financial impact of the PNGS retirement is estimated and should be interpreted.

Figure 1 – Interpretation of economic and financial impact of the retirement of PNGS



We estimate the economic and financial contribution of PNGS in 2015 (the baseline year), 2020 and 2025 to Pickering. PNGS no longer generates electricity in 2020 and prepares for the long decommissioning process that lasts several decades. For the purposes of this study:

- The economic and financial impact of the **retirement of PNGS in 2020** is equal to the economic and financial contribution of PNGS in 2020 (Area B) less the economic and financial contribution of PNGS in 2015 (Area A);
- The economic impact of the **retirement of PNGS in 2025** is equal to the economic and financial contribution of PNGS in 2025 (Area C) less the economic and financial contribution of PNGS in 2015 (Area A).

Economic and financial impact results

The table below shows the total economic impact associated with the retirement of PNGS in 2025 relative to 2015 (Area C less Area A in the diagram above). These results were estimated by HDR based on data and information collected from Ontario Power Generation (“OPG”) and other sources and employing standard and accepted economic impact methodologies (see the main body of the report for a description of the methodology and specific data sources employed). To estimate the economic impact of the retirement of PNGS to City of Pickering residents and the Corporation of the City of Pickering, we first estimated the economic impact of the retirement of PNGS to Ontario and then assessed what proportion of this impact is localized in the City of Pickering to: residents, local businesses and the Corporation of the City of Pickering.

Table 1 – Total gross economic and financial impact (direct, indirect and induced) of the retirement of PNGS from 2015 to 2025

	Ontario	City of Pickering
GDP (millions)	-\$789.7	-\$48.8
Wages and salaries (millions)	-\$367.1	-\$21.4
Employment (FTEs)	-4,698	-231
Government revenues (millions)†	-\$191.2	-\$0.5

† Government revenue economic impacts for Ontario refer to revenues generated from all forms of taxation, for the City of Pickering they refer to Payments in lieu of Property Taxes only.

Estimates presented above are considered **gross** as opposed to **net** economic impacts because we have not considered economic impacts arising from the refurbishment of Darlington Nuclear Generating Station (“DNNGS”) and Bruce Nuclear Generating Station (“BNGS”). We also have not considered any potential positive economic impacts that could result from a change in energy prices arising from the retirement of PNGS. By 2025, the gross economic impact of the retirement of PNGS is expected to result in \$789.7 million less in GDP to Ontario, which represents 0.1% of Ontario’s economy, and \$48.8 million less in GDP to Pickering. With respect to employment, by 2025, the retirement of PNGS will result in 4,698 job losses across Ontario on a gross basis and the retirement of PNGS is expected to decrease government revenues from all forms of taxation by roughly \$191 million.

That said, only 8% of the employees at PNGS actually live in the City of Pickering and a majority of PNGS’s non-wage expenditures occur outside the City of Pickering. We therefore estimate that 231 residents of the City Pickering, of which 203 work at PNGS (see Table 9 in the main body of the report), will lose their jobs as a result of the retirement of PNGS by 2025. While this is still a large a number, it is far less than the gross economic impact of the retirement of PNGS to Ontario. On the other hand, the average salary of individuals that lose their jobs is estimated at roughly \$93,000, which is significantly greater than the average wage in Ontario. **Despite the loss of some high paying jobs, our analysis suggests that the economic**

impact of the retirement of PNGS will be distributed across the Greater Toronto Area (“GTA”), Durham Region and other parts of Ontario where employees of PNGS and employees of contractors and suppliers of PNGS live.

It is also important to assess the retirement of PNGS within some of the broader trends impacting Pickering. The development of Seaton in central Pickering will dramatically change the City’s population composition and employment profile. Seaton is expected to increase Pickering’s population by up to 70,000 people and generate up to 35,000 jobs. Even if PNGS was to remain commercially operating, the development of Seaton and the jobs that would be created as a result would likely decrease the importance of PNGS to Pickering’s economy and labour market and help diversify Pickering’s economy.

In this regard, the Province of Ontario – as the owner of substantial employment lands in Seaton – has an opportunity to play a key role in offsetting job losses from the retirement of PNGS by directing and delivering highly-skilled, well-paying jobs to the Seaton community from the outset of that development.

With respect to PNGS’s financial impact to the City, in 2015, PNGS made Payments in Lieu of Property Taxes of \$4.9 million. The City of Pickering retains approximately 60% of these payments – approximately \$3.0 million, which represents an important part of the City of Pickering’s overall revenues. **Based on OPG’s projections, annual Payments in Lieu of Property Taxes that are retained by the Corporation of the City of Pickering are expected to decline by roughly \$0.5 million in or by 2025 and significantly more by the end of the decommissioning period.** As of the date of this report, OPG is in the process of assessing various repurposing options for the PNGS site. **There may be an opportunity for OPG to reduce a potentially significant loss of annual Payments in Lieu of Property Taxes to the City through the appropriate selection of repurposing options at the PNGS site.**

Figure 2 – Map of City of Pickering with location of Seaton Community



1. Introduction

Background

The Pickering Nuclear Generating Station (“PNGS”) is one of the largest nuclear generating stations in the world. It produces a significant amount of Ontario’s electricity and is the largest employer in the City of Pickering employing 2,700 people. PNGS commenced commercial operations in 1971. The table below provides some background information in regards to the generators/units that comprise PNGS.

Table 2 – PNGS background information

PNGS site	Units/Generators	Commenced commercial operations	Combined energy generation capacity
Pickering A	Units 1 through 4	Between 1971 and 1973	1,000 MW
Pickering B	Units 5 through 8	Between 1983 and 1986	2,100 MW

Between 1983 and 1986, four additional reactors were added. In total, eight units comprise PNGS, but only six are currently operating.¹ PNGS has a combined energy capacity of 3,100 MW.² At the end of 1997, PNGS’s first four units (Pickering A) were voluntarily shut down as part of Ontario Hydro’s nuclear improvement program.³ Unit 1 and Unit 4 of Pickering A returned to commercial operations in 2003 and 2005 respectively.⁴ In 2010, OPG announced a large scale nuclear refurbishment strategy. The strategy called for significant investments at Bruce Nuclear Generating Stations (“BNGS”) and Darlington Nuclear Generation Station (“DNBS”) to extend the useful life by 30 years and further investments at PNGS to ensure the continued safe and reliable performance of PNGS for another 10 years – PNGS End of Commercial Operations (“PECO”) is currently scheduled to occur around 2020.⁵ Figure 3 below summarizes the timeline of key events.

¹ Pickering Nuclear Generating Station. Canadian Nuclear Safety Commission. Retrieved from <http://nuclearsafety.gc.ca/eng/reactors/power-plants/nuclear-facilities/pickering-nuclear-generating-station/index.cfm>.

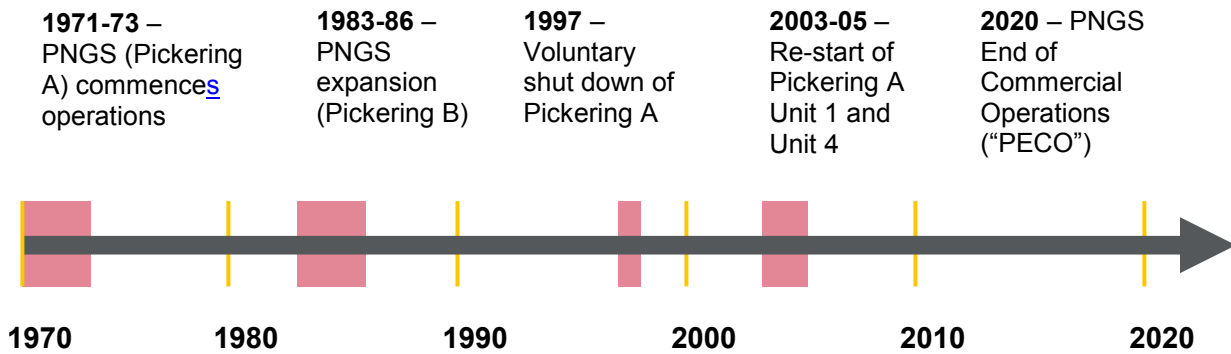
² Pickering Nuclear. Ontario Power Generation. Retrieved from <http://www.opg.com/generating-power/nuclear/stations/pickering-nuclear/Pages/pickering-nuclear.aspx>.

