SUPPLY

1.0 INTRODUCTION

Q. What is the purpose of this evidence?

A. This evidence describes the supply resources that are included in the IPSP and outlines how the supply-related requirements of the Supply Mix Directive (the "Directive"), are met.

2.0 DEFINITIONS

Q. What are Existing, Committed, Directed, and Other Potential Resources?

A. Existing Resources - means those resources that were in commercial operation as of the second quarter of 2011 ("Q2 2011"), or as of August 5, 2011 for FIT resources. The capacity values assumed in the IPSP are equal to the amounts of installed capacity registered with the IESO.

Committed Resources - means those resources that are not Existing Resources and were a) non-FIT resources under contract to the OPA as of Q2 2011, or b) FIT resources under contract as of August 5, 2011, or c) the subject of the Green Energy Investment Agreement ("GEIA") entered into between the Government of Ontario and the Korean Consortium. The capacity values assumed in the IPSP are equal to the OPA contract amounts.

Directed Resources - means those resources that the government has directed the OPA to plan for and/or procure and that are not Existing or Committed Resources. It includes both specific procurement directives issued to the OPA by the Minister of Energy (or formerly the Minister of Energy and Infrastructure) under section 25.32 of the *Electricity Act, 1998* and those resources for which the government has indicated that it

is committed to meet a specified amount[1]; because these amounts are specified, they can be modelled for planning purposes. Examples of Directed Resources are renewable generation (including hydroelectric on the one hand and wind, solar and bioenergy on the other) and refurbished and new nuclear generation.

Resources whose amount is subject to a decision-making process that is outside of the IPSP are excluded from this category. They are considered to be "Other Potential Resources".

The capacity values assumed in the IPSP are equal to the directed amounts where these are specified, and are otherwise equal to forecast amounts based on available information as of the end of Q2 2011, or as of August 5, 2011 for FIT resources

Other Potential Resources - means those resources that are not Existing, Committed or Directed. This category includes new resources whose amount is subject to a decision-making process that is outside of the IPSP. Other Potential Resources include:

- Additional conservation and demand response in excess of the target amount in the Directive;
- Additional coal-fired units that could be converted to gas-fired operation as the result of a government decision in 2012 (to about 2,700 MW);
- Expiring non-utility generation ("NUG") contracts (mostly natural gas-fired generation) that could be renegotiated in accordance with the November 23, 2010, directive (over 1,400 MW by 2023); and
- Firm (contract) imports that can be accommodated by the Existing transmission capability and the capability of Committed and Directed transmission projects (up to about 1,400 MW). Firm imports may be an alternative option if they meet system requirements at a lower cost than the other available options.

[1] Where the Supply Mix Directive specifies a total amount of a more general resource category (for example, non-hydroelectric renewables and conservation), the sub-components of that amount are treated as Directed Resources.

3.0 DEMAND RESPONSE

Q. How does the IPSP treat demand response?

A. Conservation is generally divided into five categories: demand response, energy efficiency, fuel switching, conservation behaviour and customer based generation. For planning purposes, the latter four categories of conservation are applied to the load forecast to produce a load forecast that is net of conservation. Demand response (with the exception of time-of-use rate impacts) is not netted from the load forecast. It can be dispatched to meet peak demand requirements. Because of this unique characteristic, it is treated in the IPSP as a dispatchable generator that is available to meet system peak demand requirements. Regardless of this distinction, demand response is a form of conservation that applies to meeting the Supply Mix Directive's conservation targets.

4.0 EXISTING RESOURCES

Q. What do Existing Resources consist of?

A. Existing Resources consist of all demand response and generation resources in commercial operation as of Q2 2011 or August 5, 2011 for FIT resources, and include:

- Existing demand response;
- Existing renewable generation (consisting of existing hydroelectric, wind, bioenergy and solar resources);
- Existing gas-fired generation;
- Existing nuclear generation; and
- Existing coal-fired generation.

Together these represent over 35,000 MW of installed capacity. A summary of these resources is shown in Table 1.

