Ontario Electricity Options Comparison

Illustrating the Economics of Ontario Energy Supply Options

Final Report

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STRATEGIC POLICY ECONOMICS

Executive Summary

Ontario's Long-Term Energy Plan (LTEP) was released in November 2010 and was intended to ensure a dependable future electricity system for Ontario characterized by low greenhouse gas energy sources while encouraging job growth in the clean energy sector. In April 2013, the Minister of Energy announced that the Ontario government would conduct a review of the LTEP to be completed within six months.

Many observers have speculated that with slower than forecast growth in energy demand in Ontario, building out the full capacity contemplated by the LTEP could result in higher than anticipated costs to ratepayers and a large surplus of power generation capacity. Strapolec's January 2013 report[1] estimated the cost implications of the LTEP under these conditions. While several reports and studies have looked at different supply/demand scenarios for Ontario, none have assessed the economic and greenhouse gas impacts associated with supply mix options and the potential consequences for Ontarians.

This report illustrates two supply mix scenarios to contrast the implications of these possible supply mix alternatives. The two scenarios are compared on the basis of total energy costs, electricity rates, economic impacts of investments to bring the alternative scenarios online, and greenhouse gas (GHG) emissions.

- Retained Wind scenario: assumes the development of new wind generation goes forward as outlined in the LTEP* while investments in nuclear generation are curtailed. Under this scenario, additional gas-fired generation is introduced as a backstop to the intermittency of wind generation.

- Retained Nuclear scenario: foresees that refurbishments and new build nuclear generation will proceed according to the LTEP* while development of wind generation build out is curtailed.

Study results indicate that, over the period to 2035, the retained nuclear scenario, while reducing investments in wind generation, would:

- Deliver $56 billion (B) in direct benefits to Ontario's economy through $27B in savings to ratepayers (Exhibit A) and $29B in direct Ontario investment (Exhibit B). When compared to the retained wind scenario, the net incremental benefit of choosing the retained nuclear scenario is $60B;

- Provide $9B more direct employment income benefits (a primary factor driving secondary economic impacts) and create over 100,000 more PYE jobs than the retained wind scenario; and,

- Reduce incremental GHG emissions after 2023 by 108 million tonnes which represents 80% less emissions than the retained wind scenario would add. Prior to the refurbishment period 2020-2022, emissions reductions for the retained nuclear scenario are 4% lower.

By contrast, reducing the nuclear footprint in favour of the retained wind scenario would result in increased costs for electricity ratepayers, lower investment in Ontario's economy and increased GHG emissions.

[1] *Ontario Electricity Cost Forecast, Strapolec, Jan 2013*

Exhibit A

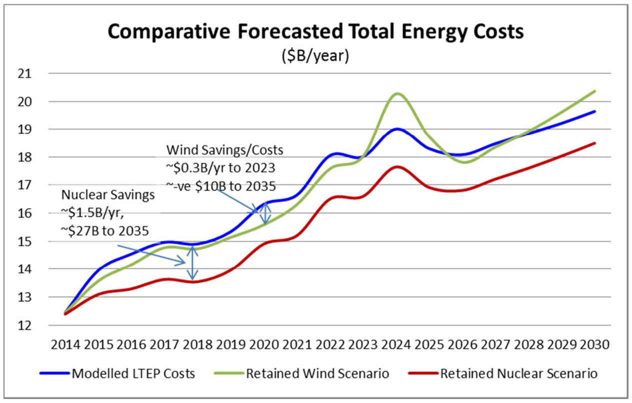
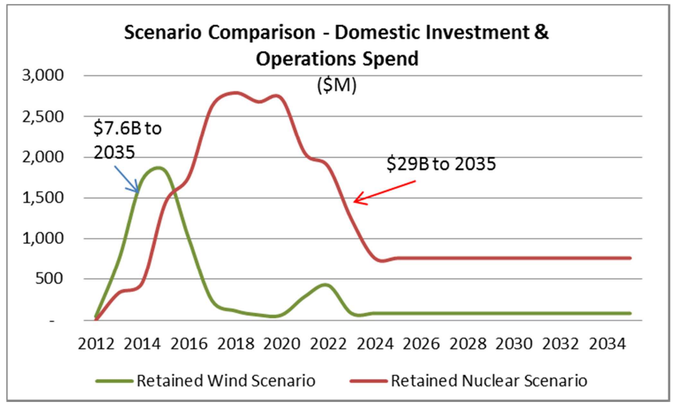


Exhibit B



This paper includes an analysis of available public sources with a view to developing evidence-based assumptions for the scenarios. The study looks specifically at energy cost forecasting and the direct economic impact modeling. The energy cost forecasts have relied upon data from the Ontario Power Authority, Independent Electricity System Operator and the Ontario Energy Board, supplemented by additional publicly available third party materials.

The framework for the economic impact assessments has been developed from a report by ClearSky Advisors on the economic impact of wind investments and a Canadian Manufacturers and Exporters report on the economic impact of nuclear investments. Strapolec has undertaken a validation exercise of the assumptions in these reports to formulate a reasonable and consistent set of assumptions for use.

This report is focussed on contrasting near term supply decision options being considered now, with the forecasts extending to 2035. This time frame was chosen to reflect when the assessed wind assets will have reached the end of their useful life and hence captures the full economic benefit of the decisions regarding those assets. Associated future supply mix decisions to be made, potentially over 15 years from now, are outside the consideration of this report. The assumptions of the Retained Nuclear scenario and the modelled LTEP* scenario converge after 2035.

Summary Scenario Findings *(Total Values over 2014-2035)*	**Modelled LTEP**	**Retained Nuclear**	**Retained Wind**	**Benefit Nuclear vs Wind**
Total Energy Cost *($B)*	$ 393	$ 366	$ 404	$ 38
Average Residential Rate *($/MWh)* *	$ 119	$ 110	$ 120	$ 10
Average Industrial Rate *($/MWh)***	$ 86	$ 84	$ 92	$ 9
Total Direct Ontario Spend (e.g. GDP) *($B)* ***	$ 36	$ 29	$ 7	$ 22
Net Economic Benefit ($B)		**$ 56**	**-$ 4**	**$ 60**
Total PYE Jobs *(000s)*****	150	131	24	107
Total Direct PYE Income *($B)*	$ 11.8	$ 10.6	$ 1.2	$ 9.4
Total GHG (CO_2) Emissions *(Million Tonnes)*	167	206	313	107
** Residential rate in 2011 was $71/MWh ; 2035 LTEP forecast =*	*$ 133*	*excluding OCEB*		
*** Industrial Rate in 2012 was $51/MWh ; 2035 LTEP forecast =*	*$ 113*	*excluding industrial rate incentive programs*		
****Direct Ontario Spend includes capital and constructon investments and domestic operations spend*				
***** Modelled LTEP jobs do not include jobs from gas plants added for Retained Wind scenario*				

** The modelled LTEP scenario reflects deferred renewable, gas, and refurbished nuclear asset schedules as reported and indicated by events since the LTEP was formed.*

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1.0 Introduction

Many observers have speculated that with slower than forecasted growth in energy demand in Ontario, building out the full capacity contemplated by Ontario's Long-Term Energy Plan (LTEP) could result in higher than anticipated costs to ratepayers and a large surplus of power generation capacity. In April 2013, the Minister of Energy announced that the Ontario government will conduct a review of the LTEP to be completed within six months.

This report has developed two contrasting scenarios to illustrate the implications of possible alternative supply mix choices for: total energy costs and electricity rates; the economic impacts of the investments required to bring the alternative generation capacities online; and, greenhouse gas (GHG) emissions. The two scenarios have been selected as opposite ends of the option spectrum, not as policy recommendations, but rather to simply contrast the implications of choices:

- Retained Wind scenario: assumes the development of new wind generation goes forward as outlined in the LTEP while investments in nuclear generation are curtailed. Under this scenario, additional gas-fired generation is introduced as a backstop to the intermittency of wind generation.
- Retained Nuclear scenario: foresees that refurbishments and new build nuclear generation will proceed according to the LTEP while development of wind generation build out is curtailed.

While other reports and studies have looked at supply impacts on Ontario's economy, none have comprehensively assessed the full implications of the supply choices for Ontarians. This paper includes an analysis of available public sources with a view to developing evidence-based assumptions for the scenarios. The study looks specifically at energy costs and direct economic impacts over a forecast period from 2011 to 2035. After this date the wind assets will have reached end of life and the retained nuclear and modelled LTEP scenarios converge to similar supply mix capacity assumptions.

The definition of the scenarios modelled and the associated generation capacities are presented in Section 2.0. Section 3.0 provides the summary results contrasting implications for direct investments in Ontario, direct income for Ontarians, jobs, total energy costs, ratepayers and greenhouse gas emissions.

Section 4.0 presents the energy cost modelling assumptions including surplus energy and HOEP impacts.

Section 5.0 summarizes the economic impact assumptions used, their basis and validation for the purposes of this comparative study. The framework for the economic impact assessments has been developed from the ClearSky report on the economic impact of wind investments[2] and Canadian Manufacturers and Exporters report on the economic impact of nuclear investments[3]. Strapolec has undertaken a validation exercise on the assumptions in these reports to formulate a reasonable and consistent basis for contrasting the two scenarios.

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[2] *Economic Impact of Wind Energy in Ontario, July 2011, ClearSky Advisors Inc.*

[3] *The Economic Benefits of Refurbishing and Operating Ontario's Nuclear Reactors, CME (2010; updated in 2012)*

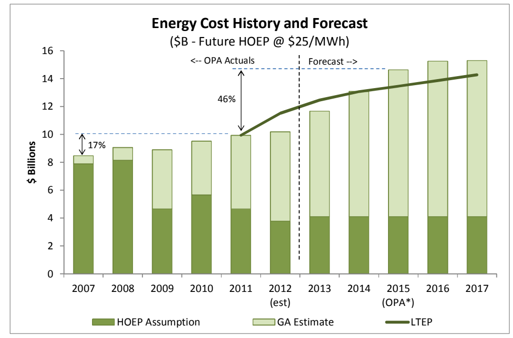
2.0 Modelled LTEP Cost Assumptions and Capacity Scenarios

This section provides an overview of the LTEP cost issues and the capacity scenarios being illustrated in this report. The major findings summarized in this section include:

- Energy costs will grow by 90% or $9B from 2012 to 2024
- Definition of the two scenarios: Retained Nuclear & Retained Wind

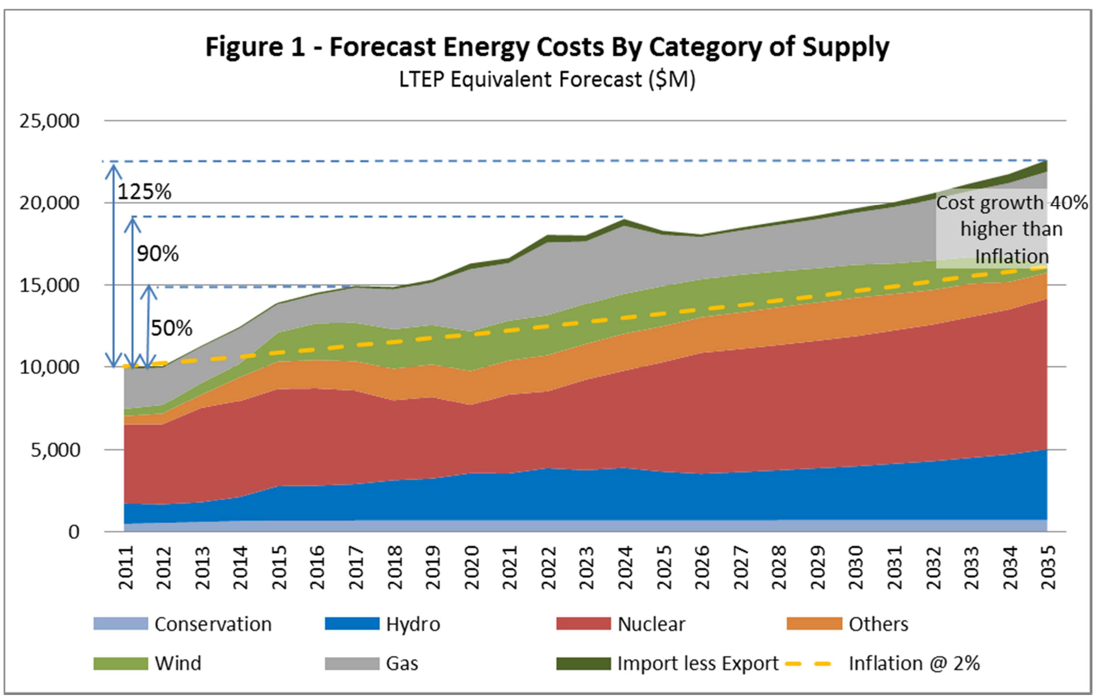
Cost forecast for completing the LTEP Capacity Plan

Strapolec produced a report in January, 2013[4], that highlighted the near term energy cost growth to 2017 that would result from completing the LTEP capacity plan. In that report it was forecast that total energy costs would grow from $10B in 2011 to over $15B in 2017. Strapolec has now developed a cost forecast to 2035, which shows that costs will not stop growing after 2017. Figure 1 shows how the production from commissioning all of the generation capacity contemplated by the LTEP will result in total energy costs growing by 90% or $9B to $19B from 2011 to 2024 and rise by 125% to $22.5B from 2011 to 2035. This is $6.5B or 40% more growth than a 2% annual inflation rate from 2011 would suggest.



SOURCE: Ontario Electricity Cost Forecast, Strapolec

In January 2013, Strapolec prepared a cost forecast for Ontario's energy system that was based on annual production volume expectations and rate assumptions obtained from a variety of sources. The 2015 forecast was validated and aligned with OPA presentations made at the APPrO 2012 conference and showed 40% growth in energy costs to $14.6B in 2015 assuming an HOEP of $25/MWh.



4 *Ontario Electricity Cost Forecast, Strapolec, Jan 2013*

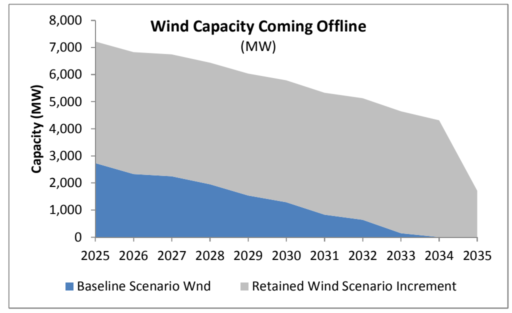
The capacity assumptions reflected in the cost forecast in Figure 1 are based on the LTEP supply mix as modelled for the purpose of this report. Strapolec has made the following assumptions:

- The near term cost forecast reflects the planned in service dates for renewables as reflected by the Ontario Power Authority (OPA) quarterly review[5] and the restart of the Bruce Power A units 1 & 2.
- The retirement of renewable assets at the end of their 20-year economic life has been reflected in the 2026 to 2035 time period.
- Of the LTEP gas fired generation capacity, the commissioning of 1000 MW has been deferred to 2017, 1000 MW to 2020, and 1000 MW has been excluded[6]. This assumption modestly reduces our previously published cost forecast[7].
- Nuclear refurbishment of Darlington units will not materially affect energy production until 2017[8] and Bruce B unit refurbishments have been deferred to after 2020[9].

Capacity Scenarios Modelled

The question of "what options remain for Ontario to reduce the cost of energy" is the motivator for this analysis. Strapolec's original analysis suggests that the LTEP capacities should be reduced by 3000 MW of supply by 2024. There are three classes of supply in the LTEP that are not yet under construction: (1) remaining gas capacity; (2) remaining renewable capacity; and, (3) nuclear life extension, refurbishments, and new build.