³ *Ibid.*

⁴ *Ibid.*

⁵ Refurbishment for Darlington, but not Pickering B. World Nuclear News. Retrieved from http://www.world-nuclear-news.org/C-Refurbishment_for_Darlington_but_not_Pickering_B-1702105.html.

Figure 3 – PNGS timeline of key events to 2020



The retirement of PNGS is expected to impact the City of Pickering given that PNGS, as noted above, is the largest employer in the City and plays an important role in helping anchor a vibrant Energy, Environmental and Engineering (“EN3”) sector that has emerged in the City of Pickering.⁶ Previous studies on the impact of decommissioning of nuclear generating facilities suggest that the impact can be significant particularly if the community hosting these facilities depends exclusively on them as a source of employment. It is noted that this is not the case in Pickering.

Study objectives

Given the importance of PNGS, the City of Pickering engaged HDR Corporation (“HDR”) to assess and estimate the economic and financial impact of the retirement of PNGS to Pickering on an objective, transparent and credible basis over the 2015 to 2025 period. The time period selected for this study broadly reflects the operations, site preparation and decommissioning periods associated with the retirement process for nuclear generating facilities.⁷ The time period for this study is associated with initial stages of the nuclear facilities decommissioning profile which is referred to as retirement in this report.

Approach

This section of our report provides a detailed description of the approach employed to complete this study. The table below outlines the steps we took as part of this study. **Users of this report should carefully review the table below to understand the scope and nature of this study.** Appendix A provides a detailed description of methodology employed to estimate the economic and financial impact of the PNGS retirement.

⁶ See <https://www.pickering.ca/en/business/energyenvironmentengineeringen3.asp> for more information regarding Pickering’s EN3 cluster.

⁷ Section 3 of this report provides a more detailed description of the decommissioning process for nuclear generating facilities.

Table 3 – Overview of our approach

Phase	Tasks and activities
Phase 1 – Project initiation	<ul style="list-style-type: none"> • Obtained and reviewed any relevant background material and report. • Developed a draft annotated table of contents for the final report (the reporting framework). • Conducted a formal kick-off meeting at the City of Pickering to re-confirm the study objectives, review the project plan and the reporting framework.
Phase 2 – Methodology and data collection	<ul style="list-style-type: none"> • Developed the economic methodology of the economic/financial model and outlined the methodology in flowchart format (see Appendix A). • Collected all necessary data from the City, OPG and other relevant stakeholders to estimate the economic/financial impact of retirement of PNGS over the study period (2015 to 2025). • Met with OPG several times over the course of this project to ensure we understand the data provided and to confirm our understanding of the decommissioning profile and to address gaps in the underlying data. • Redeveloped the economic/financial methodology to address gaps in the underlying data. OPG was not able to provide us a detailed breakdown of their expenditures over the analysis period and had little information in regards to how the retirement of PNGS would impact employees. • Conducted additional research to address gaps in the data and to conform to the updated methodology. The data we collected was sent to OPG for review and approval. • Developed assumptions regarding the impact that the retirement of PNGS will have on expenditures associated with the provision of City services. • Interviewed a few key suppliers of PNGS to fully understand the direct and indirect impacts to key suppliers with respect to PECO.
Phase 3 – Financial economic impact analysis	<ul style="list-style-type: none"> • Developed the financial/economic model to estimate the financial/economic impact of the retirement of PNGS to Pickering based on the redeveloped methodology and data collected in Phase 2. • Tested and validated financial/economic results based on discussions with the City and OPG and comparison with other relevant studies. • Refined financial/economic results based on the above.

Phase	Tasks and activities
	<ul style="list-style-type: none"> Presented preliminary findings to the City and OPG.
Phase 4 – Reporting	<ul style="list-style-type: none"> Developed the draft report based on the reporting framework established in Phase 1. Received and reviewed a consolidated list of comments from the City. Updated and finalized the report based on comments provided by the City.

Data

The credibility of any economic impact assessment relies on using the best available data and information. All efforts were made to ensure that we met this objective as part of this project. Data obtained from third party sources to address gaps was closely and carefully scrutinized. This included reviewing data with the City and OPG. Formal approval from OPG was obtained in regards to the future number of employees and expenditures over 2015 to 2025 time period. The table below summarizes the key data sources used to estimate the financial and economic impact of the retirement of PNGS. We should note that while we think we received sufficient data from OPG to estimate the economic impact of retirement of PNGS, we would have preferred obtaining more detailed information regarding PNGS’s non-wage expenditures, which we were unable to obtain for confidentiality reasons. Any additional analysis and studies on the economic and financial impact of the decommissioning of PNGS should make use of more detailed information.

Table 4 – Description of key data sources

Data	Description	Source
PNGS employment	Projections of employment at PNGS in 2015, 2020 and 2025.	OPG
PNGS wages, salaries and benefits	Projections of wages, salaries and benefits paid to PNGS staff in 2015, 2020 and 2025.	OPG
Residency of current employees at PNGS	The percentage of PNGS employees that reside in the City of Pickering.	OPG
PNGS non-wage operating and capital expenditures	Detailed breakdown of projections of non-wage operating and capital expenditures in 2015, 2020 and 2025.	OPG provided aggregate non-wage operating and capital expenditures over the analysis period, but were unable to provide a detailed breakdown. To obtain a more detailed breakdown of the expenditures we used information

Data	Description	Source
		published by the Canadian Energy Research Institute. OPG confirmed that this is an appropriate source to characterize non-wage operating and capital expenditures.
PNGS suppliers	Information regarding PNGS key suppliers – more specifically, a supplier list was obtained that showed the names of suppliers that comprise 75% of PNGS purchases.	OPG
Input-Output Tables	The Input-Output Tables show the interrelationship between industries that comprise an economy. Specifically, they show the extent of purchases from one industry to another and within each industry. They are used to estimate multiplier effects of spending in an economy.	Statistics Canada For this study, the 2010 Ontario Input-Output Tables are used, which is the latest version of the Input-Output Tables.
Various socioeconomic data	Various demographic, economic and industrial level data and information used to characterize socioeconomic characteristics in Pickering and as input into the economic impact model.	Statistics Canada – National Household Survey, Census of Populations and other relevant Statistics Canada surveys and data sources.
City of Pickering revenues and expenditures	Data and information regarding the amount and composition of City revenues and expenditures.	City of Pickering – the City’s most recent publicly available financial statements were used.

Limitations

HDR relied upon the completeness, accuracy and fair presentation of all the information, data and representations obtained from various sources which were not audited or otherwise verified. These sources (collectively, the “Information”), include:

- The City of Pickering;
- OPG;

- Statistics Canada; and
- Information from other relevant studies.

The findings in this report are conditional upon such completeness, accuracy and fair presentation of the information, which has not been verified independently by HDR. HDR reserves the right at its discretion to withdraw or make revisions to this report should we be made aware of facts existing at the date of the report that were not known to us when we prepared this report. The findings are as of the date hereof and HDR is under no obligation to advise any person of any change or matter brought to its attention after such date, which would affect the findings and HDR reserves the right to change or withdraw this report. This information has been prepared solely for the use and benefit of, and pursuant to a client relationship exclusively with the City of Pickering.