Table 1: Existing Generation Resources as of Q2 2011, or August 5, 2011 for FIT resources

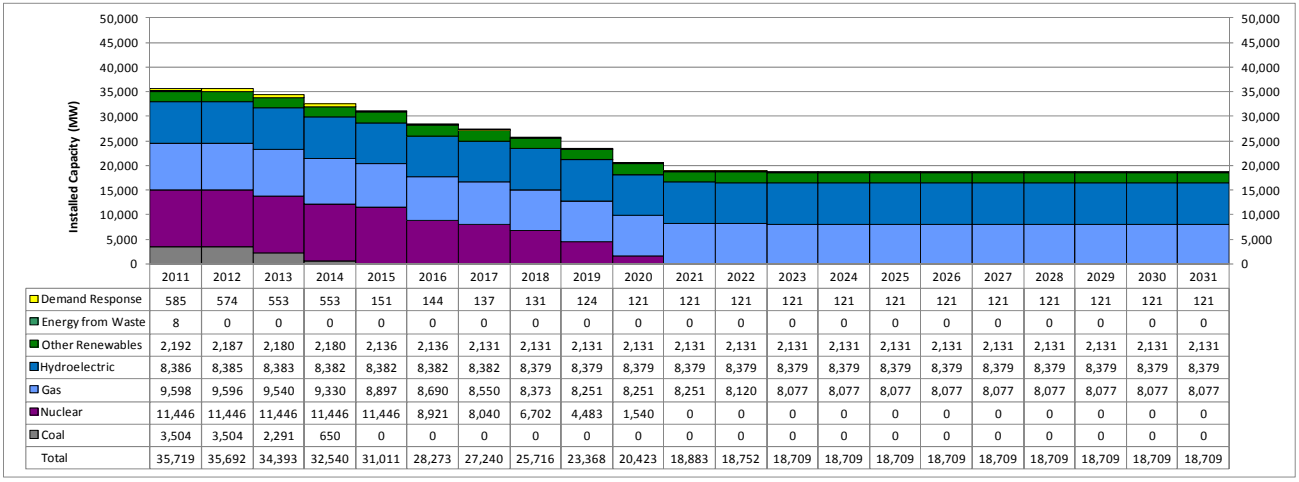
Resource	Commitment/Project	Installed MW
Demand Response	Demand Response I, II, III and Other Direct Load Control Programs	585
Energy from Waste	Non-Utility Generation	8
Wind	Renewable Energy Supply I, II, III	1,412
	Renewable Standard Offer Program	234
	Feed-In Tariff	1
	Other	11
Bioenergy	Non-Utility Generation	113
	Renewable Energy Supply I	9
	Renewable Standard Offer Program	39
	Feed-In Tariff	8
	Other	77
Solar	Renewable Standard Offer Program	213
	Feed-In Tariff and microFIT	75
Hydroelectric	Hydroelectric Contract Initiative	1,055
	Hydroelectric Supply Aggrement	577
	Non-Utility Generation	130
	Renewable Energy Supply I	32
	Renewable Energy Standard Offer Program	28
	Other	6,564
Gas/Oil	Advanced Clean Energy Supply	2,338
	Clean Energy Supply	1,948
	Combined Heat and Power I	481
	Early Movers Clean Energy Supply	1,110
	Lennox	2,100
	Non-Utility Generation	1,521
	Other	100
Nuclear	Bruce NGS	4,828
	Darlington NGS	3,524
	Pickering NGS	3,094
Coal	Various	3,504
Total		**35,719**

Source: OPA

Q. What are the amounts of the various Existing Resources over the planning period?

A. The installed capacity of Existing Resources declines from over 35,000 MW in 2011 to about 18,700 MW by 2031. An annual summary of these resources is shown in Figure 1.

Figure 1: Existing Generation Resources 2011-2031



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Demand Response	585	574	553	553	151	144	137	131	124	121	121	121	121	121	121	121	121	121	121	121	121
Energy from Waste	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Renewables	2,192	2,187	2,180	2,180	2,136	2,136	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131	2,131
Hydroelectric	8,386	8,385	8,383	8,382	8,382	8,382	8,382	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379	8,379
Gas	9,598	9,596	9,540	9,330	8,897	8,690	8,550	8,373	8,251	8,251	8,251	8,120	8,077	8,077	8,077	8,077	8,077	8,077	8,077	8,077	8,077
Nuclear	11,446	11,446	11,446	11,446	11,446	8,921	8,040	6,702	4,483	1,540	0	0	0	0	0	0	0	0	0	0	0
Coal	3,504	3,504	2,291	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	35,719	35,692	34,393	32,540	31,011	28,273	27,240	25,716	23,368	20,423	18,883	18,752	18,709	18,709	18,709	18,709	18,709	18,709	18,709	18,709	18,709

Source: OPA

5.0 COMMITTED RESOURCES

Q. What do Committed Resources consist of?

A. Committed Resources are resources that were under contract to the OPA as of Q2 2011, or August 5, 2011 for FIT resources, or are the subject of the GEIA. They consist of:

- Committed renewables other than hydroelectric;
- Committed hydroelectric renewables;
- Committed gas-fired generation; and
- Bruce NGS Units 1 and 2 restart projects.