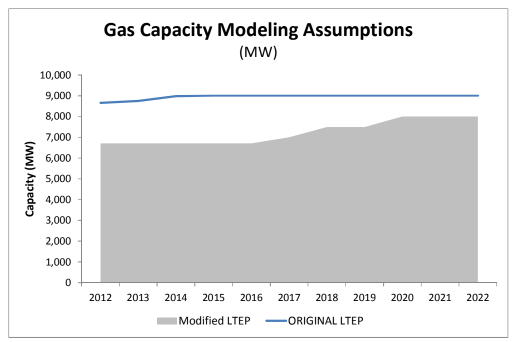
The scenarios illustrated in this report consider possible trade-offs between these supply options. Capacity choices between retaining wind or nuclear are contrasted with all other assumptions kept equal. Specific capacity trade-offs for other supply types have not been considered in this analysis for the following reasons:



SOURCE: OPA commissioned dates, Strapolec Analysis

Since the forecast window is out to 2035, to properly reflect the supply mix challenges and implications over that time frame, the retiring of the wind (and solar) assets has been modelled as 20 years after their in service operational dates.

The deferred gas fired generation capacities modelled are shown below as they compare to the original LTEP assumptions.



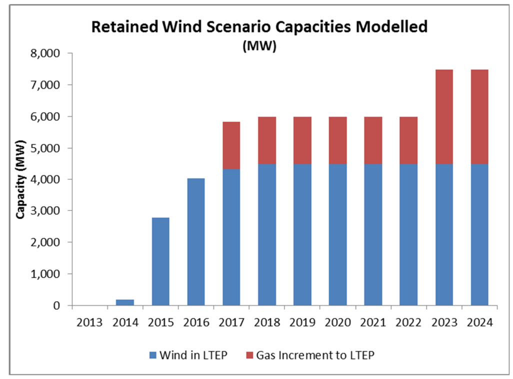
[5] *OPA 2012 3rd Quarter Review*
[6] Inspired by *Ontario Market Update and 10-year Energy Price Forecast, LEI (2013)*
[7] *Ontario Electricity Cost Forecast, Strapolec, Jan 2013*
[8] *Darlington Refurbishment Project – Challenges and Opportunities, OPG (2012)*
[9] Strapolec assumptions based on *Bruce Power Promotional Brochure "Revitalizing the Bruce Power site" (2012)*

- As solar generation is coincident with day time demand, its profile functionally differs from both wind and nuclear, and would primarily displace gas fired generation except in times of surplus peak power.
- Gas capacity primarily serves a peaking function and its need is determined by reserve margins. Under a retained wind scenario where nuclear capacity is reduced, gas capacity has been added as discussed below. As such, the retained wind scenario also provides indications of the effects of greater gas fired generation in the supply mix versus retained nuclear.

Two scenarios have been purposely selected to highlight and contrast the implications of potential supply mix choices:

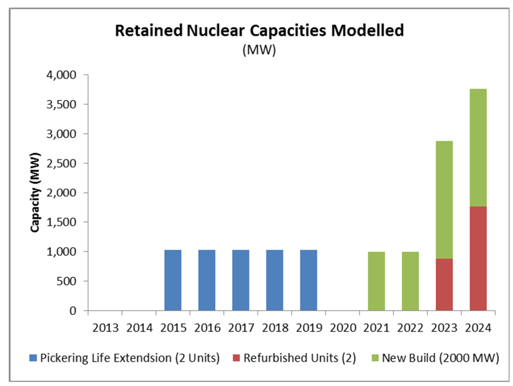
- LTEP contemplated wind build out with a reduced nuclear footprint (Retained Wind Scenario). This scenario requires additional gas fired generation capacity be constructed in lieu of the retired nuclear assets.
- LTEP contemplated nuclear build out with a reduced wind footprint (Retained Nuclear Scenario). This scenario accommodates up to 75% more imported energy on an hourly basis (Note: 2011 is modelling assumption base reference).

To contrast the choices, the methodology used to create the capacity scenarios established a capacity reference based on the modelled LTEP capacities but with the removal of the incremental nuclear and wind capacities being contrasted. The retained wind scenario is created by adding back the incremental wind capacity, to reflect the full LTEP wind target, along with additional gas capacity to offset the reduced nuclear footprint. Similarly, the retained nuclear scenario is created by adding back the incremental nuclear capacity being contrasted, again to reflect the full LTEP nuclear capacity plan, and providing for additional import flexibility reflective of the reduced gas-fired capacity modelled for the LTEP. Except for the scenario specific capacity characteristics that have been stated, all other assumptions have been commonly applied in all scenario forecasts. As a result, the implications of the comparative results are not materially sensitive to the assumptions used to establish the common base reference.



SOURCE: Strapolec Analysis

Wind capacity not expected to be in service before Q4 2014 has been used as the illustrative wind capacity for comparison purposes. Three thousand megawatts (MW)of gas has also been added to accommodate wind intermittency and balance system reserve margins as a required offset to the modelled 3600 MW of long term nuclear unit removal.



SOURCE: Strapolec Analysis

The nuclear capacity used for modelling illustration is 2 Pickering units, 2 refurbished nuclear units and 2 new build units. The rationale is recent OPA presentations (APPrO 2012) indicate that such considerations are being contemplated. In addition, 75% more imports are allowed under the retained nuclear scenario, but this capacity is the first supply curtailed when not needed.

3.0 Scenario Comparison Highlights

The objective of this report is to contrast the economic and greenhouse gas emission outcomes of alternative supply mix options. This section presents the summary findings for total energy costs and net benefit to Ontario; the economic impacts of the investments to bring the capacities online; and the resulting GHG emissions measured by CO_2.

3.1 Ontario Energy Cost Comparisons

Many arguments discovered in the course of the research for this analysis have focussed on the direct costs to construct wind and nuclear capacities and a discussion of expected pricing for generated electricity on a $/MWh basis. Strapolec believes these simple metrics are potentially misleading due to the differences in the operational characteristics of these two types of generation. Furthermore, Ontario's electricity system is a complex mix of multiple generation sources that also have varied contractual arrangements. The Independent Electricity System Operator (IESO) also has an important role to play in managing the physical dispatch of generation in order to balance the supply and demand across the many zones in the province and to ensure grid stability. Given this complexity and to ensure a proper assessment of the cost implications of the two scenarios, Strapolec adopted a Total Energy Cost approach that considers the full dynamics of matching supply and demand for electricity in the province. As such, the scenario models include all supply generation, all components of the Global Adjustment (GA), and the impact on and total cost contribution from the Hourly Ontario Electricity Price (HOEP).

This section presents the following three results:

- Total system costs will be lower in a retained nuclear scenario;
- The net benefit of the retained nuclear scenario is $60B; and
- Residential ratepayers would benefit significantly more from the retained nuclear scenario. Industrial customers would be exposed to the greatest cost with the retained wind scenario.

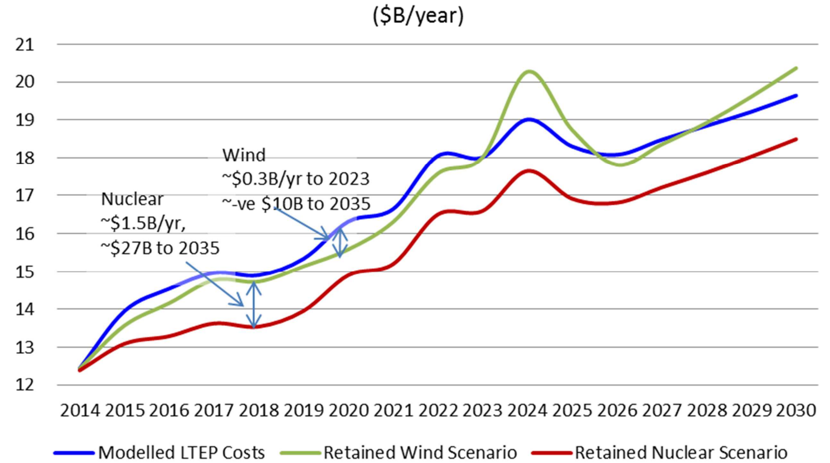
Total Energy Cost Comparison Results

Ontario energy production from all sources was modelled at a detailed level to capture the interplay of each supply type. The simulation considers:

- Expected normal operating capacity factors of all generators;
- Surplus situations, import/export constraints, as well as the variable and intermittent supply nature of wind and solar generation;
- Curtailment requirements during surplus situations;
- All regulated prices including escalation factors; and,
- HOEP dynamics associated with supply, demand, gas-fired generation and system peak reserve margin.

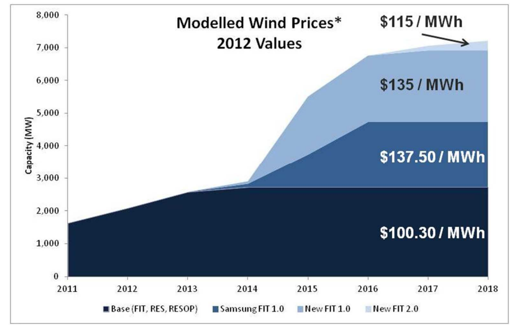
Figure 2 presents the resulting total cost comparisons between the modelled scenarios resulting from Strapolec's simulation model.

Figure 2 - Comparative Forecasted Total Energy Costs
($B/year)



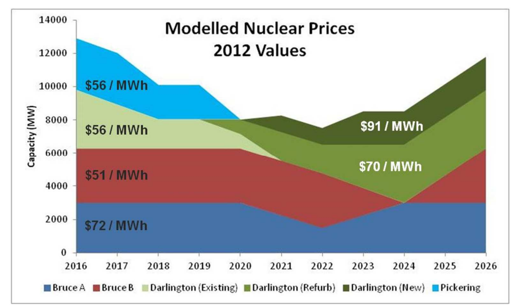
The Retained Nuclear scenario reduces LTEP costs by almost $1.5B/year or $27B by 2035. The Retained Wind scenario cost is marginally lower than the LTEP scenario in the near term, until nuclear capacity is retired. It begins to cost more than LTEP half way into the economic life of the wind asset, and amounts to a cumulative cost of over $10B more than for the LTEP by 2035.

Reductions in surplus energy account for almost half of the savings forecast for the retained nuclear scenario, with the remaining savings



SOURCE: OPA Quarterly Review, FIT 2.0 Review, Strapolec Analysis

Wind pricing was modelled based on the FIT 2.0 review results and the applicability to new supply based on the OPA Q3 2012 quarterly review.



SOURCE: OEB RPP forecast, April 2013, Strapolec Analysis

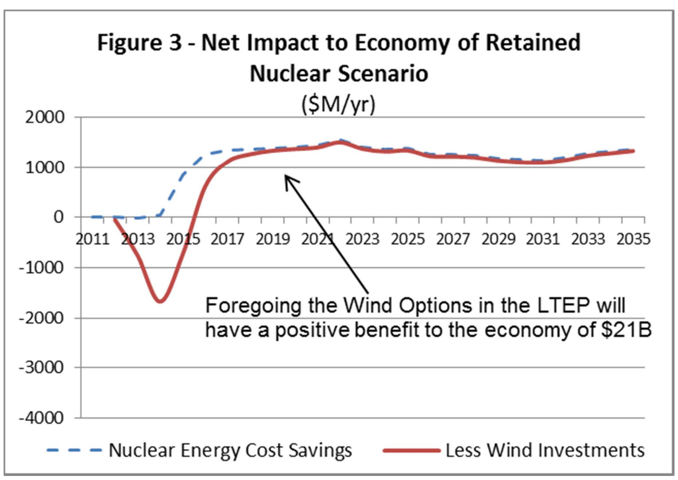
Existing nuclear pricing based on current regulated rates and historical escalation factors. Future Nuclear pricing was based on Strapolec financial analysis of likely nuclear rates given the investment assumptions.

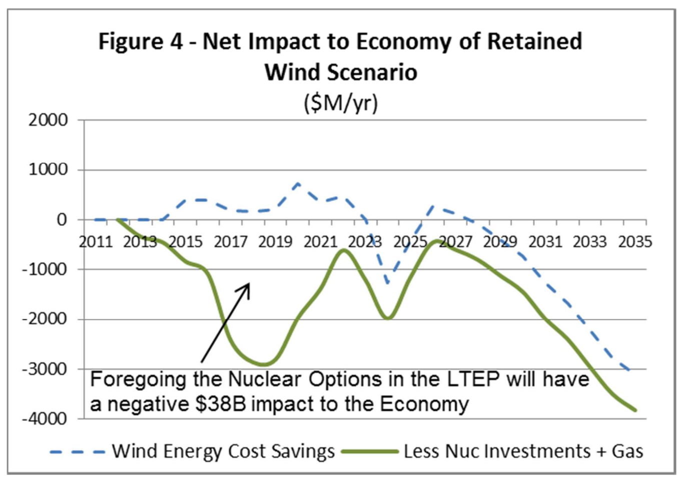
resulting from the avoided cost of wind generation. One of the main reasons that the retained wind scenario is only marginally less costly than the full LTEP scenario is due to the addition of the 3000 MW of gas capacity and the associated fixed monthly payments. These have been assumed to be approximately $17K/MW/month as described in the RPP forecast[10]. Another source of scenario cost variations is the impact of capacity mix on HOEP as discussed in section 4.0.

Net economic impact of investments and energy costs

The scenario cost implications identified above are equivalent to an economic impact. Lowered energy costs allow for redirection of that spending towards other economic activity. To assess the full economic impact of the scenarios, the changes in energy costs from a scenario must be combined with the opportunity cost of the lost investments if the capacities of the other scenario are not developed. For example and in the context under which the scenarios have been defined in this report, the benefits of reduced energy costs in the retained nuclear scenario come at the cost of not getting the economic stimulus from the wind investments.

Figures 3 and 4 illustrate the net economic impact of the two scenarios considering both energy costs and investments foregone.





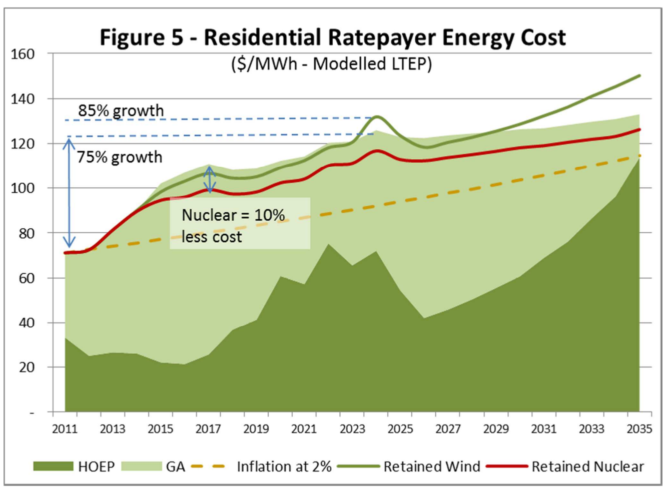
The simulation shows that the retained nuclear scenario will have a positive benefit to the economy of over $21B in the period leading to 2035 in relation to LTEP. In stark contrast, the simulation shows that

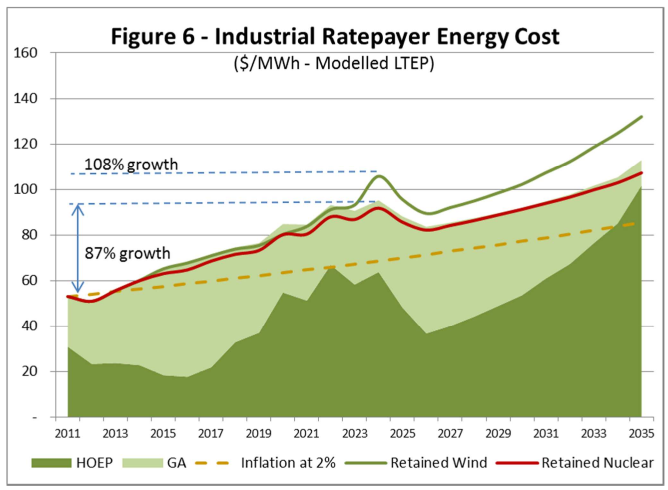
[10] *Navigant Consulting, OEB Regulated Price Plan Price Report, April 2013*

pursuing the retained wind scenario will have a negative impact of over $38B to the economy relative to the LTEP. The selection of one of the two scenarios over the other has a potential economic impact swing of $60B in the period to 2035.