Report structure

This report is structured as follows:

- Section 2 provides a high level population, economic and industrial profile of Pickering and the Region of Durham.
- Section 3 shows the economic and financial impact results associated with the retirement of PNGS. This section also includes a discussion regarding terminology and how to interpret the results.
- Appendices are contained under separate cover

2. City of Pickering population and economic profile

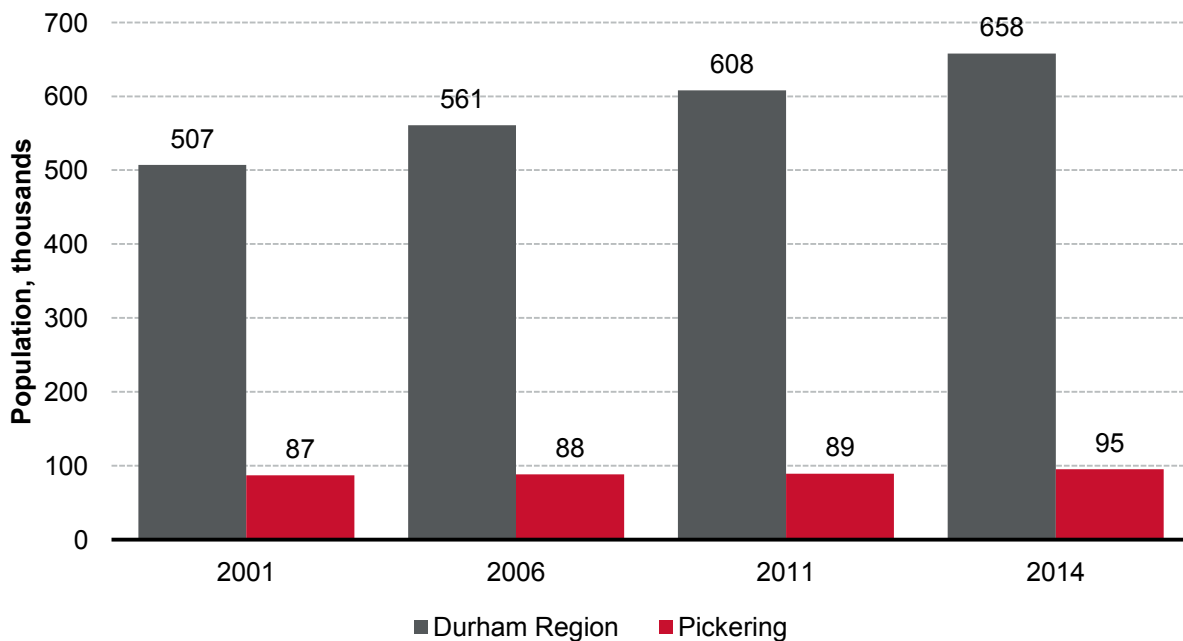
Introduction

This section of the report provides a brief population and economic overview of the City of Pickering and Durham Region as a reference point. Data and information was primarily obtained from the 2001, 2006 and 2011 Census and the 2011 National Household Survey, which is the latest available census data. Updated 2014 population data is based on estimates prepared by the Region of Durham.⁸ Other data presented for 2014 is based on projections developed by the City of Pickering for planning purposes. Information from other sources is also used to assess how trends may change over this study’s analysis period. We conclude with a discussion about what these trends mean for the City of Pickering in regards to the retirement of PNGS.

Population profile

The population profile below highlights key population trends and dynamics in Durham Region and Pickering. Figure 4 below shows the trend in population growth in Pickering and Durham Region.

Figure 4 – Durham Region and City of Pickering population (2001, 2006, 2011 and 2014)



In 2014, the City of Pickering’s population is estimated to be 95,200⁹, which represents approximately 14% of the population in Durham Region. The relative importance of the City of

⁸ Report to The Region of Durham Planning & Economic Development Committee from the Commissioner of Planning and Economic Development titled Monitoring of Growth Trends, September 23, 2014

⁹ City Development Department, City of Pickering.

Pickering in terms of population to Durham Region has decreased since 2001 when the City of Pickering accounted for 17% of the population in Durham Region. This is due to faster population growth in other parts of Durham Region relative to Pickering. From 2001 to 2011, Durham Region’s population grew by a Compounded Annual Growth Rate (“CAGR”) of 1.8% whereas Pickering’s population grew by 0.2% CAGR. More recent data from the Region of Durham Planning and Economic Development Committee, however, shows that population growth in Pickering has in fact accelerated. In 2014, Pickering’s population was estimated at roughly 95,200, which means that the City of Pickering’s population grew by 2.3% CAGR since 2011. Intensification in Pickering’s core, new home construction in Pickering’s Duffin Heights neighbourhood and more affordable housing prices in the City of Pickering relative to the City of Toronto may help explain this trend.

Looking forward, the City of Pickering’s population will likely expand much more dramatically over the analysis period of this study and beyond. The community of Seaton, which lies within Central Pickering, will accommodate a population of up to 70,000 residents and approximately 35,000 jobs. Seaton will be one of the largest greenfield developments in Canadian history.¹⁰ The potential construction of a new airport in northwest Pickering could increase Pickering’s population and attract employment to an even greater extent.¹¹ Construction and development of some of the key infrastructure has already begun in the area and the City of Pickering is actively marketing and promoting the Seaton development. Needless to say, the development of Seaton and the potential development of a new airport will likely dramatically change Pickering’s population and will become a more critical part of Durham Region and the Greater Toronto Area (“GTA”). These broader population trends and dynamics were considered in assessing the economic and financial impact of PECO to Pickering.

Figure 5 – Map of City of Pickering with location of Seaton Community



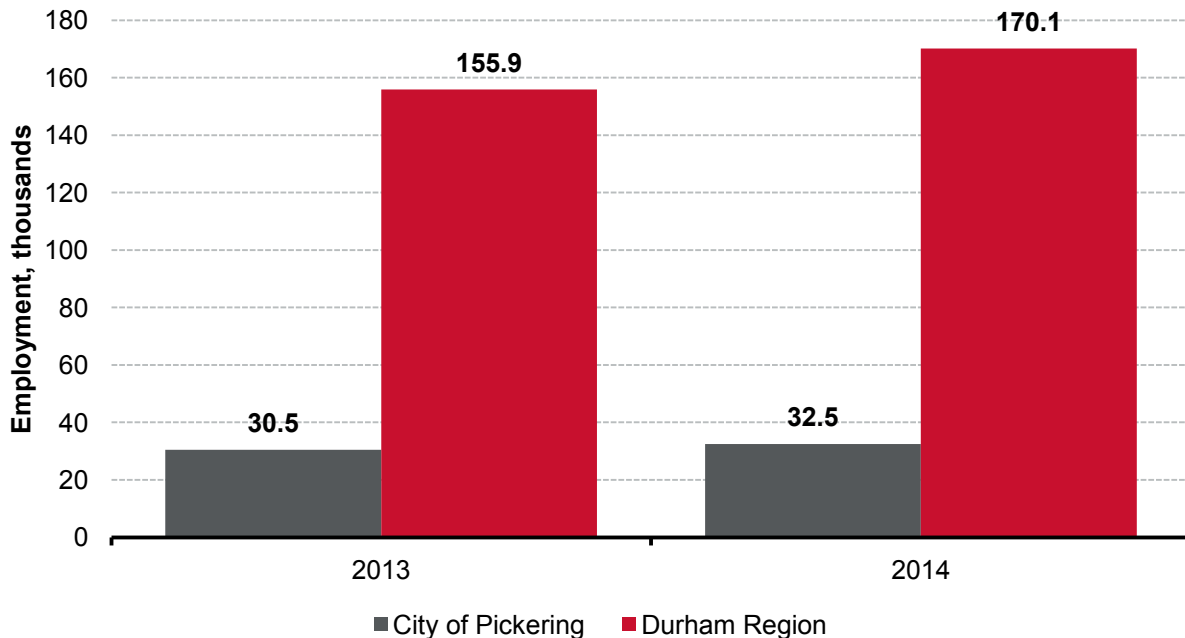
¹⁰ Report to The Region of Durham Planning & Economic Development Committee from the Commissioner of Planning and Economic Development titled Monitoring of Growth Trends, September 23, 2014

¹¹ It should be noted that it is still unclear if an airport in Pickering will be developed, but the Federal Government have set aside lands for the construction of an airport – www.tc.gc.ca/eng/ontario/pickering-maps-1432.htm.

Economic profile

This section of the report highlights key economic trends impacting the City of Pickering. Census and other related data from Statistics Canada and information provided by the City of Pickering is used to assess these historical trends. Lastly, we briefly discuss implications for the financial and economic impact assessment of the retirement of PNGS. The diagram below shows the number of jobs in the City of Pickering and Durham Region in 2013 and 2014 based on data provided by the City of Pickering.

Figure 6 – Durham Region and City of Pickering number of jobs (2013 and 2014)



From 2013 to 2014, the number of jobs in the City of Pickering and Durham Region increased significantly. In the City of Pickering, the number of jobs increased from approximately 30,500 to 32,500 – a 6.7% growth rate. During the same period, jobs in Durham Region increased even more significantly by 9.1%, growing from 155,900 to roughly 170,100. In 2014, the City of Pickering accounted for nearly 20% of total employment in Durham Region. The development of Seaton and the employment that it could generate would more than double employment in the City of Pickering.