Together these represent about 9,200 MW of contracted capacity by 2031. A summary of these resources is shown in Table 2.

Table 2: Committed Generation Resources as of Q2 2011, or August 5, 2011 for FIT resources

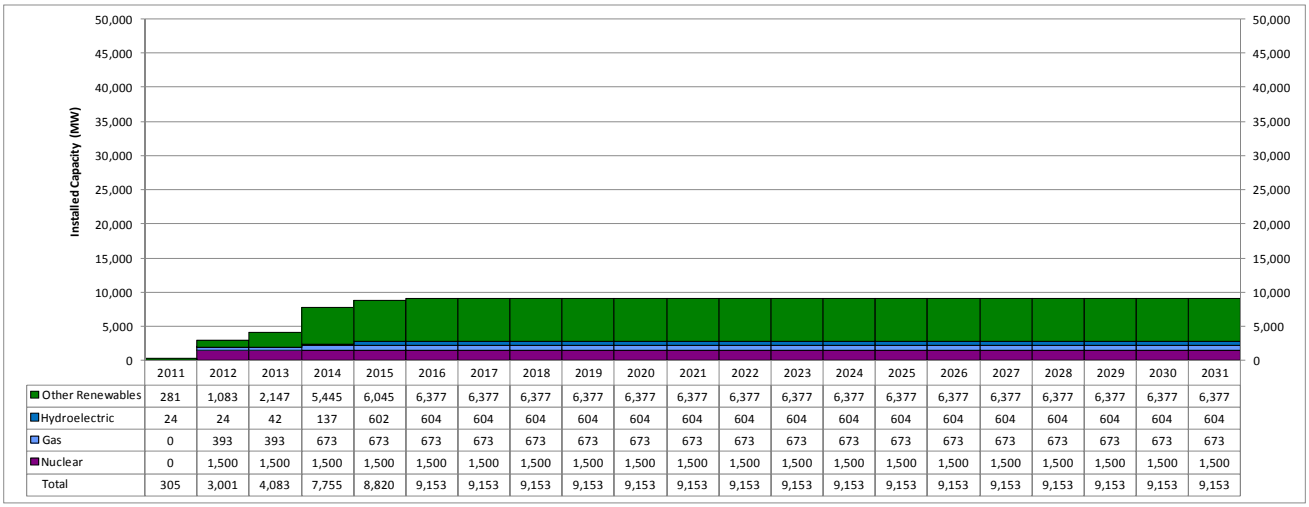
Resource	Commitment	Project	Contracted MW
Wind	Renewable Energy Supply III	Greenwich Wind Farm	99
	Renewable Standard Offer Program	Various	85
	Feed-In Tariff	Various	2,350
	Green Energy Investment Agreement	Various	2,000
Solar	Renewable Standard Offer Program	Various	278
	Feed-In Tariff	Various	953
	Green Energy Investment Agreement	Various	500
Bioenergy	Combined Heat and Power III	Becker Cogeneration	15
		St. Marys	30
	Renewable Standard Offer Program	Various	31
	Feed-In Tariff	Various	36
Hydroelectric	Hydroelectric Energy Supply Agreement	Lower Mattagami	438
	Renewable Energy Supply II	Island Falls	20
	Hydroelectric Contract Initiative	Various	4
	Feed-In Tariff	Various	141
Gas	Clean Enery Supply	Greenfield South	280
		York Energy Centre	393
Nuclear	Bruce Power Refurbishment Implementation Agreement	Bruce Unit 1 & 2	1,500
Total			**9,154**

Source: OPA

Q. What are the amounts of the various Committed Resources over the planning period?

A. The installed capacity of Committed Resources increases from about 300 MW in 2011 to about 9,200 MW by 2031. An annual summary of these resources is shown in Figure 2.