Impact on Electricity Consumers

Ontario's electricity consumers are affected differently by changes in total cost. In particular, the method for attributing costs to Class A (e.g. Industrial consumers) versus Class B (e.g. Residential ratepayers) is sensitive to the Global Adjustment (GA) and HOEP portions of the total energy cost. Due to the GA formula, Industrial consumers generally benefit from lower HOEPs that result from an over-supply situation such as exists under the current plan. Conversely, as HOEP increases, costs to Ontario's industry grow faster. Figures 5 and 6 illustrate the scenario ratepayer impacts.





Overall, the modelled LTEP scenario projects an 87% growth in Industrial rates from $51/MWh in 2012 to $95/MWh in 2024 and a 75% growth in residential rates from $71/MWh in 2011 to $126/MWh by 2024, without considering the implications of the removal of the Ontario Clean Energy Benefit discount on their electricity bills.

Residential rates are forecast to be on average 10% less in the near term under the retained nuclear scenario (eg. $99/MWh in 2017 vs modelled LTEP estimate of $111/MWh) and remain lower throughout the forecast period. That represents 25% less cost growth by 2017 than projected to occur under the modelled LTEP scenario. Industrial ratepayers are forecast to experience small near term savings under the retained nuclear scenario.

The retained wind scenario offers no material savings to either electricity consumer class in the near term, with rates forecast to grow more rapidly after 2023. Future rates will more greatly impact industrial consumers, potentially reaching $132/MWh in 2035 due to the forecasted HOEP and associated implications of the GA formula.

3.2 Economic Impact Comparisons

The economic impact measures assessed in this section of the report include total domestic spend (proxy to direct GDP), employment income, and jobs. In order to develop a meaningfully robust comparison of the two scenarios, a literature review was conducted to establish reasonable assumptions that are common in their derivation between the scenarios and validated against multiple benchmarks.

Two main sources that describe economic impacts of Ontario energy choices have been used to provide the initial framework:

- ClearSky Advisors' 2011 report on Ontario wind development[11]
- Canadian Manufacturers and Exporters (CME) 2010 & 2012 reports on nuclear development in Ontario[12]

Additional materials were reviewed and compiled in order to benchmark the assumptions in these two sources and develop a set of reasonable parameters for comparing the capacity scenarios. Economic impact comparisons in this report are focussed on direct impacts as indirect impacts have varied widely in the literature reviewed. Direct impacts have been more consistently defined. For the purposes of this analysis, direct manufacturing jobs are included.

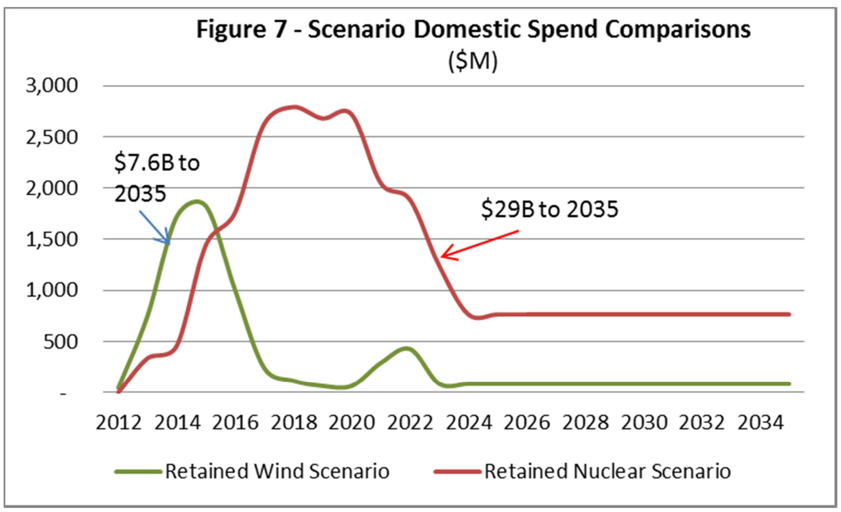
This section presents the resulting comparisons for two topics: Domestic Investment and Direct Employment Income.

[11] *Economic Impact of Wind Energy in Ontario, July 2011, ClearSky Advisors Inc.*
[12] *Economic Benefits of Refurbishing Nuclear Reactors, CME (2010; updated in 2012)*

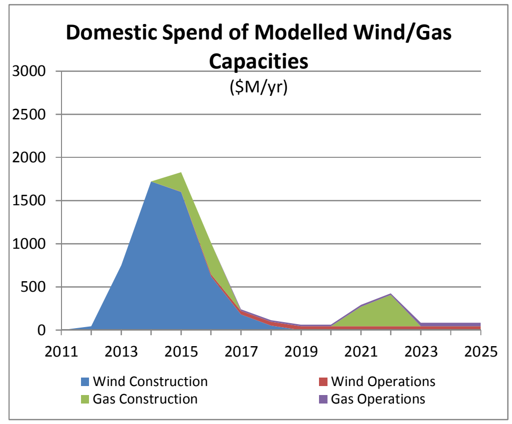
Domestic Investment

As discussed in more detail in Section 5, the results of our benchmarking suggested that the expected total costs of the capacity investments described in the ClearSky and CME reports are higher than have been experienced in other jurisdictions. As a result the investment estimates warranted a reduction of 25% for wind and 15% for nuclear new build. These reductions were applied uniformly to all sub metrics including domestic spend and jobs.

Figure 7 shows the resulting comparison of the direct Ontario domestic investments, which is a proxy for Gross Domestic Product (GDP). Included are the development and construction phase domestic investments as well as the domestic operating cost spend after the units are commissioned.

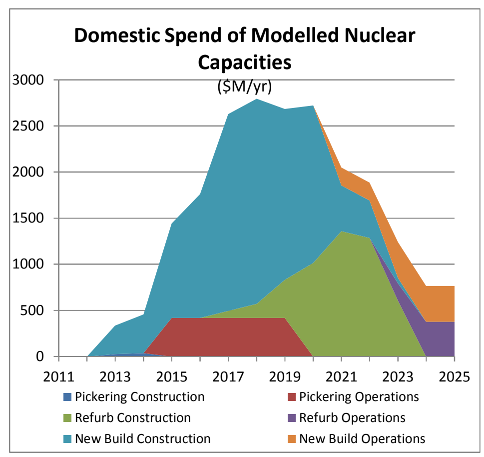


Expected domestic investments in the retained nuclear scenario are $29B in the period to 2035. This is significantly higher than the $7.6B expected from the investments in wind and gas fired generation capacity in the retained wind scenario. It should be noted that the wind assets will be reaching their economic end of life in the forecast timeframe. The nuclear assets, through operating costs and on-going capital maintenance will continue for another 12 to 40 years creating an additional future $20B of domestic economic activity. This is higher than, for example, reinvesting the same $7.6B in expired wind assets after 2035.



SOURCE: ClearSky, NREL, LEI, MoE, Strapolec Analysis

The investments for the retained wind scenario include wind farm developments required to complete the LTEP as well as the additional gas fired generating plants. Investments in wind farms have been reduced from ClearSky's $269M/100MW wind farm to $205M to reflect recent actuals as described in Section 5.0.



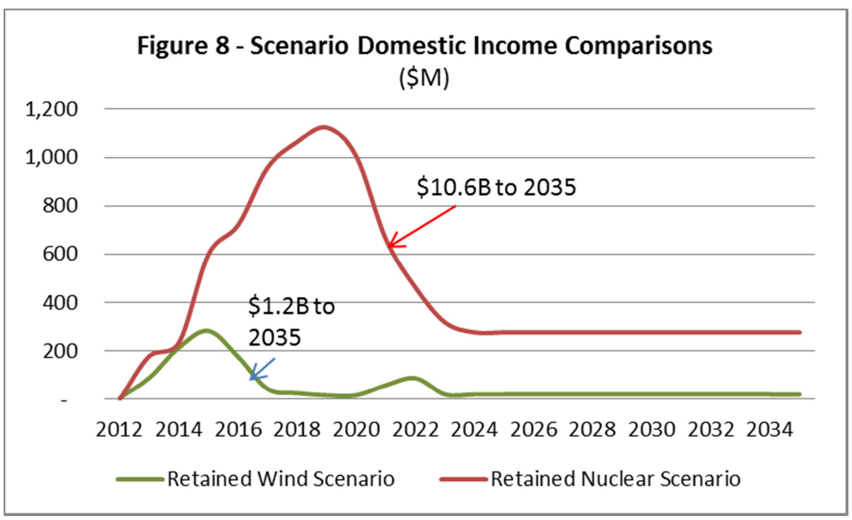
SOURCE: CME, EUCG, NEI, EIA, Strapolec Analysis

Nuclear direct investments include: Pickering domestic operating cost spend for 5 years; the refurbishment investments based on CME's report; and, New Build investments which have been reduced from CME's $8.75B to $7B based on Nuclear Energy Institute (NEI) metrics. Ongoing operating cost spend for refurbished units is based on OPGs Darlington operating costs, while New Build operating costs are based on Best-in-Class Electricity Utility Cost Group (EUCG) data and Energy Information Agency (EIA) forecasts.

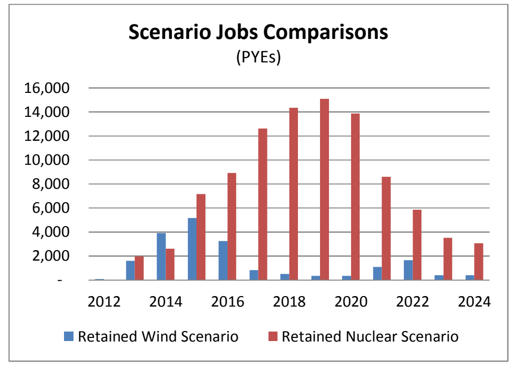
Direct Employment Income

Strapolec believes the most relevant economic impact measure arises not from jobs created but from income earned by those jobs through direct employment. This is because the true economic measure for determining secondary and induced effects pertains to the circulation of that income through the economy. However jobs statistics are also presented.

To validate employment impacts in the reference reports, Strapolec examined the correlation of identified jobs on a domestic labour per $M spend basis. Strapolec applied StatsCan salaries[13] to the stated jobs and discovered discrepancies for the construction phase for both scenarios. In the context of the stated domestic spend, Strapolec determined it was reasonable for the purpose of this analysis, based on independently derived reasons to adjust upwards the direct construction phase jobs for both scenarios. The employment statistics were then also adjusted downwards to reflect the benchmarks on total costs as described above. Figure 8 illustrates the resulting comparison of Domestic Income between the retained wind and nuclear scenarios.



The cumulative direct income earned from nuclear investments and operating spend to 2035 will be over $10B. This is more than a factor of 8 greater than that expected from the retained wind scenario in the same time frame. Furthermore, unlike the wind assets, the



SOURCE: Strapolec Analysis

Job creation is typically considered to be the main focus of economic impact assessments. While jobs are indeed important, from an economic impact perspective, the income earned by those jobs and its impact on GDP is more significant. Nevertheless the total jobs are presented here which shows that in the modelled timeframe, the retained nuclear scenario is forecast to create over 130,000 jobs in comparison to the 24,000 that will be created by the retained wind scenario. That's a factor of 5 more jobs.

Over the life of the nuclear assets, another 75,000 person years of employment (PYEs) of employment are predicted. This does not include decommissioning jobs, which are paid for with funds included in the price of nuclear generated electricity. These are estimated as an additional 4,000 direct PYE jobs. Decommissioning costs for wind assets appear to not be addressed in any economic discussions that Strapolec has encountered.

One final note is the difference in ratios of total economic activity versus job creation. The construction phase of nuclear is far more labour intensive. Manufacturing is typically not included in direct economic impact definitions but has been included here using a commonly accepted 9% of domestic manufacturing spend as representing direct income earned for both the wind and nuclear scenarios.

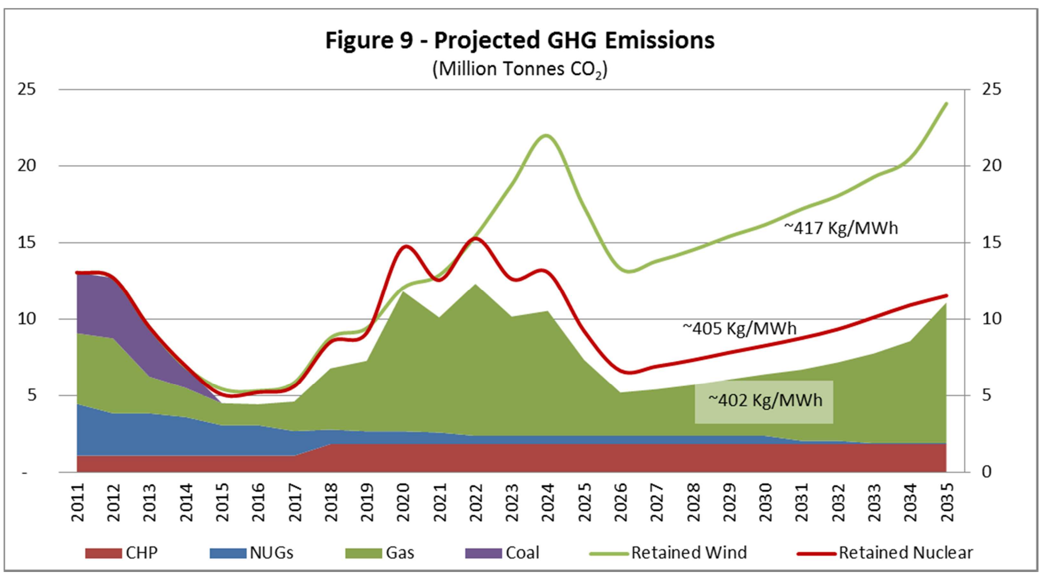
[13] *CANSIM report, wages and salaries, Ontario, by industry*

economic life of the nuclear assets will extend for 12 to 40 more years yielding an additional $6B in direct income. The ratio of direct income between the scenarios (8:1) is higher than the ratio of direct jobs (5:1) as in general, nuclear related jobs pay almost 75% more[14].

Considering the magnitude of the differences in economic stimulus between these two scenarios, it is apparent that the adjustments Strapolec deemed appropriate to make when validating the assumptions against the benchmarks have turned out to be immaterial to the conclusions.

3.3 Greenhouse Gas (CO_2) Emissions

After the coal assets are retired in 2014, gas-fired generation will have the biggest impact on GHG emissions from Ontario's electricity sector. Figure 9 illustrates the modelled GHG emissions for the two scenarios as well as for the LTEP scenario. As would be expected, GHG emissions are the lowest for the LTEP due to the significant share in the supply mix of clean nuclear, hydro and other renewable generation assets.



Under all scenarios, there is an increase in GHG emissions during nuclear refurbishment. In the near term, the retained nuclear and

[14] *CANSIM report, wages and salaries, Ontario, by industry*

wind scenarios both have a similar projected increase in GHG emissions. Throughout the forecast period, the retained nuclear scenario has higher emissions than the modelled LTEP scenario due to the lost benefit of wind generation. The retained wind scenario results in greater GHG emissions due to the gas-fired generation capacity required to manage wind intermittency and to replace the nuclear base load capacity removed from service.

In the longer term from 2022 to 2035, the retained wind scenario incurs an increase in GHG emissions of 135 million tonnes of CO_2, that's 125% more emissions than expected from the modelled LTEP scenario. The increase is due to the reliance on gas-fired generation in the absence of base load nuclear and arises immediately upon the absence of the return to service of the otherwise refurbished nuclear and new build units. The retained nuclear scenario increases GHG emissions in the same time frame, by a relatively modest 25% over LTEP or 27 million tonnes of CO_2. The retained nuclear scenario saves 108 million tonnes by producing 80% less of an increment in GHG emissions than created by the retained wind scenario.