PNGS is an important contributor to the City of Pickering’s and Durham Region’s employment base and represents 8.3% and 1.6% of total employment respectively. This is a large percentage of total employment for any one entity to represent, particularly in the City of Pickering. If OPG employees at sites other than PNGS were also counted, then the percentage of jobs in the City of Pickering’s at OPG or PNGS would be greater than 10%.¹² On the surface,

¹² It should be noted that this study only considered the economic impacts of the decommissioning of PNGS from changes in PNGS’s operations in Pickering. The impact of the decommissioning of PNGS on OPG employees in the City of Pickering was not considered. OPG was unable to provide information on whether the decommissioning of PNGS would impact employment at other OPG sites in Pickering, which is why they were not considered as part of this study.

the retirement appears likely to have a significant impact to the City of Pickering in the near term. In the long run, however, the employment generated by the Seaton development would more than offset these job losses. Nevertheless, to get a more accurate picture of what the retirement of PNGS means for the City of Pickering we need to better understand the percentage of Pickering residents that work in the City.

Commuters represent a large proportion of Pickering and Durham Region residents, which complicates the estimation of the economic and financial impact of the retirement of PNGS. Isolating and estimating what the retirement of PNGS means for Pickering, which is the main objective of this study, depends partly on identifying how the retirement of PNGS will impact those individuals that live and work in Pickering. Commuters (e.g., those that live in Pickering but work elsewhere) would not be directly impacted by the retirement of PNGS. However, they could be impacted on a more indirect basis. For instance if the retirement of PNGS results in decreased revenues for the City then current residents could be impacted by decreased City services or higher property taxes. The diagrams below show the place of work of Pickering's labour force in 2006 and 2011.

Figure 11 – Place of work of Pickering residents, 2006

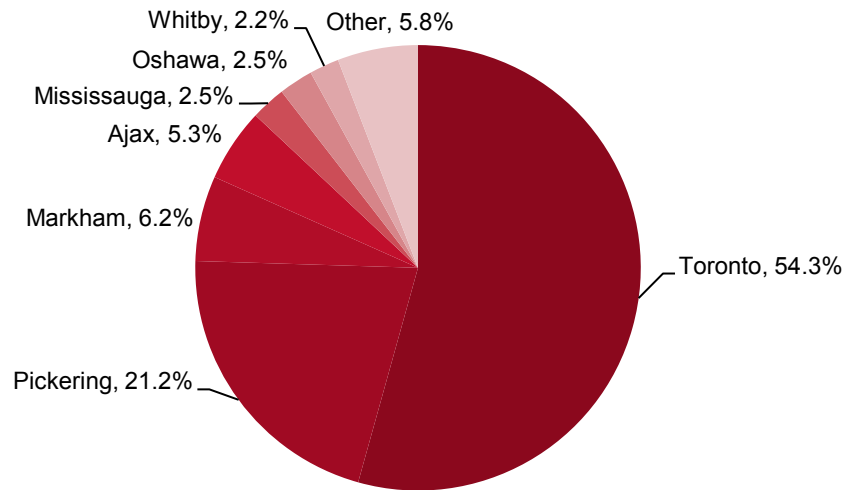
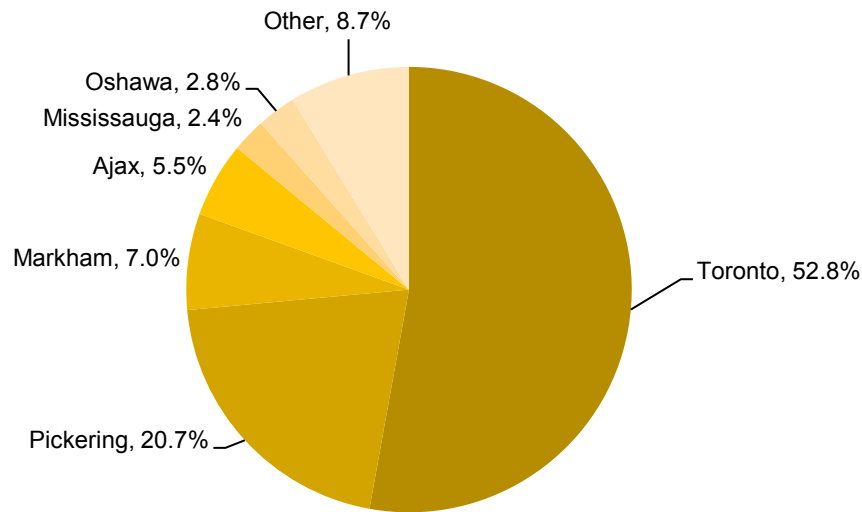


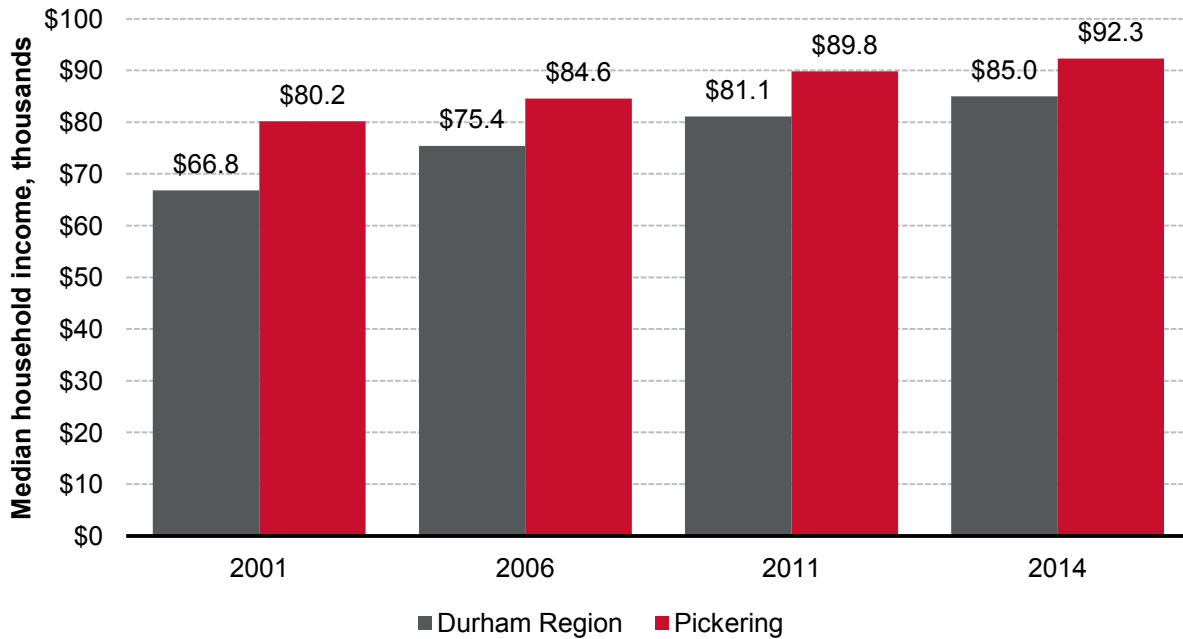
Figure 12 – Place of work of Pickering residents, 2011



From 2006 to 2011, the percentage of Pickering’s population working in Pickering decreased slightly from 21.2% to 20.7%. The percentage working in Toronto decreased during this period as well, but remains the most important employment destination for Pickering residents. In 2011, the percentage of Pickering’s population working in Toronto was well over two-times that in Pickering. Commuting flows are generally characterized by Pickering residents travelling west of the City for work; the percentage of Pickering’s population that does so has remained relatively constant since 2006. Less than 10% of Pickering’s population travelled east of the City for work in 2011. The economic impact of PECO to Pickering will at some level depend on the percentage of PNGS employees that live in Pickering. As shown above, Pickering’s economy is not dependent on PNGS as a source of employment even though it represents the largest employer in the City. Indeed, nearly 80% of Pickering’s population work outside of the City and they are unlikely to be significantly affected by PECO.

The discussion above suggests that the retirement of PNGS will likely have a smaller impact on residents of the City of Pickering than previously thought due to commuting flows. However, the retirement of PNGS could likely have a significant impact on average household incomes in Pickering particularly given that average incomes of employees at PNGS are nearly \$100,000 – roughly double the average salaries in Ontario. The figure below shows the trend in median household incomes in Pickering and Durham Region.