Figure 2: Committed Generation Resources 2011-2031



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Other Renewables	281	1,083	2,147	5,445	6,045	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377	6,377
Hydroelectric	24	24	42	137	602	604	604	604	604	604	604	604	604	604	604	604	604	604	604	604	604
Gas	0	393	393	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673
Nuclear	0	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Total	305	3,001	4,083	7,755	8,820	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153	9,153

Source: OPA

6.0 DIRECTED RESOURCES

Q. What do Directed Resources consist of?

A. Directed Resources are resources that the government has directed the OPA to plan for and/or procure and that are not in commercial operation or under contract as of Q2 2011. They consist of:

- The demand response component of the conservation target that is not an Existing Resource;
- Renewables other than hydroelectric resources including bioenergy resources procured under the Combined Heat and Power ("CHP") III program, the Atikokan Biomass Energy Supply Agreement and additional resources (solar, bioenergy and wind) required to meet the 10,700 MW non-hydroelectric renewables target in the Supply Mix Directive;
- Hydroelectric resources required to meet the 9,000 MW hydroelectric generation target in the Directive;
- Conversion of two units at Thunder Bay Generating Station ("GS") to run on natural gas, procurement of a natural gas-fired plant in the Kitchener-Waterloo-Cambridge area, and other CHP procurements to meet the Supply Mix and CHP Directives;

- Refurbishment of existing Bruce Units 3 to 8 and the Darlington station; and
- New nuclear generation.

Together these represent about 15,500 MW of directed or forecast capacity by 2031. A summary of these resources is shown in Table 3.

Table 3: Directed Generation Resources as of Q2 2011, or as of August 5, 2011 for FIT resources

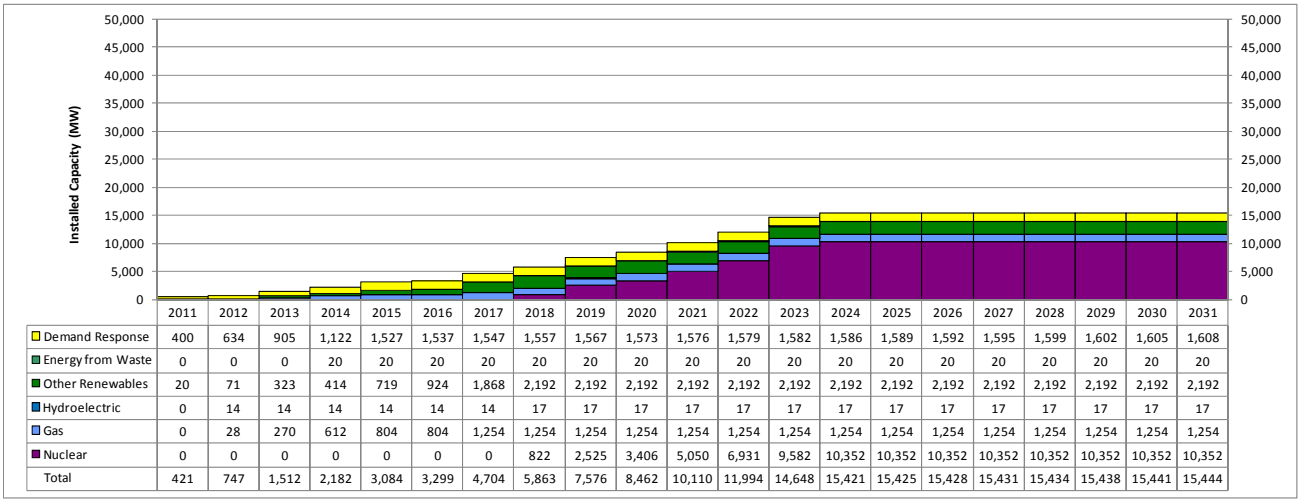
Resource	Commitment	Project	IPSP
Demand Response	Demand Response I, II, III and Other Direct Load Control Programs	Various	1,608
Energy from Waste	Other	Durham-York Energy Centre	20
Wind	FIT and microFIT Forecast	Various	843
Bioenergy	Atikokan Biomass Energy Supply Agreement	Atikokan	201
	Combined Heat and Power III	Thunder Bay Condensing Turbine	40
	FIT and microFIT Forecast	Various	8
Solar	FIT and microFIT Forecast	Various	1,100
Hydroelectric	Other	Various upgrades	17
Gas	Coal to Gas Conversion	Thunder Bay	304
	Future Combined Heat and Power Procurement	Various	500
	Peaking Generation	Kitchener-Waterloo-Cambridge	450
Nuclear	Refurbishment	Darlington NGS	3,524
		Bruce A NGS	1,540
		Bruce B NGS	3,288
	New Nuclear	Darlington NGS	2,000
Total			**15,443**

Source: OPA

Q. What are the amounts of the various Directed Resources over the planning period?

A. The installed capacity of Directed Resources increases from about 400 MW in 2011 to about 15,500 MW by 2031. An annual summary of these resources is shown in Figure 3.