Achieving the GHG forecast in the LTEP compared to the retained nuclear scenario would cost the estimated $27B of energy cost savings estimated for this scenario. This is equivalent to paying $700/tonne of avoided emissions.

GHG Emission Assumptions

Source	Generation Type	kg/MWh	
OSPE	Natural Gas	398	45% efficiency
	Coal	973	35% efficiency
California Energy Commission			
	Conventional Simple Cycle	490	
	Advanced Single Cycle	452	
	Conv Combined Cycle	374	
Resulting Modelled Blend			
	Modelled LTEP	402	
	Retained Nuclear	405	
	Retained Wind	417	
Driving GHG Emission Modelling Assumptions			
	New Gas Capacity is Advanced Single Cycle		
	- in order to provide ramping capability to match intermitent supply		
	Retained Wind has a higher usage of new gas capacity		
	- so blended emissions are higher		

California parameters as stated by Pembna Report "Behind the Switch"
OSPE as stated in report "Wind and the Electrical Grid"

SOURCE: OSPE, Pembina, Strapolec Analysis

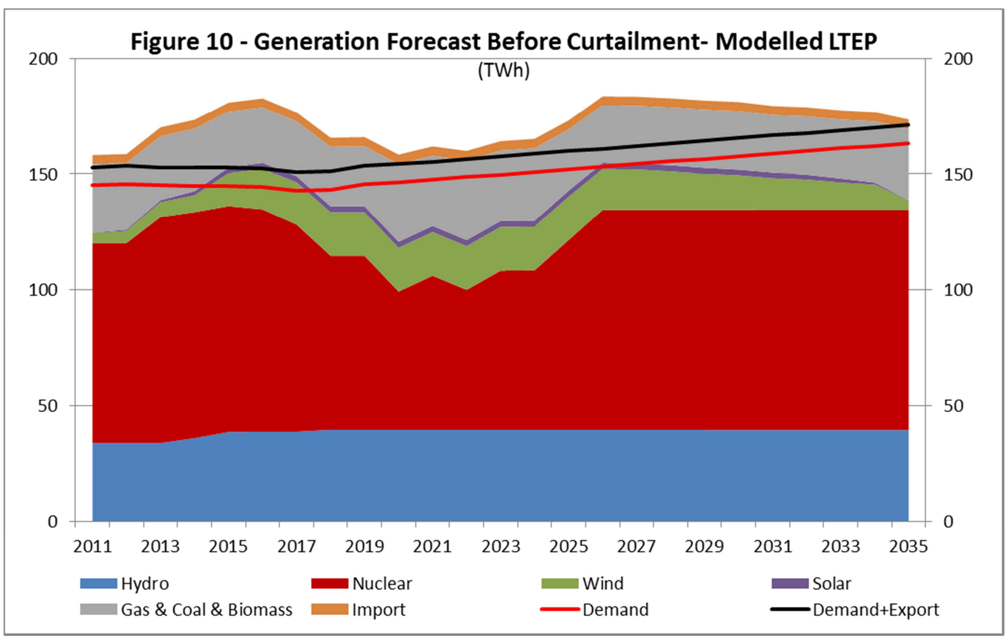
4.0 Understanding the Electricity Cost Forecast

This section briefly summarizes the methodology used to develop the energy cost forecast and presents several model outputs used for validation for the purposes of this analysis. The topics include:

- Basis for the production forecast;
- Forecast surplus energy and associated validation of the production forecast;
- HOEP modelling and its validation; and,
- Establishing nuclear pricing used in the forecast.

4.1 Production Forecast Assumptions

The modelling approach used to compare energy costs begins with forecasting individual supply production levels. The fundamental production level estimation assumption is that historical production capacity factors reflect a normal operational expectation. Therefore as annual capacity evolves in accordance with the LTEP, production is modelled as changing proportionately, retaining the same production capacity factor. Figure 10 illustrates the production capability forecast under the modelled LTEP scenario assumptions. This is before any curtailment of surplus energy has been applied. Demand is based on the OPA forecast to 2020 and LTEP medium growth from 2021 to 2035.



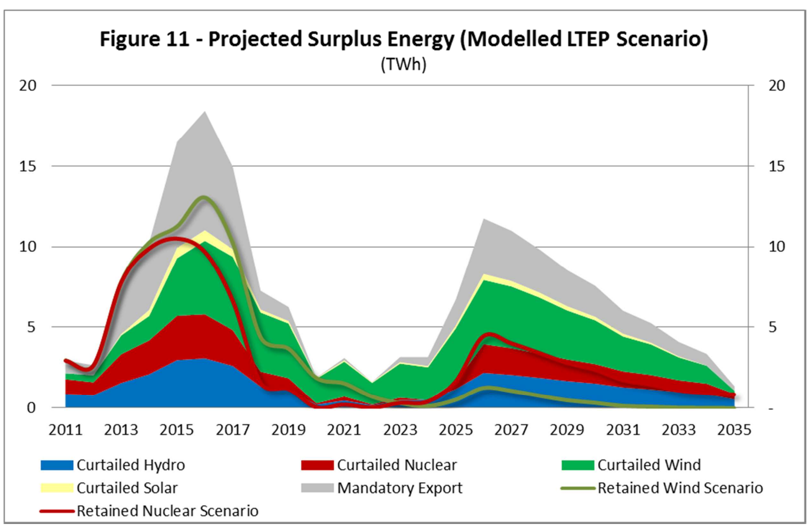
The retirement of the wind and solar assets is evident as the forecast approaches 2035. This forecast period thus completely bounds the implementation of the Green Economy Act as presented by the Ministry of Energy's LTEP. Imports have been assumed to reflect 2011 levels, as have exports during peak hours (defined as 7am to 10pm). Exports have been restricted outside these hours to accommodate modelling needs for predicting surplus energy situations and the impacts on HOEP. Gas-fired generation is increased when demand plus exports exceeds supply, supplemented by imports if gas generation capacity is reached.

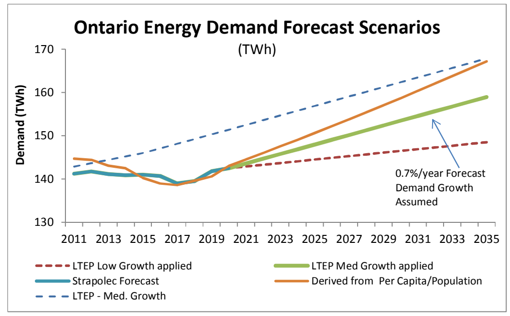
Figure 10 illustrates that, under operating assumptions reflective of 2011 capacity factors, Ontario's generators will produce energy in excess of demand for the entire forecast period to 2035.

4.2 Surplus Energy

Surplus energy is energy production that exceeds demand (or demand plus exports) and that cannot be easily dispatched. Easily dispatched supply is gas-fired generation and imports. When they are dispatched off, there is no cost incurred and the energy is not wasted. Wind and nuclear are typically not supply types that make sense to dispatch off given the fixed nature of their costs. Curtailing these supply types does not save energy costs, rather likely incurs costs for the privilege.

Figure 11 shows the surplus energy forecast for the modelled LTEP scenario with the equivalent levels of surplus that are forecast for the retained nuclear and wind scenarios.

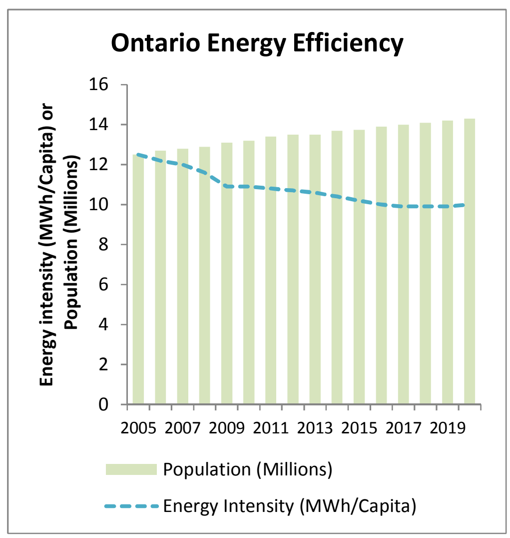




SOURCE: OPA APPrO 2012 presentation, Strapolec Analysis

The demand forecast in short-term was based on OPA's forecast presented at the APPrO 2012 conference.

The long term forecast used has taken the medium growth forecast rate of 0.7%/yr from the LTEP. This has been validated as the most reasonable forecast to use given the expected population growth in Ontario and the reducing energy use per capita data presented by the OPA the APPrO 2012 conference (see below). Despite recent trends that have been tracking a low growth scenario, it seemed unreasonable to continue projecting the LTEP low growth rates in the long term. Conversely, applying the trend from the efficiency projections suggests a growth rate materially greater than the medium growth assumptions of the LTEP.



Under the modelled LTEP scenario, surplus energy is evident throughout the forecast with wind resources being the largest contributor. Under LTEP, over 20% of wind supply is surplus in the 6-year periods both before and after nuclear refurbishment. Even during refurbishment, wind generation will cause surplus energy conditions in the modelled LTEP scenario.

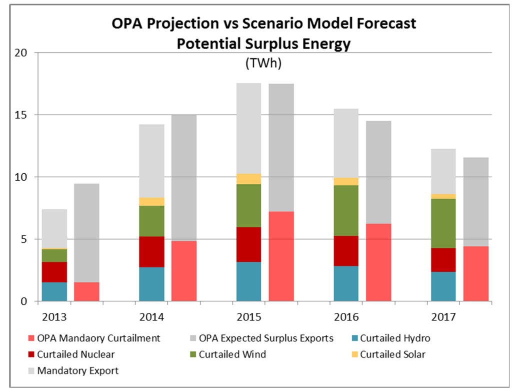
The presence of surplus solar may be surprising to some, as this represents a condition referred to as surplus peak energy, a term that is not widely discussed in the literature reviewed during this project. The retained nuclear scenario has the lowest surplus energy in the near to medium term with the retained wind scenario having the lowest in the long term. The retained wind scenario has the lowest in the long term due to the much higher share of natural gas-fired generation in the supply mix. Gas-fired generation has been modelled as easily curtailed and hence does not contribute to the surplus energy calculation. As discussed in the HOEP and GHG forecast sections of this report, the significant use of natural gas-fired generation has other costs associated with it.

In order to develop this depiction, the curtailment logic methodology is applied on an hourly production basis and first curtails imports, then, gas-fired generation, neither of which are treated as surplus energy. Then, in order of highest cost first:

- Solar/Wind in a balanced manner during Peak Surplus;
- Any remaining Wind that is in surplus;
- Nuclear to 20% of Bruce B production; and,
- Hydro to 20% of regulated production.

After the above limits are reached, any remaining surplus is defined as mandatory exports. The rationale for curtailing the highest cost supply type first is to facilitate, for the purpose of modelling, the calculation of the costs of the surplus energy.

Figure 12 illustrates the costs of surplus energy for each scenario. The LTEP costs peak at $1.8B in 2016, representing 12% of total energy costs.



SOURCE: OPA APPrO 2012 presentation, Strapolec Analysis

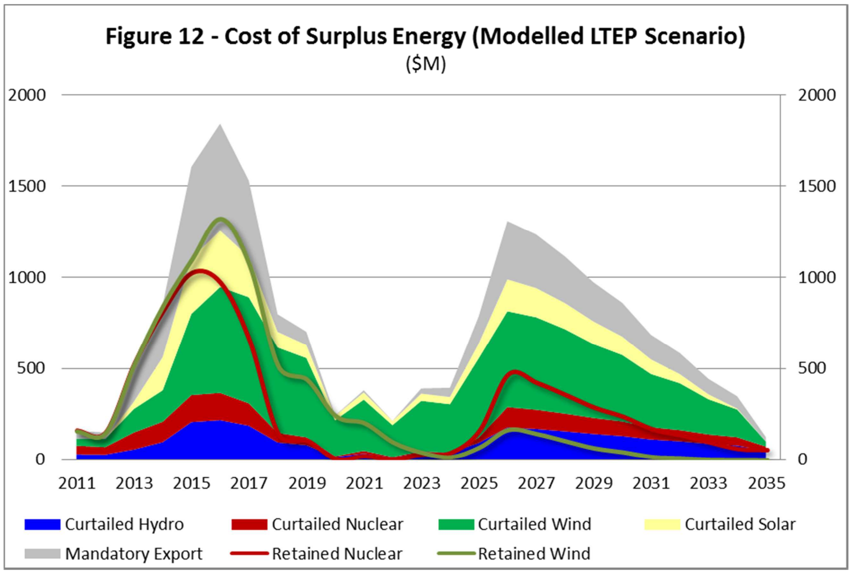
The surplus energy calculation has been validated against and compares very closely to the OPA prediction for potential surplus energy presented at the 2012 APPrO conference.

Replicating the assumptions we believed OPA used, shows our modelled surplus is very similar. Assumptions used in the validation include original LTEP phased wind capacity build up in 2014 and two Pickering units removed from service in 2016 and 2017.

For the purpose of this analysis, the primary validating factor is that the magnitude of projected surplus is the same, as the two portrayals differ in definition of the sub components:

- The OPA portrayal is predicated on determining how much could be exported and then determining the required amount to curtail
- The Strapolec scenario model identifies how much can be curtailed and then identifies the mandatory exports

Mandatory exports are used in the Strapolec simulation as part of the HOEP forecast.

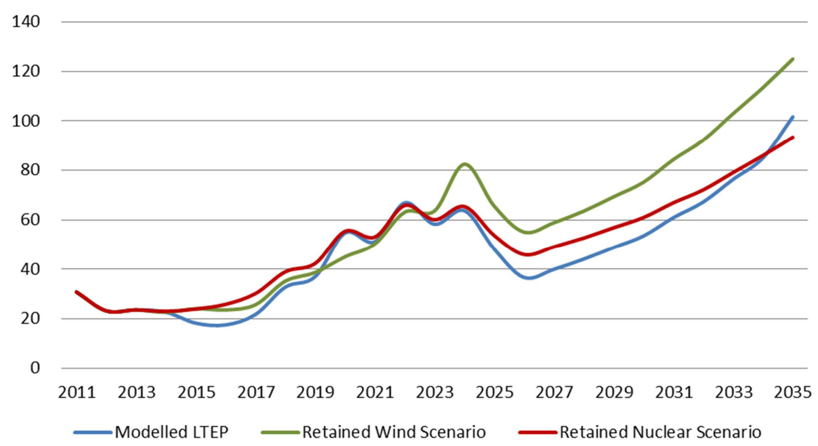


The retained nuclear scenario reduces this cost by about $800M/year in the near term, one of the main reasons that the retained nuclear scenario has ~$1.5B/year lower cost than the modelled LTEP. The cost of surplus peak in the form of curtailed solar is material. In the long term, the retained nuclear scenario has a higher forecast surplus energy immediately after refurbishments are completed, but it represents less than 3% of total energy costs for that scenario and declines to negligible amounts by 2035 as does the wind scenario. Given that the demand forecast used is only 0.7%/year after 2020, the chief contributor to the long-term decline of surplus energy in all scenarios is renewable generation asset retirement as it reaches end of life.

4.3 HOEP Forecast

The HOEP value is the most influential contributor to the variability in overall system costs between scenarios. The value of the HOEP affects the cost in the energy system due to three generation types: Gas-fired and combined heat and power (CHP) generators; unregulated hydro; and, Bruce B generation when the HOEP exceeds its floor price. The value of the HOEP is affected by surplus energy, the peak reserve margin, gas production levels, and the cost of natural gas. Figure 13 illustrates the HOEP forecasts for each scenario.