Figure 13 – Median household income in Pickering and Durham Region (2001, 2006, 2011 and 2014)



From 2001 to 2014, median household incomes in Durham Region increased from \$66,800 to \$85,000, which represents an annual growth rate of 1.9% (CAGR). Median household incomes in the City of Pickering grew at about half this rate. However, median household incomes in Pickering were still quite a bit larger than the rest of Durham Region. In 2014, the median household income in Pickering was \$92,300 which is over \$7,000 more than that of Durham Region's. PNGS currently employs 2,700 individuals and on average pays salaries roughly twice the average Ontario earnings and higher than the average in the City of Pickering. The loss of these high paying jobs can potentially impact the median household income in the City of Pickering.

Importance of PNGS to Pickering's economy

The high level socioeconomic assessment and outlook of Pickering suggests the following with respect to the retirement of PNGS and broader trends impacting Pickering:

- PNGS is certainly an important part of Pickering's economy and labour market and the retirement of PNGS will impact the City. However, Pickering does not depend exclusively on PNGS as a source of employment and Pickering's residents working outside of the City would not necessarily be significantly affected purely from an employment perspective.
- Certainly an important PNGS supplier community has emerged in Pickering that includes a variety of engineering, environmental services and other professional and technical

service providers.¹³ Accordingly, understanding how these organizations and companies will react to the retirement of PNGS and the refurbishment of DNGS is critically important to assessing the impact of the retirement of PNGS.

- It is also important to assess the retirement within some of the broader trends impacting the City of Pickering. Development of Seaton will dramatically change the City of Pickering's population composition and employment profile. Indeed, the development of Seaton is expected to increase Pickering's population by 70,000 and generate up to 35,000 jobs.¹⁴ Even if PNGS was to remain commercially operating, the development of Seaton and the jobs that it would result in would likely decrease the importance of PNGS to Pickering's economy and labour market over time.

The following section of this report shows the results of the financial and economic impact assessment.

¹³ For a list of organizations and companies that comprise the EN3 cluster see Energy, Environment & Engineering (EN3). City of Pickering. Retrieved from <http://www.pickering.ca/en/business/energyenvironmentengineeringen3.asp>.

¹⁴ New Sustainable Community Moves Forward in Durham (August 29, 2014). Government of Ontario. Retrieved from <http://news.ontario.ca/mah/en/2014/04/new-sustainable-community-moves-forward-in-durham.html>.

3. Economic and financial impact of the retirement of PNGS

Introduction

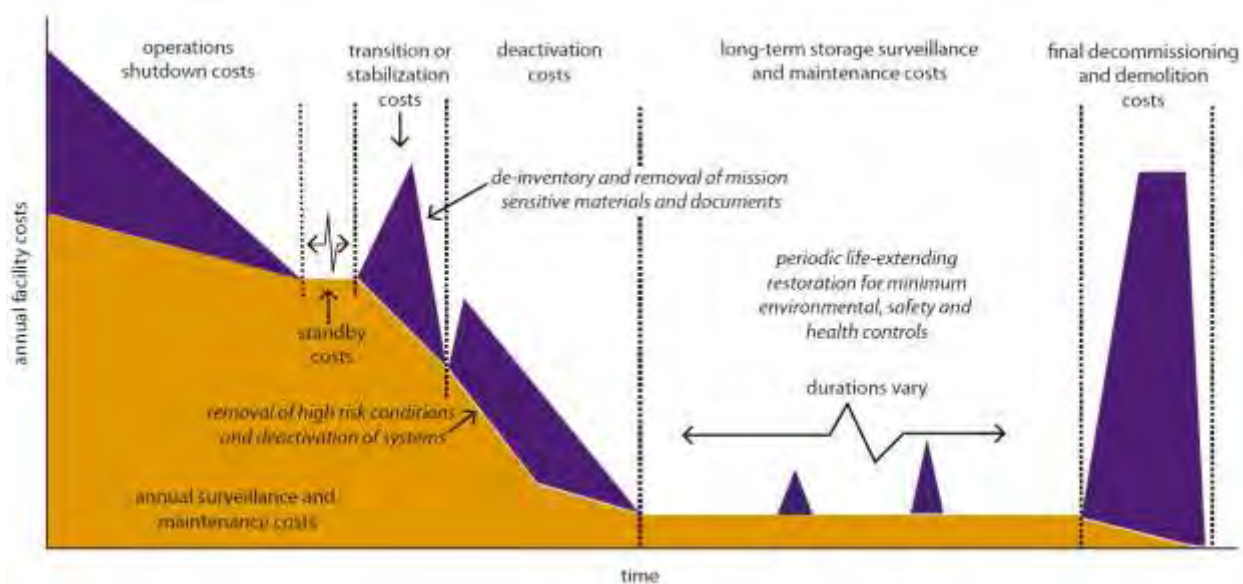
This section of the report shows our projected results of the economic and financial impact of the retirement of PNGS. For context, we first briefly describe a typical decommissioning process of a nuclear generating facility. A primer on economic impact analysis, which defines and explains key terminology, is then presented followed by the economic and financial impact results. We conclude with a summary of key findings and a discussion about what this means for the City of Pickering.

Decommissioning of nuclear generating facilities

Many nuclear generating facilities across North America were initially developed in the late 1960s and early 1970s with useful lives of 30-40 years.¹⁵ Accordingly, many nuclear generating facilities across North America in the next several years will begin the long process of decommissioning, which can last several decades. In this respect, the City of Pickering is not unique. However, the size and scale of the decommissioning of PNGS is likely one of the largest ever. For the purposes of this study, the economic impact of the retirement of PNGS is forecasted by estimating the economic contribution of PNGS in 2015, 2020 and 2025 and then taking the 2020 and 2025 estimates and subtracting them from 2015 – the baseline year. How spending changes over time will determine the extent of the economic and financial impacts since economic impacts are driven by spending in an economy. The figure below shows an expenditure profile of a typical nuclear generating facility decommissioning process.

¹⁵ Decommissioning Nuclear Facilities (2014). World Nuclear Association. Retrieved from <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Nuclear-Wastes/Decommissioning-Nuclear-Facilities/>.

Figure 14 – Expenditure profile of typical nuclear generating facility decommissioning process¹⁶



The decommissioning of nuclear generating facilities can take several decades and expenditures associated with the decommissioning of nuclear generating facilities can be quite erratic over the decommissioning time period. Initial expenditures result from preparing the site for decommissioning. During this period, annual surveillance and maintenance costs still comprise a large part of the total facility costs. The expenditure profile then typically spikes as stabilization and deactivation costs are incurred – annual maintenance and surveillance costs begin to decrease during this period. Thereafter, the facility undergoes a prolonged period of safe storage where only minor maintenance and surveillance costs are incurred. Costs jump at the end of the decommissioning period as the site is demolished and repurposed. Discussions with OPG suggested that the profile for the decommissioning of PNGS is generally consistent with this description. The time period for this study is associated with initial stages of the nuclear facilities decommissioning profile which is referred to as retirement in this report.

Economic impact analysis primer

The basic premise behind economic impact analysis is that spending in one industry generates additional spending (i.e., multiplier effects) in other industries and potentially even in the same industry. For example, the purchase of manufactured steel products (e.g., rebar) generates spending in supplying industries: steel refining, energy production, transportation, professional services; which, in turn source this supply from other industries such as coal mining, iron ore mining and several other industries. Statistics Canada produces the Input-Output Tables that quantify the inter- and intra-dependencies of industries that comprise the Canadian economy. The Input-Output Tables enable us to quantify how spending in one industry tracks through the Canadian economy and, thus, how this spending impacts the Canadian economy. Economic impacts are generally estimated for the following standard measures of economic activity:

¹⁶ Closing and Decommissioning Nuclear Power Reactors (2012). United Nations Environment Programme. Retrieved from http://www.unep.org/yearbook/2012/pdfs/UYB_2012_CH_3.pdf.

- **Value-added or Gross Domestic Product (GDP)** – the value added to the economy or the unduplicated total value of goods and services. GDP includes only final goods to avoid double counting of products sold during an accounting period.
- **Wages and salaries** – the total value of derived from labour.
- **Employment** – the number of jobs created or supported. It is expressed as the number of equivalent full-time jobs indicated in person years.
- **Government tax revenues** – the amount of tax revenues generated. In this study, total taxes are calculated.