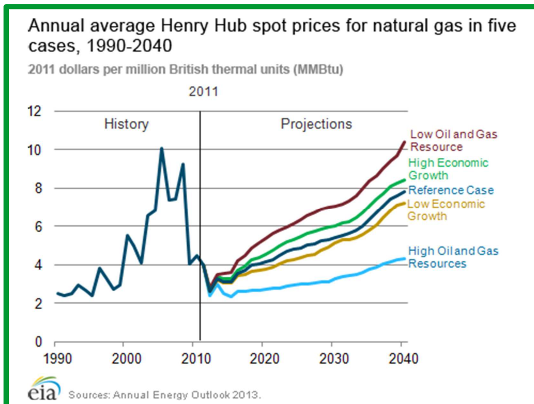
Figure 13 - HOEP Forecast by Scenario
($/MWh)



HOEP for all scenarios is similar throughout the forecast period until the nuclear refurbishments are complete. Low HOEP forecasts in the near term reflect the surplus energy situation present in all scenarios, the most impacted scenario being the modelled LTEP, which has the greatest surplus. The retained nuclear scenario has the more normal near term HOEP forecast as the scenario assumptions produce the greatest reduction in surplus energy.

The HOEP pricing model reflects the assumption that curtailing energy doesn't reduce the impact on market price of the surplus electricity. This may be overly conservative, but is consistent across the scenarios and useful for the purposes of comparison. Total surplus energy, when present, is the primary driver for predicting low to negative HOEP prices during surplus times. Negative pricing has been limited to negative $10/MWh to reflect the recent IESO rule for nuclear and wind participants in the market[15].

During periods when surplus energy is not present, the HOEP forecast model considers gas-fired generation capacity factors, system reserve margins and the price of natural gas. Figure 14 illustrates how the modelled HOEP forecast compares to recent actuals and other forecasts that are publicly available. Overlaid for comparison purposes in the longer term are the system peak reserve margins, a key element in establishing the influence of market forces on HOEP pricing that is independent of the price of natural gas.



SOURCE: EIA Annual Energy Outlook 2013

One of the drivers of HOEP is the price of natural gas used by gas-fired generators.

The most recent EIA Reference Case forecast has predicted a 3.6% annual increase in the price of natural gas for the forecast period.

[15] *Floor Prices Update – Revised, IESO (Aug 2012)*

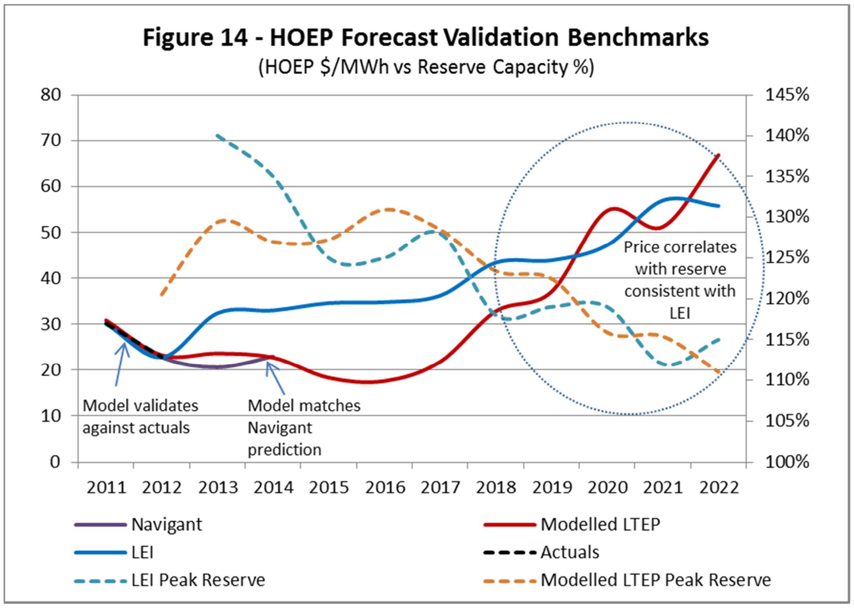
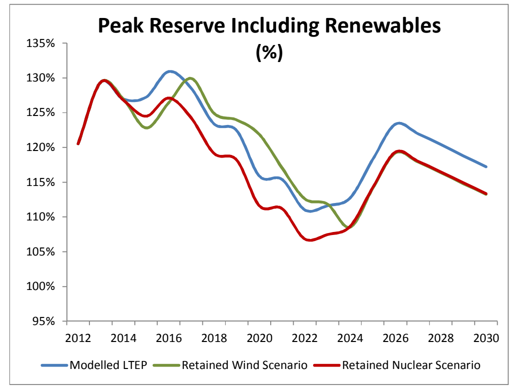


Figure 14 - HOEP Forecast Validation Benchmarks

The HOEP forecast model predictions used in this analysis compare favourably to recent actuals and Navigant's HOEP forecast[16] in the near term. The model outputs also compare favourably to the London Economics International (LEI) forecast in 2020 to 2022[17]. While the LEI forecast would not appear to take into consideration the impacts of surplus energy in the near term, it forecasts similar results to the Strapolec model when surplus does not exist. This is supported by the high correlation of the two forecasts as they relate to system peak reserve margins. The difference between the Strapolec and LEI HOEP forecasts in the periods from 2018 to 2022 is in direct proportion to the relative differences in the system peak reserve margin respectively assumed.

Gas-fired generation receives a much higher price for its production than the overall HOEP suggests. This is because gas-fired generation is used predominantly during peak times and, in the simulation, never during times of surplus energy. Figure 15 shows the model results of HOEP that occurs during gas-fired generation production. Gas-fired generation HOEP is higher in the modelled LTEP scenario because it is used less often, but, when volume demands are high, it commands a higher price.

[16] *Navigant Consulting, OEB Regulated Price Plan Price Report, April 2013*
[17] *Semi-Annual Market Update and 10-year Energy Price Forecast: Ontario. LEI (2013).*

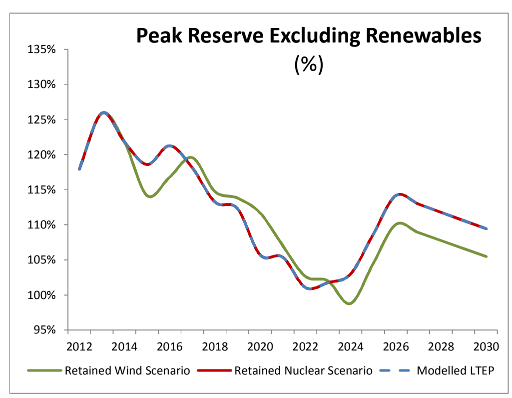


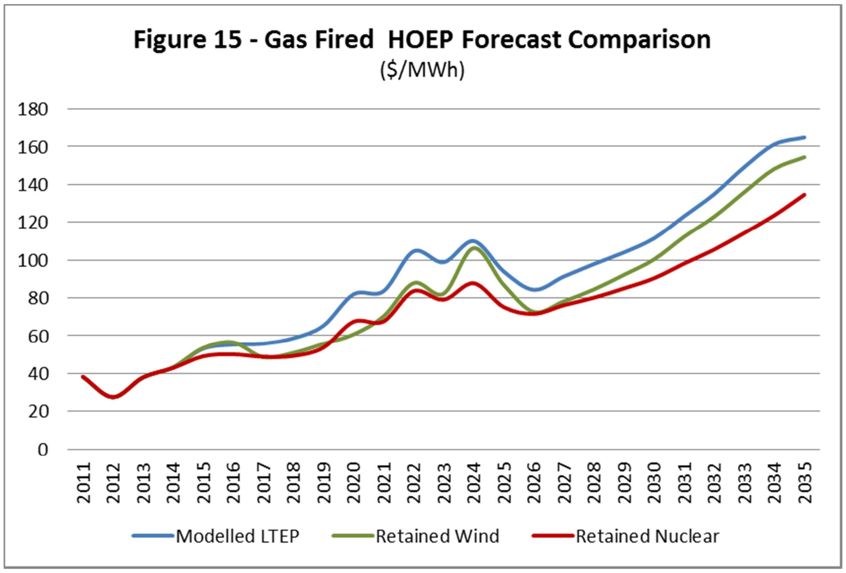
SOURCE: Strapolec Analysis

Having similar reserve margins in the scenarios ensures similar HOEP forecasting drivers. The modelled peak reserve, driven by de-rated capacity assumptions, is similar in all scenarios when using the LTEP definitions.

The modelled LTEP has similar peak reserve margins to the retained wind scenario in the near term, both being higher than the retained nuclear scenario. In the long term, the modelled LTEP has higher reserve margins with the retained nuclear and wind scenarios converging to identical values.

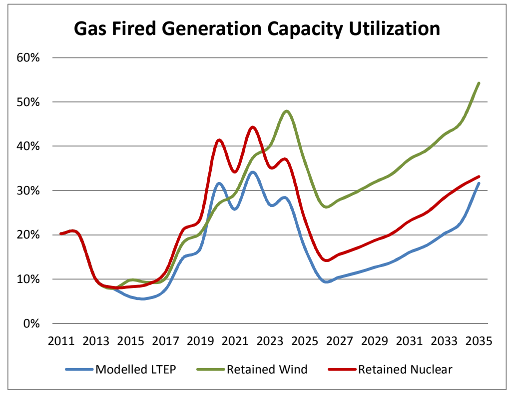
However, the HOEP forecasting model used excludes renewables from the calculation of the reserve margin. Under this assumption, the modelled LTEP and the nuclear scenarios both have identical margins throughout, while the wind scenario in the near term has had gas capacity added in 2017 to offset the reduced nuclear footprint. By this measure, for the retained wind scenario, additional gas capacity beyond that assumed may be warranted in the long term. A lower reserve margin puts upward pressure on HOEP.





Understanding HOEP prices that accrue specifically to gas-fired generation helps clarify some of the cost drivers that distinguish the scenarios. Under all scenarios, after nuclear refurbishments are completed, the variable cost of gas-fired generation is predicted to exceed the cost assumptions made for new or renewed nuclear assets. Another factor is that the assumed inflation escalation for gas supply is 3.6%/year while nuclear trends for the last 5 years have indicated only 1.4%/year escalation[18], both under an assumed CPI inflation of 2%.

An additional cost implication is that when gas-fired generation is the driving factor in the value of the HOEP, production from unregulated hydro and Bruce B assets also receive the same pricing. This compounding effect is one of the reasons the retained nuclear scenario, with its modest gas-fired generation requirements, presents a lower cost footprint than the retained wind scenario.



SOURCE: Strapolec Analysis

Gas-fired generation capacity factors differ between the scenarios based on the presence of renewables or base load generation. The figure above excludes production from non-utility generators (NUGs) or CHP facilities which have been assumed constant for all three scenarios. The retained nuclear scenario has more gas generation than LTEP as a result of the removal of the wind resources. The retained wind scenario has greater gas-fired generation than LTEP throughout the forecast period due to the lower nuclear footprint.

When considering the HOEP implications it is clear that the retained nuclear and wind scenarios use gas resources more broadly and also specifically in times of high peak reserve margin than does the modelled LTEP scenario.

4.4 Assessing Future Nuclear Costs

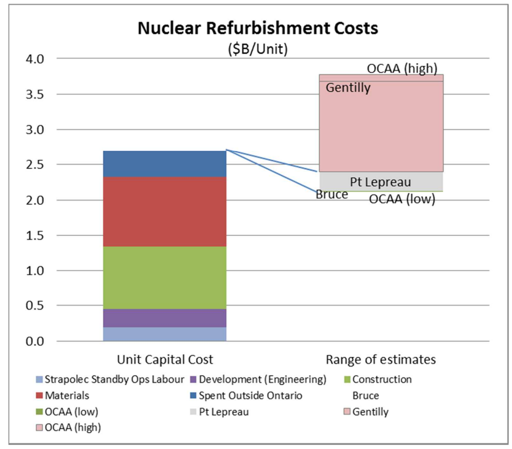
One of the uncertainties in the literature reviewed is the future price of refurbished or new built nuclear capacity. The FIT program pricing terms are used for wind assumptions in this analysis. Pricing assumptions for future nuclear assets need to be derived.

[18] *Derived from OEB filing EB-2010-0008, May'10, Navigant authored RPP Apr 2013*

Two sources have put a price on nuclear refurbishment: (1) Hydro Quebec identified an incremental price of $83/MWh for Gentilly-2 based on an incremental capital cost of $3.4B for a 675MW facility[19]. This capital cost appears high, and the capacity of Gentilly-2 is lower than the assets in Ontario. Both of these factors suggest that the $83/MWh is likely higher than would be expected in Ontario. (2) Bruce A has undergone recent refurbishments and is carrying a price of $74/MWh[20].

In order to create assumptions to be used in the scenario model Strapolec has mocked up illustrative financial statements for gas-fired generation, wind, refurbished nuclear and new build nuclear generation. The intent is to create a common framework and to develop consistent and reasonable assumptions for this analysis. Based on the economic impact benchmarks described in section 5.0 of this report, which define the capital cost assumptions used in this analysis, Table 1 illustrates the breakeven financials that indicate a minimum price given the cost of debt and the desired return on equity (RoE) assumptions.

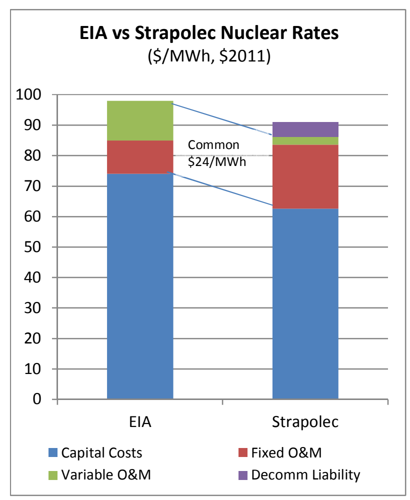
The structure of the analysis used the set of assumptions described in LEIs report[21] which were replicated to confirm that the framework resulted in a financial breakeven for a gas-fired generating plant. The resulting predicted price for refurbished units is $70/MWh, or very similar to Bruce A pricing, and the new build pricing is modelled at $91/MWh. Applying that framework to the wind assumptions showed that the maximum capital cost for a 100 MW wind farm under FIT 1.0 pricing would be $225M. This is much less than that presented in ClearSky's report. For the nuclear refurbishments and new build, two additional assumptions were made: (1) The capital costs assumed from the benchmarks were $2.5B and $7B respectively per unit. (2) Given that OPG is the target owner for these assets, the cost of capital assumptions have been modified to reflect a public owner and the OEB inclination to restrict RoE to about 9% for regulated assets[22].



SOURCE: CME, media releases, Strapolec Analysis

As described in Section 5, refurbishment capital cost benchmarks from recent projects in Canada suggest $2.5B per unit is a reasonable assumption for the purposes of this analysis.

This reflects actuals from the recently completed Bruce A restarts and Point Lepreau refurbishments. Both of these projects were discussed in the media as having incurred significant overruns. The final numbers used in the model reflect these realized higher than expected costs.



SOURCE: EIA, Strapolec Analysis

The EIA in the 2013 Annual Outlook, put forth an anticipated cost breakdown for future new build nuclear. This compares favorably to Strapolec's assumptions which were derived independently, based on cost of capital and best in class EUCG costs.

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[19] *Executive Summary, Gentilly-2 Closure. Hydro Quebec (2012).*
[20] *Navigant Consulting, OEB Regulated Price Plan Price Report, April 2013*
[21] *Semi-Annual Market Update and 10-year Energy Price Forecast: Ontario. LEI (2013).*
[22] *Ontario Electricity Cost Forecast, Strapolec, Jan 2013*

Table 1 – Financial Mock-Up of Generation Capacity Breakeven[23]

Illustrative Financial Break Even Income Statement			Gas	Wind	Nuclear Refurb	Nuclear New Build
Assumptions	Financing leverage		60%	70%	80%	80%
	debt interest rate		8%	6%	5%	5%
	after tax return on equity		15%	15%	9%	9%
	income tax rate		40%	40%	0%	0%
	debt financing term (yrs)		20	20	25	55
	life to recover equity (yrs)		20	20	25	55
	construction time (yrs)		3	3	3	5
	Nameplate Capacity (MW)		1,000	100	881	1,000
	average load factor		85%	30%	91%	95%
	annual MWh		7,446,000	262,800	7,022,980	8,322,000
	energy price ($/MWh)		$ 34	135	70	91
	Fixed revenues($/MW/Month)		$ 17,000	-	-	-
	capital cost ($M)		1,000	225	2,500	7,000
	capital cost $/kW		1,000	2,250	2,838	7,000
	carry charge during construction	$M	60	10	94	438
	debt financed portion	$M	660	168	2,094	6,038
	equit financed portion	$M	400	68	500	1,400
Revenue ($M)			$ 460	$ 35.5	$ 492	$ 757
Costs ($M)	FixedCost components					
	O&M		15	3.4	200	175
	Fuel				25	22
	Other			2	20	40
	Total Fixed Costs		**15**	**5.4**	**245**	**236**
	Variable costs					
	O&M		27			
	cost of fuel		229			
	Total Variable Costs		**256**	**-**	**-**	**-**
Margin ($M)			189	30	247	521
Cost of Capital	Dep & Amort annualized values	$M				
	debt capital repayment		33	8	84	110
	equity capital repayment		20	3	20	25
	Interest annualized	$M	34	6	65	214
Total Cost of Capital Related Expenses *(excl RoE)*		$M	**87**	**18**	**169**	**349**
EBIT ($M)			101	12	78	171
After Tax Profit ($M)			**61**	**7**	**47**	**103**
	Annualized Required RoE		44	7	31	102
	Profit in excess of required RoE		17	- 0.2	15.9	1.2
	Margin in Analysis		*4%*	*0%*	*3%*	*0%*

The capital costs as presented in Table 1, does not fully represent the actual capital cost of acquiring these forms of generation capacity when the useable energy production is considered. For example, in the above table, at $7000/kW, nuclear appears more expensive than the $1000/kW for gas-fired generation. To put these capital costs in perspective, Table 2 illustrates the equivalent capital cost for building

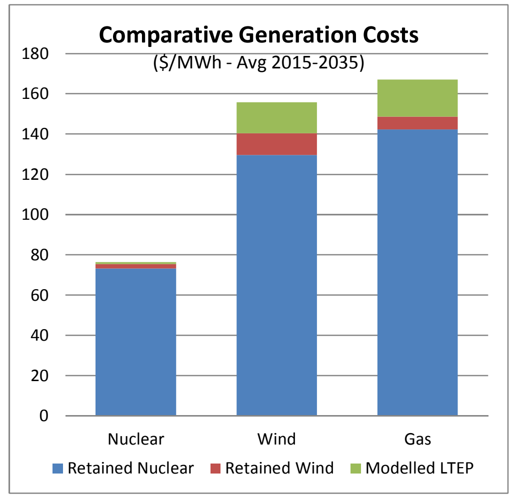
[23] *Semi-Annual Market Update & 10-year Energy Price Forecast: Ontario. LEI (2013).*

sufficient capacity that would produce the same amount of energy, or kWh, within the context of Ontario's energy system.

Table 2 – LTEP Equivalent Production Comparable Investment Costs

Cost Metric	Wind	Gas	Nuclear Refurb	Nuclear New Build
Cost $/kW	$ 2,050	$ 1,000	$ 2,750	$ 7,000
Life (years)	20	20	25	55
per year capital cost allocation ($M)	$ 103	$ 50	$ 110	$ 127
Capacity Factor under LTEP*	30%	20%	91%	95%
Production reduction due to curtailment	17%	0%	1%	1%
Forecast Years Used	2015-2030 as wind reaches end of life	2018-2030, average for gas production is already net of curtailment	avg from 2023-2030 to give same time frame	avg from 2023-2030
Net Capacity Factor	25%	20%	90%	94%
Equivalent Capital Cost for same energy ($/kW/year)	**$ 410**	**$ 250**	**$ 122**	**$ 135**

The net capacity cost differences for equivalent energy production shown in Table 2 indicate that effective wind capacity cost is three times greater than nuclear, while gas-fired generation capacity is twice as great. These capital cost differences are a contributor to and help put in perspective the differences in total energy cost forecasted by the scenario analyses.



SOURCE: Strapolec Analysis

The total forecast costs and production (after curtailment) from the scenario model for the period from 2015 to 2035, shows that wind generation will cost twice that of nuclear and gas-fired generation up to 10% more. (Note: This includes all forms of gas-fired generation including CHP and NUGs).

The cost of nuclear cost in all three scenarios is ~$75/MWh, varying only +/- $1 between scenarios.

The effective wind generation cost under the retained wind scenario is $140/MWh, and is higher than in the retained nuclear scenario cost of $130/MWh due to addition of higher cost wind resources over the base RESOP & RES rates retained in the nuclear scenario. Wind costs are highest under the modelled LTEP scenario at $165/MWh due to the curtailment of surplus energy.

Gas-fired generation, when considering both the fixed and variable HOEP cost, has the highest cost in all scenarios ranging from $176/MWh under the modelled LTEP scenario to $142/MWh under the retained nuclear scenario which makes the most efficient use of the gas assets.

5.0 Developing Economic Impact Assumptions

The objective of this report is to contrast the implications of alternative energy options. Economic impact is one measure, which includes total domestic spend (proxy to direct GDP), jobs, and employment income. In order to develop the desired comparisons, a literature review was conducted to compile and develop a set of reasonable assumptions that are common in their derivation between the scenarios being compared.

Two main sources that describe economic impacts of Ontario energy choices were leveraged as the initial framework for our forecast development:

- ClearSky Advisors' 2011 report on Ontario wind development[24]
- CME 2010 & 2012 reports on nuclear development in Ontario[25]

Additional materials were reviewed and compiled in order to benchmark the assumptions in these two reports and develop a set of reasonable assumptions to use for the capacity scenarios compared in this report.

This section first presents the assumptions developed for modelling wind investments and their validation benchmarks that were evaluated. The second section discusses the nuclear assumptions.

The findings are that economic impacts used for modelling are reduced by approximately 25% and 15% from the levels in the reference reports for wind and nuclear respectively as a result of benchmarks indicating that the capital costs for recent actual projects are lower than the assumptions contained in the reference reports.

5.1 Wind Economic Impact Assumption Derivation

As mentioned, the primary source for economic impacts of wind developments in Ontario is the ClearSky report published in 2011. In order to validate the assumptions for use in this analysis, several other sources were consulted as part of a benchmarking exercise to develop confidence in the assumptions to be used for this analysis. Benchmarking was investigated for: overall capital cost and annual

[24] *The Economic Impact of Wind Energy in Ontario, July 2011, ClearSky Advisors Inc*
[25] *Economic Benefits of Refurbishing Nuclear Reactors, CME (2010; updated in 2012)*

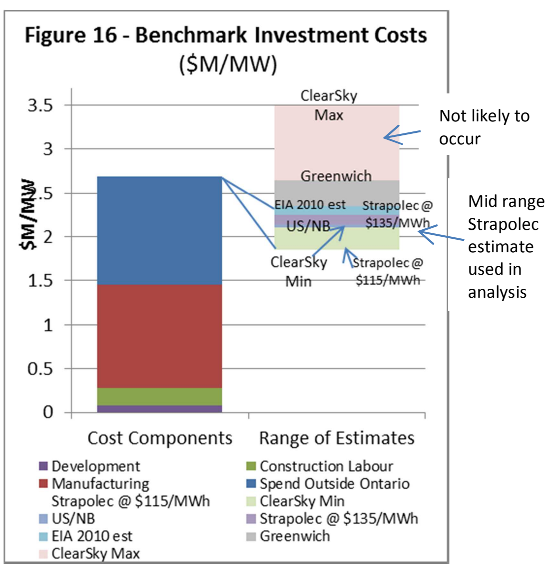
operating costs, which should be relatively consistent across jurisdictions; the number of jobs created, which have been benchmarked on a jobs/$M domestic spend basis; and, the associated employment income which can be used to validate the job creation statistics.

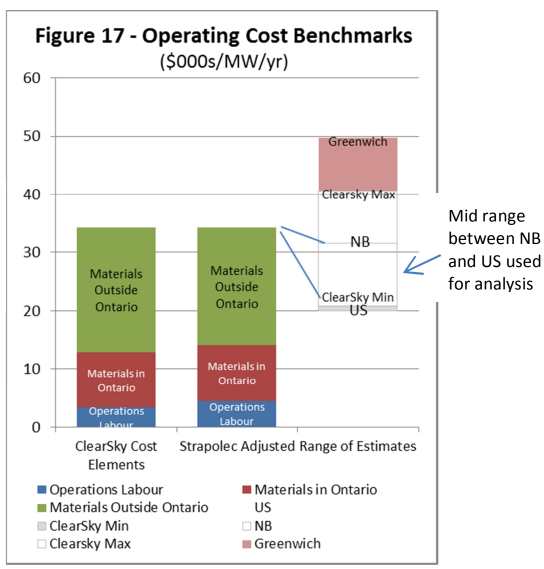
Two other Canadian studies were reviewed: University of Moncton's analysis for wind farms in New Brunswick[26], and a study conducted for the Ontario Ministry of Natural Resources on the Greenwich wind farm in Ontario[27].

In addition, a recent 2012 study from the US was reviewed. Compiled by the National Renewable Energy Laboratory (NREL), this study catalogued the economic impacts from 200 wind projects between 2009 and 2011[28]. Finally, a financial validation, presented in section 4.4, was conducted to assess the likely capital costs assumed in the derivation of the FIT pricing for both FIT 1.0 and 2.0.

Total Cost Benchmarks

The results of the cost benchmarking are illustrated in Figures 16 and 17 which includes a depiction of how ClearSky articulated the components of domestic spend.





26 *Economic Impact of Wind Farm in New Brunswick, Dec'08, Univ of Moncton*
27 *Economic Impact of the Greenwich Wind Farm, 2012, Crupi Consulting Group*
28 *Preliminary Impacts of Renewable Energy Projects 2009-2011, NREL, 2012*

Findings show that the capital costs of $2.69M/MW assumed in the ClearSky report are at the high end of other estimates. The EIA estimated in 2010 that wind farms should cost $2.35M/MW. The recent 2012 NREL review of 200 projects demonstrated the average capital cost to be $2.14M/MW. Finally, Strapolec's financial analysis of the average breakeven for the FIT 1.0 rates suggests a $2.25M/MW maximum investment cost. However, FIT 2.0 breakeven is $1.85M/MW, potentially reflecting media reports that costs are declining[29].

For the purposes of this analysis, the expected investment level for a 100 MW wind farm will be assumed to be the average from Strapolec's analysis which is $2.05M/MW. This is only marginally below the US average value of $2.14M/MW for the last 3 years and appears reasonable amid generally held expectations that costs are declining.

Similarly, ClearSky operating cost assumptions of $34K/MW/yr are above the benchmark range. An average of benchmarks from NB and the US of $26K/MW/yr has been assumed for modelling purposes. The rationale is further explained in the following sections.

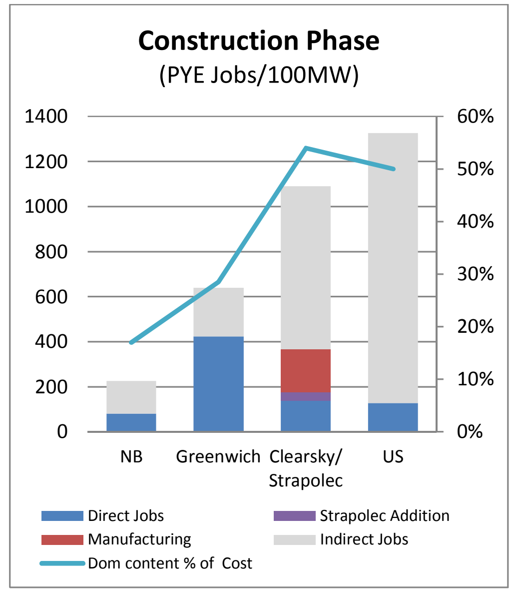
As a result, the Investment and Operations spend assumptions used in this report reflect a scaling down of the ClearSky assumptions to 76% and 74% respectively.

The annualized domestic spend profile is based on ClearSky's profile of the percentage of the PYE jobs created by year.

Economic Impact Definitions - Jobs

There are several standard definitions used when conducting economic impact analyses:

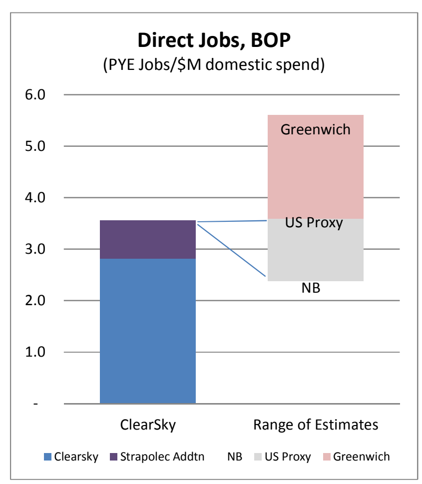
- Direct – jobs directly paid from Capital and O&M expenditures for services rendered (typically only direct construction, development, and operations jobs)
- Indirect – jobs associated with employment in supply chain that are directly procured for purchased materials, as well as



SOURCE: Multiple, Strapolec Analysis

Notwithstanding common definitions, the number of indirect jobs identified in the reports consulted has varied significantly. The first measure is whether the multiples are consistent. The graph above shows they are not. The second measure is domestic content for which both the NB and Greenwich situations differed materially.

As it is general practice in wind developments to use local services for the Balance of Plant construction, isolating this part of the project permitted some benchmarking which indicated ClearSky construction job assumptions may be low. Strapolec has increased the number of jobs.



[29] *Bloomberg, 2011, Wind costs should be less than $1.3M/MW or $68/MWh for turbine. Also Lawrence Berkeley National Laboratory, Oct 2011*

supply chain support to direct materials purchases. Typically includes manufacturing jobs and other services

- Induced – jobs created through the spending of income by the above two categories - No studies reviewed included induced jobs

ClearSky has included manufacturing and government jobs in their definition of Direct Jobs, which we observe is a non-standard assumption that was also not used in the CME's report regarding nuclear. Strapolec has chosen to include direct Manufacturing jobs, in the analysis which ClearSky has defined as jobs created by the direct manufacturing suppliers to the wind farm developer. To accommodate this assumption, Strapolec developed an equivalent assumption for the nuclear economic impact validation. Additional jobs resulting from downstream supply chain participants and any jobs created to develop the manufacturing facilities have been properly defined by ClearSky as Indirect.

Strapolec analyzed the domestic cost breakdown presented by ClearSky in the context of the jobs they identified. As a cross check, Strapolec obtained from StatsCan the average Ontario salaries for construction and general manufacturing in order to assess the implied income earned by the direct jobs. Table 3 summarizes the results of this assessment, which identified a discrepancy between the construction jobs and the implied income as a percentage of direct labour costs.

Table 3 – Assessment of ClearSky Costs/PYE Jobs vs Salaries/Income

$/MW		Total Investment	Ont Spend	% Ont	PYE Jobs/MW	Salary**	Income ($000s)	Inc % of Spend	Adjusted PYE Jobs*	Total PYE jobs/MW Used
Components										
	Nacelle	$1,120,833	$537,462	48%						
	Blades	$376,600	$232,416	62%						
	Towers	$412,467	$188,838	46%						
	BOP Gen Materials	$405,652	$217,890	54%						
Total Materials		$2,315,552	$1,176,606	51%	1.90	$54,247	103.3	8.8%		1.90
Construction Labour		$257,433	$203,364	79%	0.93	$54,642	51.1	25.1%	0.36	1.29
Development		$117,015	$72,630	62%	0.46	$55,746	25.4	35.0%		0.46
Total Cost		$2,690,000	$1,452,600	54%	3.30		179.8		0.36	3.66

* Jobs adjusted to make construction income 35% of budget assuming chargeout rate is 2.8 x salary

** Salaries obtained from Stas Can for gen manufacturing and foundation jobs in Ontario

Strapolec observed that under the assumed jobs numbers, the income earned is likely only 25% of the stated construction labour costs. This percentage appears low as it implies the charge out rates for construction labour is a factor of 4 times salary, which is high in our judgement. Strapolec has chosen to increase the number of construction jobs to make income 35% of labour costs, reflecting a Strapolec's rule of thumb 2.85 x salary multiplier in the construction.