Economic impacts are typically estimated at the direct, indirect and induced levels:

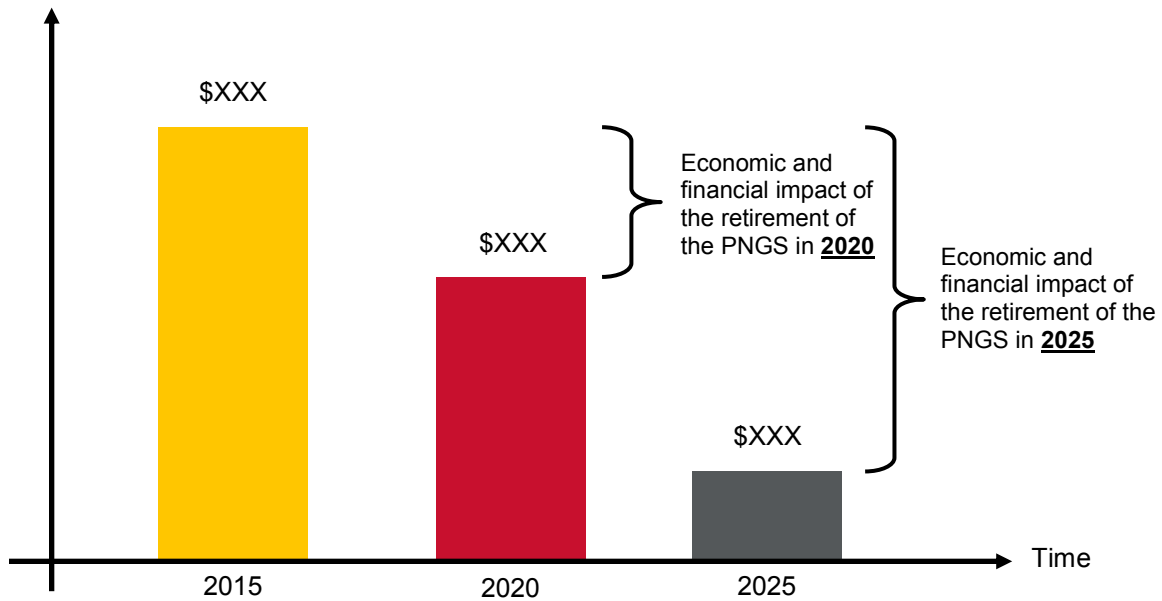
- **Direct impacts** are changes that occur in “front-end” businesses that initially receive expenditures and operating revenue as a direct consequence of operations and activities conducted.
- **Indirect impacts** arise from changes in activity for suppliers of the front-end business. For example, the purchase of rebar from a steel product manufacturer requires that the steel product manufacturer purchase refined steel from a steelmaker.
- **Induced impacts** occur when employees from businesses stimulated by direct and indirect expenditures spend their income on consumer goods and services.

Interpretation of economic impacts

Economic and financial impacts associated with the decommissioning of PNGS are estimated relative to the baseline, which for the purposes of this study is the economic and financial contribution of PNGS in 2015. The figure below illustrates how the economic and financial impact of retirement PNGS is estimated and should be interpreted.

Figure 15 – Interpretation of economic and financial impact of the retirement of PNGS

Economic and financial impact of PNGS, \$

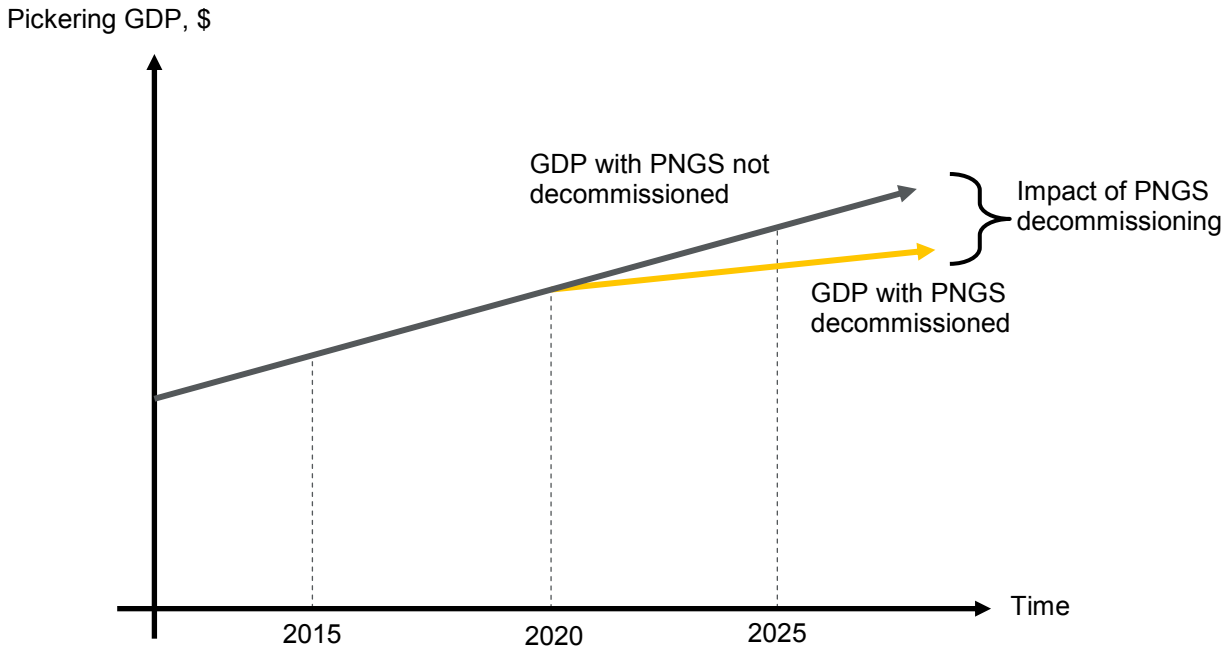


We estimate the economic and financial contribution of PNGS in 2015 (the baseline year), 2020 and 2025 to Pickering. PNGS no longer generates electricity in 2020 and begins the long decommissioning process that last several decades. For the purposes of this study:

- The economic and financial impact of the **retirement of PNGS** in 2020 is equal to the economic and financial impact of PNGS in 2020 less the economic and financial contribution of PNGS in 2015;
- The economic impact of the **retirement of PNGS** in 2025 is equal to the economic and financial impact of PNGS in 2025 less the economic and financial contribution of PNGS in 2015.

Even though PNGS is the largest employer in Pickering, decreased economic activity generated by PNGS does not mean that Pickering's economy will decrease in absolute terms. Indeed, it is entirely possible and in fact likely that Pickering's economy is still larger in 2025 than it is in 2015. That being said, the retirement of PNGS is expected to decrease the level of economic growth in the short-to-medium term in Pickering relative to the scenario where PNGS is not decommissioned. The diagram below illustrates this concept.

Figure 16 – Impact of the retirement of the PNGS decommissioning on Pickering’s economy



As shown above the economic impact of the retirement of PNGS is expected to decrease the rate of economic growth in Pickering relative to a hypothetical scenario where PNGS is not decommissioned and continues to operate commercially over the analysis period.

One important caveat to note is that as part of this study we only estimated the gross economic impact of the retirement of PNGS. The economic impact associated with the refurbishment of DNGS or BNGS was not considered. We did not consider the economic impact of changes to energy costs in Ontario.

Ontario versus Pickering impacts

The tables in the following section of this report show economic impacts of the retirement of PNGS. The Statistics Canada Input-Output Tables, which are used to estimate economic impacts, are provided for Ontario and additional modelling is required to assess impacts that result from economic activity from Pickering. To do so, high level data and information regarding the residency of PNGS employees and the extent of PNGS purchases from local suppliers was obtained from OPG. We would have preferred that we obtain more detailed information from OPG in this regard, but this data was not able to be shared with us due to confidentiality reasons. Any additional analysis and studies on the economic and financial impact of the decommissioning of PNGS should make use of more detailed information.