Comparative wind studies were also assessed against ClearSky assumptions, but significant differences in domestic content assumptions and scope against which the jobs are assigned also warranted a detailed assessment of jobs, cost, domestic content, and income. This analysis is summarized in Table 4.

The benchmarking in Table 4 categorizes the sources into two groups: (1) those where significant differences in domestic content were assumed, but Balance of Plant assumptions may be more comparable; and (2) those with higher and common domestic content assumptions for which total costs are the best framework to use.

Table 4 – Benchmarking Wind Investment Economic Impact Metrics

For 100MW Wind Farm	Balance of Plant Driven Comparisons				Total Cost Comparisons		200 proj,13GW
	NB	Greenwich	ClearSky BOP	Strapolec BOP	Strapolec Tot	ClearSky Tot	US
Total Proj Cost	200,000,000	264,930,000	78,010,000	78,010,000	269,000,000	269,000,000	213,114,754
Prov spend	34,000,000	75,585,000	49,388,400	49,388,400	145,260,000	145,260,000	106,557,377
domestic content	*17%*	*29%*	*63%*		*54%*	*54%*	*50%*
Income	4,347,593	21,940,000	7,649,081	9,659,790	9,659,790	7,649,081	8,832,000
income as % dom spend	12.8%	29.0%	15.5%	19.6%	6.7%	5.3%	8.3%
direct jobs excl manuf	81	424	139	176	176	139	128
avg salary	$ 53,674	$ 51,789	$ 55,004	54,929	54,929	$ 55,004	69,000
Dom $/direct PYE job	419,753	178,418	355,150	280,838	825,994	1,044,560	832,480
Tot $/direct PYE job	2,469,136	625,366	560,967	443,589	1,529,618	1,934,370	1,664,959
PYE Metrics	BOP Context				Total System Context		
Jobs/$M dom spend	2.4	5.6	2.8	3.6	1.21	0.96	1.20
Jobs/$M tot cost	0.4	1.6	1.8	2.3	0.65	0.52	0.60
	low dom cont	*high #jobs*	*BOP only*			*all in ball park*	

On the Balance of Plant benchmarked studies, the ClearSky jobs/$M domestic spend appear low in comparison, particularly considering the lower domestic content assumed for the New Brunswick study. Similarly on the total cost benchmarking against the U.S., which represents similar domestic content, ClearSky assumptions also appear low. The Strapolec adjustment of 37 PYE jobs puts the wind jobs on a comparable level to the U.S. benchmarks and in the mid-range of the Greenwich and NB studies.

The job assumptions being carried forward for use in this analysis represent a balanced view of:

- Income as % of domestic spend, Average Canadian salaries
- Mid-range comparable jobs/$M spend

Operating Economic Impact Benchmarks

Despite having higher overall operating cost assumptions, benchmarks suggest ClearSky has made conservatively low domestic O&M spend assumptions. ClearSky PYE jobs assumptions portrayed on a job/$M of domestic spend are comparable to other benchmarks

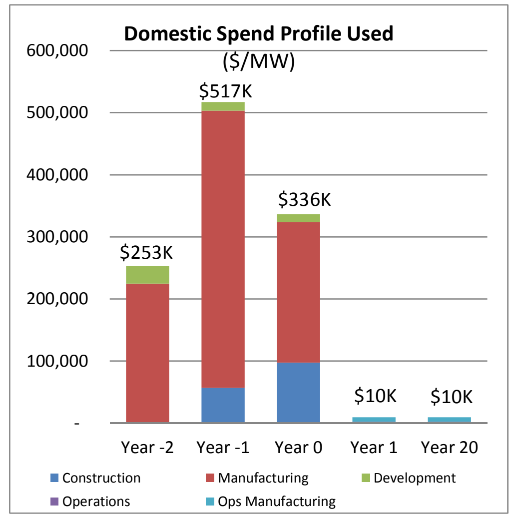
However, labour income is not consistent with jobs if comparable salaries are assumed. These findings are summarized in Table 5.

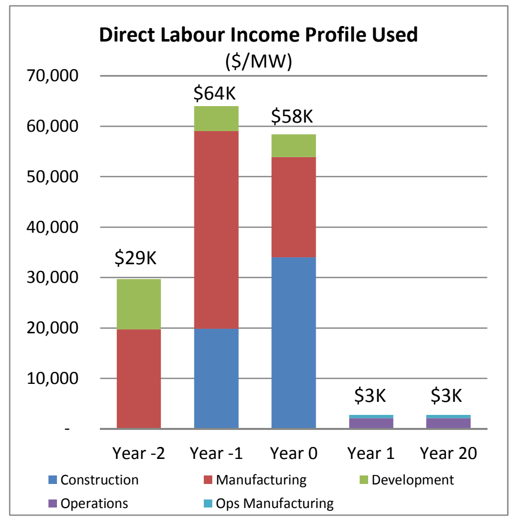
Table 5 – Wind Operating Costs, Jobs, and Income per 100 MW

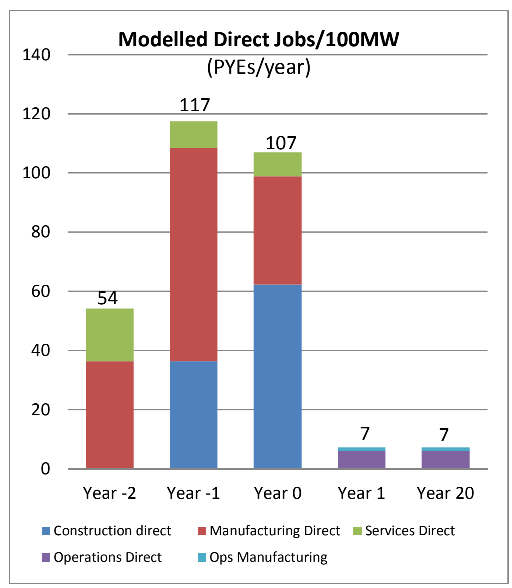
Operations Phase/yr	NB	Greenwich	Clearsky	US
Total Spend/year	3,153,600	4,968,500	3,430,000	2,000,000
Domestic spend	1,450,656	4,170,000	1,290,090	920,000.0
*Domestic Spend % **	*46%*	*84%*	*38%*	*46%*
Operations PYE Jobs	9	48	8.1	6.0
PYEs/$M Dom spend	6.2	11.6	6.3	6.5
Income**	336,441	1,610,000	$ 212,249	390,000
% income of dom spend	*23%*	*39%*	*16%*	*42%*
Average salary	$ 37,382	$ 33,368	$ 26,074	$ 65,000
*Adjusted Avg Salary ****			*$ 35,375*	
Adjusted Income			*287,964*	
Adjusted % Income			*22%*	
Notes	** Assumed NB % dom spend for US due to generally common assumptions*			
	*** ClearSky income based on 64% of Lbr cost*			
	**** if use avg of NB and Greenwich, yields % income similar to NB*			

As the number of jobs appears consistent on a per $M spend basis, adjustments were made to increase the domestic labour cost assumptions in the ClearSky report to reflect the industry metrics. The modelled increased costs are added to domestic spend to bring all metrics in alignment.

Finally, given that the overall O&M costs from the US study represent actuals and the NB data is from a study, for modelling purposes, the







average operating cost of the two ($2.6M/100MW/yr) has been assumed, with job and income metrics applied proportionately by scaling them down from the ClearSky assumed $3.4M/100MW/yr O&M estimates.

Strapolec then applied the ClearSky spending profiles to yield the modelling assumptions used in the comparative analyses.

5.2 Nuclear Economic Impact Assumption Development

As mentioned, the primary source for economic impacts of nuclear developments in Ontario is the CME report published in 2012. There were two distinct topics addressed that are relevant to developing modelling assumptions in this report.

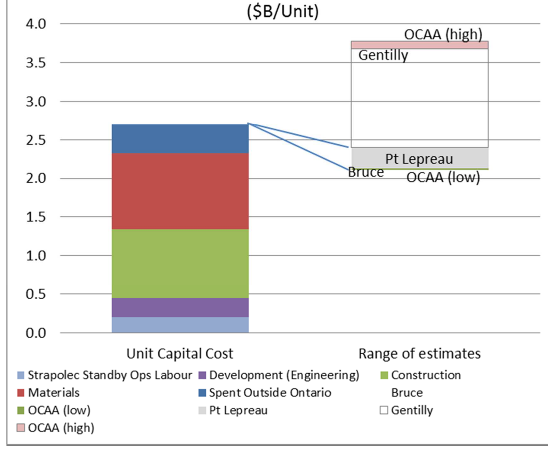
- Economic impact of refurbished nuclear
- Economic impact of nuclear new build

In order to validate the assumptions for use in this analysis, several other sources were consulted as part of a benchmarking exercise to develop confidence in the assumptions to be used in this analysis. The primary areas where benchmarking was applied included: overall capital cost and annual operating costs, which should both be relatively consistent across jurisdictions; the number of jobs created, which have been benchmarked on a jobs/$M of domestic spend basis; and the associated employment income which can be used to validate the job creation statistics. The primary independent sources consulted include the EIA[30], NEI[31], and OEB submissions[32] that have quoted EUCG operating benchmarks.

Total Cost Benchmarks - Refurbishment

Benchmarking of refurbishment investment and annual operating costs focussed on Canadian experiences. The results are summarized in Figures 18 and 19.

Figure 18 - Nuclear Refurbishment Costs
($B/Unit)



Primary benchmarks for assessing total refurbishment cost assumptions are the actuals and estimates from Canada. These

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30 *Updated Capital Cost Estimates for Electricity Generation Plants. EIA (2010).*
31 *Fact Sheet: Nuclear Power Plants Contribute to Economies. NEI (2012).*
32 *OEB filing EB-2010-0008, filed May 2010*

include the actuals from the recently completed Bruce A restarts and Point Lepreau refurbishments as well as the recently publicised estimate for Hydro Quebec's refurbishment of Gentilly-2. Both of the actual projects were discussed in the media as having incurred significant overruns. The final numbers used in this benchmark reflect these higher than expected costs. As these costs are marginally lower than the CME's assumptions, Strapolec has chosen to adopt the CME refurbishment cost estimates of $2.5B/unit.

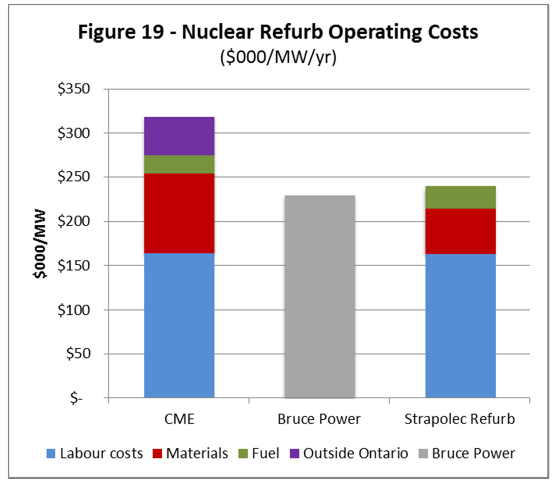


Figure 19 - Nuclear Refurb Operating Costs
($000/MW/yr)

The CME's operating cost numbers were based upon an average cost for all plants. It is widely understood that not all plants have the same operating costs. Strapolec accessed OEB submissions that quoted EUCG metrics for Darlington including total costs, operating costs per MW, and jobs.

Building up a cost structure from these assumptions indicates they are similar to Bruce Power's operating costs as reported in 2008[33]. Strapolec concludes that the CME implied operating costs are too high for use in this analysis and Strapolec has used its EUCG based developed models. The CME has assumed a domestic content of 90% for labour and 80% for purchased materials (e.g. Manufacturing) for both the refurbishment construction and operation phases. Strapolec has not found any references that can benchmark this assumption and so has adopted the 90%/80% assumption.

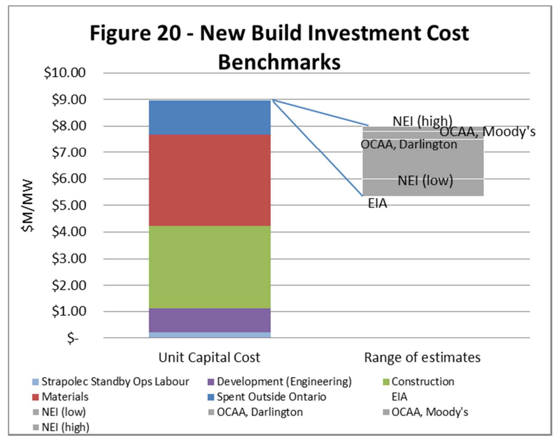


Figure 20 - New Build Investment Cost Benchmarks

Total Cost Benchmarks - New Build

For new build benchmarking, estimates from other jurisdictions were required to provide a context for the CME assumptions. The resulting benchmarking comparisons are illustrated in Figures 20 and 21.

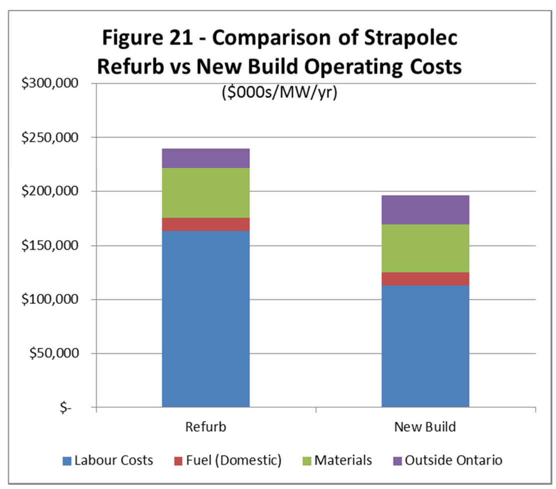


Figure 21 - Comparison of Strapolec Refurb vs New Build Operating Costs
($000s/MW/yr)

The primary sources used to validate CME's new build assumptions for use in this study have been obtained from the NEI and EIA. The NEI is forecasting a possible capital cost range of $6,000-$8,000/kW for new build nuclear. The EIA has quoted the Westinghouse build at $5,335/kW[34], but caveats this as a "brownfield" project. The EIA is currently carrying $5,429/kW[35] in its 2013 outlook as the cost for reactors built in 2012. To accommodate these benchmarks, Strapolec

[33] *BRUCE POWER 2008 Year in Review.*
[34] *Updated Capital Cost Estimates for Electricity Generation Plants. EIA 2010*
[35] *Annual Energy Outlook, EIA, April 2013, page 45*

has assumed the mid-range of the NEI estimates on the basis that the EIA "brownfield" assumption may not apply in Canada.

Strapolec has assumed a 79% domestic content and applied it by proportionally scaling down the CME's breakdown of the construction phase spend.

Similar to the validation of CME refurbished unit operating costs, Strapolec has built up an operating cost model for New Build, in this case based on best-in-class EUCG metrics. This assumption seems reasonable as new reactors should come with optimized operating control systems and automation as well as enhanced maintainability characteristics. As described in section 4.4, comparing the resulting derived assumptions with the EIA's recent forecast for a 2025 new facility shows the operating costs on a per MWh basis to be virtually identical to Strapolec's model.

Economic Impact Definitions - Jobs

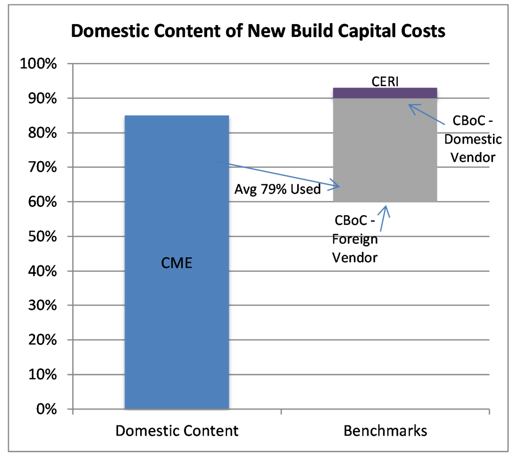
Strapolec observed inconsistencies between the jobs and income implications in the CME study. As a result, Strapolec created a framework to assess the balance of jobs and income estimates for both the refurbishment and new build projects as shown in Table 6.

Table 6 – Assessing Income and Jobs for Nuclear Projects

	CME NEW BUILD	CME REFURB	Strapolec NEW BUILD	Strapolec REFURB
Ontario Investment ($M per unit)	$ 7,436	$ 2,125	$ 7,436	$ 2,125
Domestic Content for Labour	90%	90%	79%	90%
Total PYE Jobs	30,000	6,500	29,823	8,525
Direct Domestic PYE Jobs	27,000	5,850	23,560	7,672
PYE Jobs / $1M	$ 3.6	$ 2.8	$ 3.2	$ 3.6
Total Labour Income ($M)	$ 2,220	$ 634.50	$ 2,220	$ 635
Domestic Labour Income ($M)	$ 1,998	$ 571	$ 1,754	$ 571
Avg Salary per Job	$ 74,000	$ 97,615	$ 74,440	$ 74,431
Direct PYE / MW	27	7	24	10

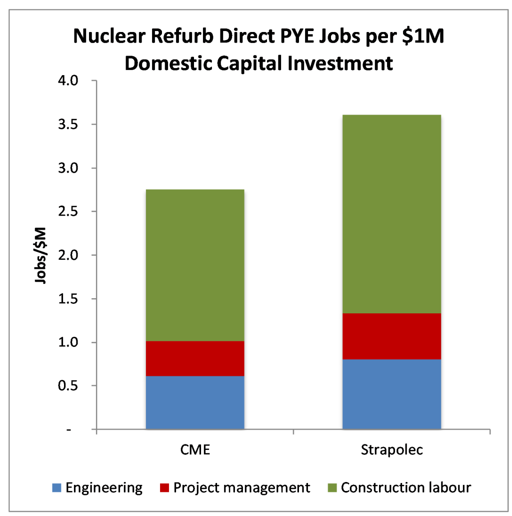
Table 6 clearly shows that the CME refurbishment assumption of an average salary of $97K is an outlier. The CME refurbishment assumptions yield higher salaries than expected and outside the range of StatsCan data. As such, the job numbers cannot be rationalized into consistent assumptions for the purpose of the analyses in this report. In contrast, by rebuilding job numbers based on StatsCan salary data, CMEs' New Build assumptions correlate at average salaries of $74K.

This examination of CME's Refurbishment and New Build jobs estimates suggests the Refurbishment jobs should be increased in lieu



SOURCE: Multiple, Strapolec Analysis

CME domestic spend assumptions have been lowered to 79% by Strapolec on the basis that the current competed bid process underway to best meet the needs of Ontarians could cause one party to reduce domestic spend in a drive to lower costs and the other while the other to increase domestic spend. An average of Strapolec's understanding of the Conference Board of Canada's assumptions from a few years ago has been used.



SOURCE: Multiple, Strapolec Analysis

To align income and jobs/$M with StatsCan salary benchmarks, Strapolec has scaled up the CME's jobs assumptions for refurbishment.

of reducing the estimates for income. This conclusion was drawn based on the observation that the assumptions applied in deriving domestic content and construction phase resource breakdowns of the two CME Refurb/New Build Scenarios are similar. Strapolec has therefore assumed a higher number of refurbishment construction phase jobs to bring average salaries in line with StatsCan references. This Strapolec adjustment is similar to that made during the wind development analysis.

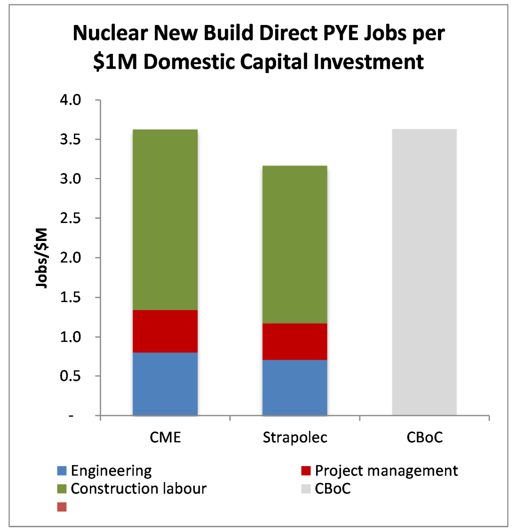
O&M jobs after refurbishment are assumed to remain unchanged. Strapolec has assumed 760 staff per unit. As new build operating costs are expected to be up to 30% lower, Strapolec has assumed that this will translate into 30% less jobs per unit for new build units for an operating assumption of 600 jobs per unit. This is 10% higher than the NEI estimate of 400 to 700 jobs per unit[36].

Modelling of Economic Impact Time Profile Assumptions

In order to model the economic impact of refurbishment and new build for the comparison approach used in this analysis requires a spending and jobs profile by year. It has been assumed that refurbishments will take three years and New Build five years of active construction. It is assumed that engineering and long lead materials items will be procured before construction activities start in both scenarios. The time-based profile for the construction phases has been developed based on proxies[37] and Strapolec's judgement.

Beyond these core assumptions, the spread of spend and jobs over time is provided as an illustration. The timing accuracy does not materially impact the comparisons being developed in this analysis.

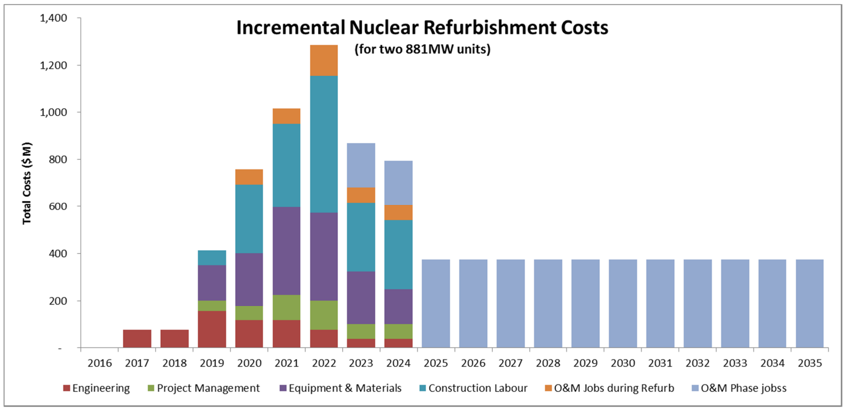
The time profiles are provided below for the Domestic Spend by spend category, which is also representative of the profiles used for income and jobs.

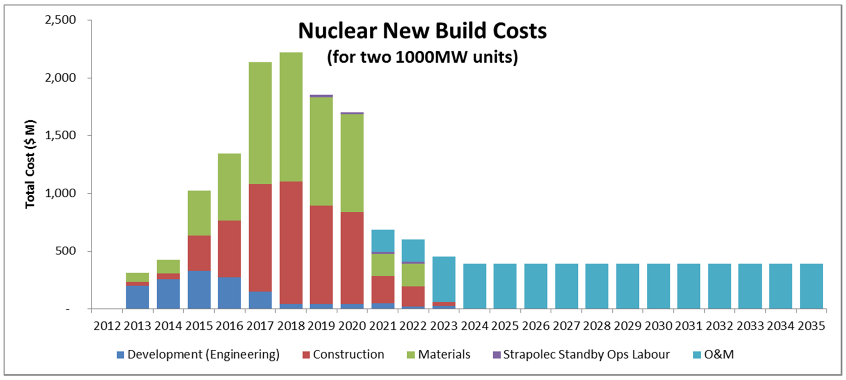


SOURCE: Multiple, Strapolec Analysis

Strapolec has applied the same domestic content assumption of 79% to domestic labour as has been applied to the total cost. As a result, the total jobs are approximately 10% less than both the CME estimates and Strapolec's understanding of jobs predicted by the Conference Board of Canada study of a few years ago.

[36] *Fact Sheet: Nuclear Power Plants Contribute to Economies. NEI (2012).*
[37] *Arnone, M. (2012). Darlington Refurbishment Project, CBoC 2008*

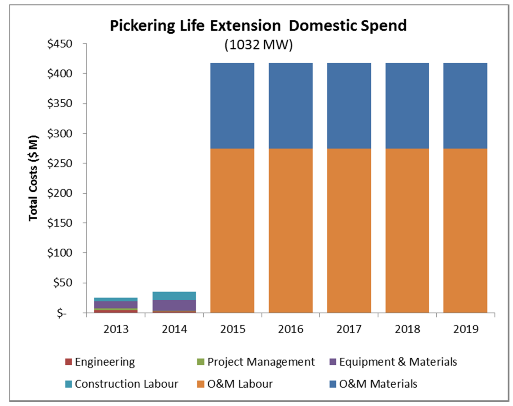




5.3 Other Considerations

As these analyses developed, it became apparent that there are other economic considerations that may be relevant to future decision-making. The primary area that potentially warrants investigation is the degree to which the government derives tax revenues from the investments and operating assets. This could arise in several areas.

- As incomes and jobs in the nuclear scenario are significantly higher than in the wind scenario, the government may derive material tax revenue differences between the scenarios
- As the operating costs, ownership, and financing models are potentially dramatically different, taxes derived from corporate profits may also vary significantly.

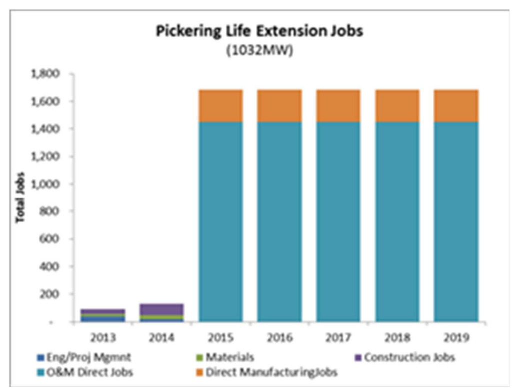


SOURCE: Multiple, Strapolec Analysis

Pickering Assumptions

The Nuclear Scenario incremental capacity model includes the life extension of 2 units of Pickering whose O&M costs and employment contribute to the benefits of the scenario.

The methodology applied to assess Pickering economic impacts is the same as that used for the Refurbishment economic impacts. Pickering specific variables have been applied for FTEs and operating costs and staffing based on EUCG benchmark data for Pickering that are contained in the referenced OEB submission.



6.0 Summary and Conclusion

While other reports and studies have looked at supply impacts on Ontario's economy, none have assessed the economic and greenhouse gas emission implications of the supply choices for Ontarians. This report focussed on contrasting near term supply decision options now being considered, with the forecasts extending to 2035. This time frame was chosen to reflect when the assessed wind assets will have reached the end of their economic life and hence captures the full economic benefit of the decisions regarding those assets. Associated future supply mix decisions to be made, potentially over 15 years from now, are outside the consideration of this report.

This paper includes an analysis of available public sources with a view to developing evidence-based assumptions for the scenarios. The energy cost forecasts have relied upon data from the Ontario Power Authority, Independent Electricity System Operator and the Ontario Energy Board, supplemented by additional publicly available third party materials. The associated data has been incorporated into Strapolec's detailed energy forecasting model.

The framework for the economic impact assessments has been developed from a report by ClearSky Advisors on the economic impact of wind investments and on two Canadian Manufacturers and Exporters reports on the economic impact of nuclear investments. Strapolec has undertaken a validation exercise of the assumptions in these reports including consideration of industry standard financial models and metrics to formulate a reasonable and consistent set of assumptions for the two scenarios.

Strapolec believes the findings are robust and accurate to within a small percentage of the implications brought forward and thus valid for the purpose of informing Ontarians and policy makers on the implications of potential future energy policy choices.

Study results indicate that, over the period to 2035, the retained nuclear scenario while reducing investments in wind generation would:

- Deliver $56 billion (B) in direct benefits to Ontario's economy through $27B in savings to ratepayers (Exhibit A) and $29B in direct Ontario investment (Exhibit B). When compared to the retained wind scenario, the net incremental benefit of choosing the retained nuclear scenario is $60B;
- Provide $9B more direct employment income benefits (a primary factor driving secondary economic impacts) and create over 100,000 more PYE jobs than the retained wind scenario; and,
- Reduce incremental GHG emissions after 2023 by 108 million tonnes (representing 80% less emissions) compared to the retained wind scenario. During the refurbishment period 2020-2022, emissions reductions for the retained nuclear scenario are 4% lower.

By contrast, reducing the nuclear footprint in favour of the retained wind scenario would result in increased costs for electricity ratepayers, lower investment in Ontario's economy and increased GHG emissions.

Acknowledgements

Overview of Strategic Policy Economics

Founded by Marc Brouillette in 2012, Strategic Policy Economics is focussed on addressing multi-stakeholder issues stemming from innovations in policy-driven regulated environments. Strapolec has clients in both the Energy and Gaming sectors. Strapolec specializes in framing strategic challenges for resolution, facilitating client teams in determining their alternatives, developing business cases and business models, and negotiating multi-stakeholder public/private agreements. Marc has been practicing strategy consulting for over 13 years and has 16 years of prior industry experience. Marc's consulting career has included CapGemini, Ernst & Young, leading his own practice, Strategic Gaming Innovations, and was most recently a Partner with SECOR Consulting, Canada's largest independent strategy boutique. At SECOR, he was the Ontario Sector lead for Energy and Gaming and led the development of SECOR's perspectives on Ontario's energy sector. Marc has helped inform federal and provincial government decision makers addressing strategic issues in gaming, science and energy policy. Marc has negotiated contract relationships with domestic and international stakeholders, working directly with federal and provincial ministries, crown corporations and regulators, as well as with the private sector, municipalities, and non-profit organizations.

The Strategic Policy Economics team deployed to develop this report included:

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- Amir Naseri, Research Assistant at the University of Toronto and PhD candidate. Amir has worked with Marc on several projects including the report on Ontario's Electricity Cost Forecast and a global survey of research laboratory governance and funding models used to support the federal government.
- Jason Ng, Research Assistant at the University of Toronto and PhD candidate. Jason has worked with Marc on several projects including the report on Ontario's Electricity Cost Forecast and the global survey of research laboratory governance and funding models.
- Fred Zhang, former colleague of Marc Brouillette at Marc's predecessor firm Strategic Gaming Innovations where Fred created the industry model in support of the $1B Charitable Gaming reform for the OLG. Fred also contributed to the report on Ontario's Electricity Cost Forecast.

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List of Abbreviations

APPrO – Association of Major Power Producers of Ontario

CBoC – Conference Board of Canada

CDM – Conservation and Demand Management

CHP – Combined Heat and Power

CME – Canadian Manufacturers & Exporters

EIA – U.S. Energy Information Administration

EUCG – Electric Utility Cost Group

FIT – Feed in Tariff

FTE – Full Time Equivalents

GA – Global Adjustment

GHG – Greenhouse Gas

HOEP – Hourly Ontario Energy Price (wholesale market)

IESO – Independent Electricity System Operator

LEI – London Economics International

LTEP – Long Term Energy Plan

MoE – Ontario Ministry of Energy

NB – New Brunswick

NEI – Nuclear Energy Institute

NREL - National Renewable Energy Laboratory (Project of US Department of Energy)

NUG – Non-Utility Generator

OEB – Ontario Energy Board

OPA – Ontario Power Authority

OPG – Ontario Power Generation Inc.

PYE – Person Year Equivalents

RoE – Return on Equity

RPP – Regulated Price Plan

StatsCan – Statistics Canada

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