To be specific, the tables below show the economic and financial contribution of PNGS and the economic and financial impact of the retirement of PNGS to Ontario and to residents and local businesses of the City of Pickering and to the Corporation of the City of Pickering. The methodology used in this study estimates the economic impact of the retirement of PNGS to Ontario and we then localize this impact to the City of Pickering

Economic and financial contribution of PNGS to Ontario and Pickering

This section of the report shows the economic contribution of PNGS to Ontario and Pickering for 2015, 2020 and 2025. In 2020, PNGS ceases commercial operations and begins the long process of decommissioning which lasts several decades. The table below shows the economic contribution of PNGS to Ontario and Pickering in 2015.

Table 5 – Economic and financial contribution of PNGS in 2015

	Direct impact	Indirect impact	Induced impact	Total impact
Ontario				
GDP (millions)	\$667.8	\$42.6	\$138.9	\$849.3
Wages and salaries (millions)	\$320.7	\$24.8	\$66.8	\$412.1
Employment (FTEs)	3,397	354	1,554	5,305
Government revenues (millions) †	\$163.3	\$10.0	\$32.6	\$205.8
Pickering				
GDP (millions)	\$48.2	\$1.4	\$1.9	\$51.5
Wages and salaries (millions)	\$22.1	\$0.8	\$0.9	\$23.8
Employment (FTEs)	225	12	21	258
Government revenues (millions) †	\$3.0	\$0.0	\$0.0	\$3.0

† Government revenue economic impacts for Ontario refer to revenues generated from all forms of taxation, for the City of Pickering they refer to Payments in lieu of Property Taxes only.

In 2015, expenditures undertaken by PNGS are expected to directly generate \$667.8 million in GDP for Ontario. Taking into consideration indirect and induced effects, expenditures undertaken by PNGS are expected to contribute \$849.3 million to Ontario's economy; approximately \$51.5 million of this GDP is generated from residents and business located in the City of Pickering.

In terms of employment, PNGS's operations and expenditures are expected to directly generate approximately 3,397 employees across Ontario in 2015. This includes 2,700 employees at PNGS and 697 generated from PNGS suppliers and contractors – of these supplier and contractor jobs only a small amount are generated in Pickering, which reflects the fact that the majority of PNGS's suppliers are located outside of Pickering.¹⁷ Further indirect impacts and induced impacts generate additional 354 and 1,554 jobs respectively across Ontario. However, only 33 of these indirect and induced jobs are expected to be generated in Pickering, which reflects that only 8% of PNGS employees actually live in Pickering.¹⁸ The majority of individuals that work at PNGS live outside of the City.

Expenditures undertaken by PNGS are expected to generate \$205.8 million in government tax revenues in 2015, which includes revenues from all forms of taxation (i.e., federal, provincial and municipal). In the same year, PNGS is expected to contribute approximately \$3.0 million in Payments in Lieu of Property Taxes to the Corporation of the City of Pickering.

The table below shows the economic contribution of PNGS in 2020, which is when PNGS ceases commercial operations. Expenditures undertaken by PNGS during this period are largely a result of various activities preparing the site for decommissioning.

¹⁷ OPG was unable to obtain a detailed breakdown of PNGS non-wage expenditures by company and relied on a list of PNGS suppliers that comprise 75% of PNGS non-wage expenditures. We checked each company on that list to determine whether they had a location in Pickering and this was used to develop assumptions regarding the extent of local purchases by PNGS. More detailed data and information regarding the actual amount of expenditures by company would have enabled a more accurate estimate.

¹⁸ This information was provided by OPG.

Table 6 – Economic and financial contribution of PNGS in 2020

	Direct impact	Indirect impact	Induced impact	Total impact
Ontario				
GDP (millions)	\$524.1	\$22.4	\$81.0	\$627.5
Wages and salaries (millions)	\$188.6	\$13.1	\$38.9	\$240.6
Employment (FTEs)	1,994	189	905	3,088
Government revenues (millions)	\$129.6	\$5.3	\$19.0	\$153.8
Pickering				
GDP (millions)	\$39.2	\$0.8	\$1.1	\$41.0
Wages and salaries (millions)	\$13.2	\$0.4	\$0.5	\$14.2
Employment (FTEs)	134	6	12	153
Government revenues (millions) †	\$3.0	\$0.0	\$0.0	\$3.0

† Government revenue economic impacts for Ontario refer to revenues generated from all forms of taxation, for the City of Pickering they refer to Payments in lieu of Property Taxes only.

In 2020, PNGS is expected to continue to generate significant economic impacts in Pickering and across the rest of Ontario, but less than in 2015. Across Ontario, PNGS is expected to generate approximately \$627.5 million in GDP in 2020. Of this, approximately \$39.2 of GDP is generated from residents and business located in the City of Pickering. Including indirect and induced impacts, PNGS is expected to generate 3,088 jobs across Ontario, of which 153 are expected to be by City of Pickering residents.

The table below shows the economic impact of PNGS in 2025. Expenditures undertaken during this period are mainly associated with the safe storage phase of a typical nuclear generating facility decommissioning profile.

Table 7 – Economic and financial contribution of PNGS in 2025

	Direct impact	Indirect impact	Induced impact	Total impact
Ontario				
GDP (millions)	\$37.8	\$6.8	\$15.0	\$59.6
Wages and salaries (millions)	\$33.6	\$4.2	\$7.2	\$45.0
Employment (FTEs)	378	63	166	607
Government revenues (millions)	\$9.5	\$1.6	\$3.5	\$14.6
Pickering				
GDP (millions)	\$2.2	\$0.2	\$0.2	\$2.6
Wages and salaries (millions)	\$2.1	\$0.1	\$0.1	\$2.4
Employment (FTEs)	22	2	3	27
Government revenues (millions) †	\$2.5	\$0.0	\$0.0	\$2.5

† Government revenue economic impacts for Ontario refer to revenues generated from all forms of taxation, for the City of Pickering they refer to Payments in Lieu of Property Taxes only.

In 2025, the economic impact of PNGS is expected to continue to decrease. During this period, PNGS is no longer operating commercially and expenditures undertaken by PNGS are largely a result of ongoing surveillance and monitoring costs. While its impact to Pickering declines significantly, PNGS continues to generate approximately 27 jobs for Pickering residents and 607 across Ontario when indirect and induced impacts are included.

The following section shows the economic impact of the retirement of PNGS and more specifically what this means for Pickering.

Economic impact of the retirement of PNGS to Ontario and Pickering

As shown above, the economic contribution of PNGS to Pickering and Ontario is expected to significantly decrease over the analysis period of this study. PNGS is still, however, expected to

remain an important source of employment for the City of Pickering going forward. The table below shows the economic impact of the retirement of PNGS in 2020 relative to 2015.

Table 8 – Economic and financial impact of the retirement of PNGS in 2020 (compared to 2015)

	Direct impact	Indirect impact	Induced impact	Total impact
Ontario				
GDP (millions)	-\$143.7	-\$20.2	-\$57.9	-\$221.8
Wages and salaries (millions)	-\$132.1	-\$11.7	-\$27.9	-\$171.7
Employment (FTEs)	-1,403	-165	-649	-2,217
Government revenues (millions)	-\$33.7	-\$4.7	-\$13.6	-\$52.0
Pickering				
GDP (millions)	-\$9.0	-\$0.7	-\$0.8	-\$10.5
Wages and salaries (millions)	-\$8.9	-\$0.4	-\$0.3	-\$9.6
Employment (FTEs)	-91	-6	-9	-105
Government revenues (millions) †	\$0.1	\$0.0	\$0.0	\$0.1

† Government revenue economic impacts for Ontario refer to revenues generated from all forms of taxation, for the City of Pickering they refer to Payments in Lieu of Property Taxes only.

PNGS officially ends commercial operations in 2020. Economic activity – employment and expenditures – occurring at PNGS decreases significantly at this time. Across the Province, the retirement of PNGS is expected to decrease GDP by roughly \$221.8 million and result in a reduction in 2,217 jobs relative to the baseline. Government revenues from all forms of taxation are also expected to decrease by \$52.0 million. The impact to Pickering residents and businesses and the Corporation of the City of Pickering is expected to be much more muted, which is due to the fact that only a small percentage of PNGS employees actually live in Pickering and a majority of PNGS expenditures occur outside the City of Pickering. Relative to the baseline, we estimate that 105 Pickering residents will lose their jobs and GDP generated by residents and local businesses will decrease by \$10.5 million when indirect and induced effects

are considered. However, based on OPG projections municipal government revenues from Payments in Lieu of Property Taxes are expected to increase slightly.

Table 9 – Economic and financial impact of the retirement of PNGS in 2025 (compared to 2015)

	Direct impact	Indirect impact	Induced impact	Total impact
Ontario				
GDP (millions)	-\$630.0	-\$35.8	-\$123.9	-\$789.7
Wages and salaries (millions)	-\$287.1	-\$20.5	-\$59.5	-\$367.1
Employment (FTEs)	-3,020	-291	-1,388	-4,698
Government revenues (millions)	-\$153.8	-\$8.4	-\$29.0	-\$191.2
Pickering				
GDP (millions)	-\$46.0	-\$1.2	-\$1.6	-\$48.8
Wages and salaries (millions)	-\$20.0	-\$0.7	-\$0.8	-\$21.4
Employment (FTEs)	-203	-10	-18	-231
Government revenues (millions) †	-\$0.5	\$0.0	\$0.0	-\$0.5

† Government revenue economic impacts for Ontario refer to revenues generated from all forms of taxation, for the City of Pickering they refer to Payments in Lieu of Property Taxes only.

By 2025, the gross economic impact of the retirement of PNGS is expected to result in \$789.7 million less in GDP to Ontario. Of this, approximately \$48.8 million in GDP results from economic activity that is no longer carried out by Pickering residents and local business. In terms of employment, the retirement of PNGS is expected to result in 4,698 less jobs in Ontario and 231 less jobs in Pickering. Contributions to government revenues are also expected to decrease by \$191.2 million across Ontario.

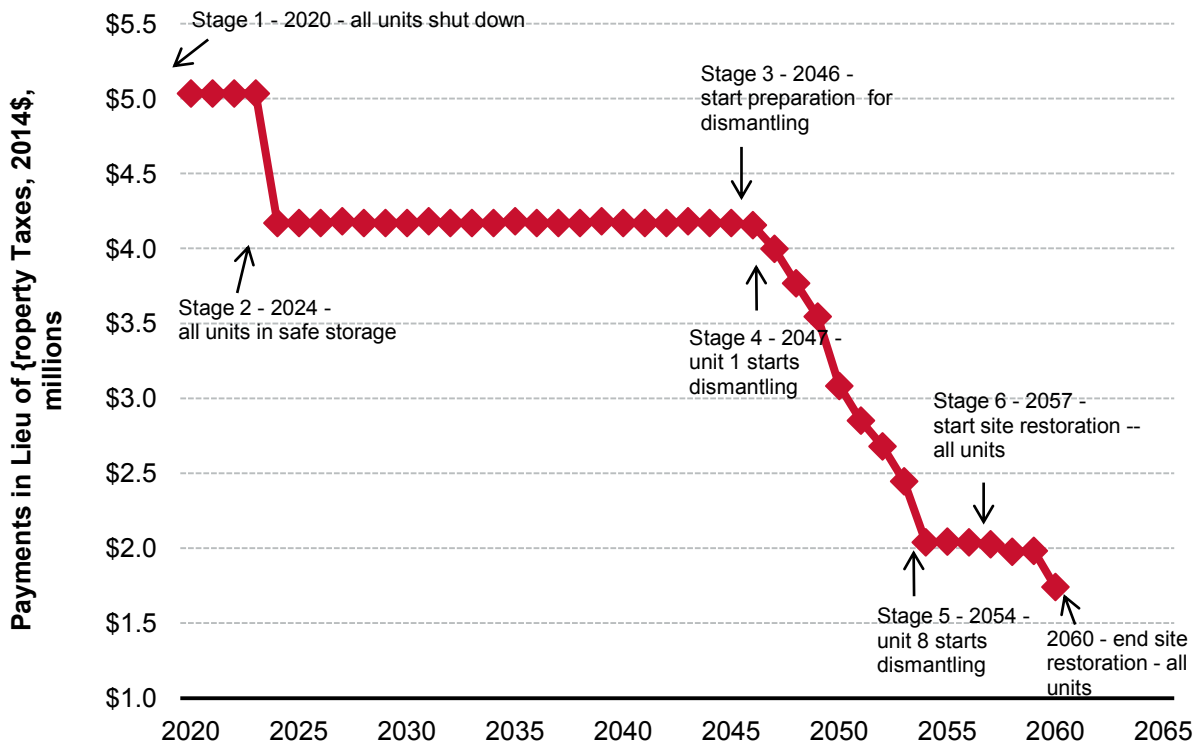
What does this mean for Pickering residents? As we have seen from some of the data presented in Section 2 of this report, the majority of Pickering residents work outside of Pickering - mainly in Toronto and Markham. Further data obtained from OPG also indicated that

only 8% of the employees at PNGS actually live in Pickering. Accordingly, we estimate that 231 residents of Pickering will lose their jobs as a result of the retirement of PNGS by 2025. While this is still a large a number it is far less than the estimates presented in the table above and suggests that the retirement of PNGS are distributed across the GTA and Durham Region and other parts of Ontario where employees of PNGS and employees of contractors and suppliers of PNGS live.

Financial impact of the retirement of PNGS

The previous section showed that the retirement of PNGS, on a gross basis, is expected to have a significant negative impact across Ontario. The impact to Pickering’s residents is less severe, which is a result of employment opportunities being dispersed across the GTA. However, PNGS currently makes approximately \$5.0 million in annual Payments in Lieu of Property Taxes of which the City of Pickering retains roughly 60%. Based on the City’s most recently available audited financial statements, this represents about 3% of the City’s total revenues. We met with the City of Pickering and OPG to discuss how these payments will change once PNGS no longer operates commercially and OPG provided a forecast of future Payments in Lieu of Property Taxes over the analysis period of this study and over the broader decommissioning horizon shown in Figure 17 below.

Figure 17 – Projected estimated Payments in Lieu of Property Taxes for PNGS site to Durham Region and Pickering based on OPG estimates



According to these estimates, the first drop in taxes will occur in 2023 when all units are in safe storage. The second major decline will last from 2046 to 2054 during the unit dismantling. Eventually, annual property taxes are expected to decrease from the current \$5.0 million to \$1.7

million in 2060 based on property tax assumptions developed by OPG. However, there was disagreement between the City and OPG with respect to certain tax assumptions and the City deemed that further investigation into the future tax structure is required. Accordingly, we have identified these payments as being “at risk” given that it is still too early to determine definitively how these payments will change. More work needs to be done, which may require the need to engage specialized consulting resources in the property tax and assessment field to investigate and defend the City’s financial interests.

Key findings

Our analysis indicates that the retirement of PNGS is not expected to significantly impact Pickering’s residents and local businesses. This is largely because the economy and labour market of the City of Pickering is relatively diversified and does not rely exclusively on PNGS as a source of employment. Furthermore, the number of individuals that work and live in Pickering is relatively small and this is especially the case for PNGS employees. The negative economic impact of the retirement of PNGS is therefore distributed much more broadly across Durham Region and the rest of Ontario. We estimate that, by 2025, 231 residents of the City of Pickering will lose their jobs as a result of the retirement of PNGS. This includes employees at PNGS, PNGS suppliers located in Pickering and employees in other industries.

While this is still a large number it is far less than the Ontario-wide impacts. The development of Seaton will more than offset these job losses and will also help further diversify Pickering’s economy. In this regard, the Province of Ontario – as an owner of substantial employment lands in Seaton – has an opportunity to play a key role in offsetting job losses from the retirement of PNGS by directing and delivering highly-skilled, well-paying jobs to the Seaton community. The City of Pickering should continue to work with the Province and other stakeholders in this regard.

The retirement of PNGS, however, is expected to negatively impact the Corporation of the City of Pickering from a financial perspective. Based on OPG’s projections, annual Payments in Lieu of Property Taxes that are retained by the Corporation of the City of Pickering are expected to decline by roughly \$0.5 million in or by 2025 and significantly more by the end of the decommissioning period. The City of Pickering has not accepted OPG’s Payments in Lieu of Property Taxes projections, arguing that it is too early to tell how Payments in Lieu of Property Taxes will change once commercial operations cease at PNGS. The City should consider engaging a specialized property tax consultant to better understand how these may change going forward. There may be an opportunity for OPG to reduce a potentially significant loss of annual Payments in Lieu of Property Taxes and other revenues to the City through the careful selection and early delivery of repurposing options at the PNGS site.