Figure 3: Directed Generation Resources 2011-2031



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Demand Response	400	634	905	1,122	1,527	1,537	1,547	1,557	1,567	1,573	1,576	1,579	1,582	1,586	1,589	1,592	1,595	1,599	1,602	1,605	1,608
Energy from Waste	0	0	0	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Other Renewables	20	71	323	414	719	924	1,868	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192	2,192
Hydroelectric	0	14	14	14	14	14	14	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Gas	0	28	270	612	804	804	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254
Nuclear	0	0	0	0	0	0	0	822	2,525	3,406	5,050	6,931	9,582	10,352	10,352	10,352	10,352	10,352	10,352	10,352	10,352
Total	421	747	1,512	2,182	3,084	3,299	4,704	5,863	7,576	8,462	10,110	11,994	14,648	15,421	15,425	15,428	15,431	15,434	15,438	15,441	15,444

Source: OPA

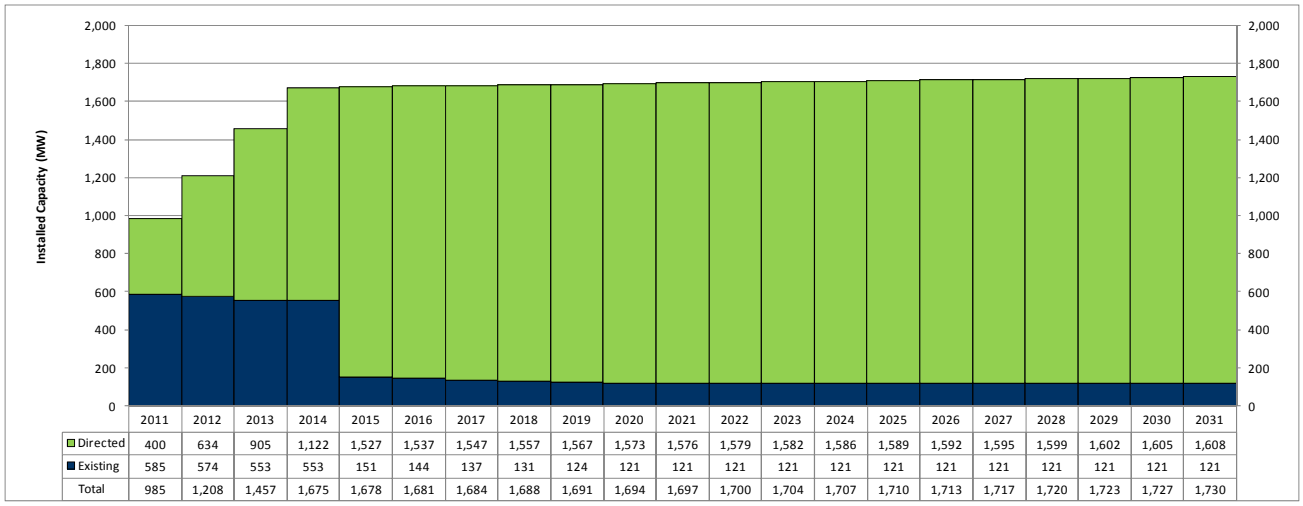
7.0 MEETING DIRECTIVE REQUIREMENTS

7.1 Demand Response

Q. What is the Directive requirement with respect to Demand Response and what amount is included in the IPSP?

A. The total conservation target in the Directive is for a peak demand reduction of 7,100 MW by the end of 2030. The Directive does not prescribe a load reduction target that is specific to demand response resources. The IPSP includes about 1,000 MW of load reduction through demand response in 2011, increasing to about 1,700 MW by 2031, as shown in Figure 4.

Figure 4: Demand Response Resources in the IPSP



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Directed	400	634	905	1,122	1,527	1,537	1,547	1,557	1,567	1,573	1,576	1,579	1,582	1,586	1,589	1,592	1,595	1,599	1,602	1,605	1,608
Existing	585	574	553	553	151	144	137	131	124	121	121	121	121	121	121	121	121	121	121	121	121
Total	985	1,208	1,457	1,675	1,678	1,681	1,684	1,688	1,691	1,694	1,697	1,700	1,704	1,707	1,710	1,713	1,717	1,720	1,723	1,727	1,730

Source: OPA

7.2 Nuclear Generation

Q. What is the Directive requirement with respect to nuclear generation?

A. The Supply Mix Directive states that :

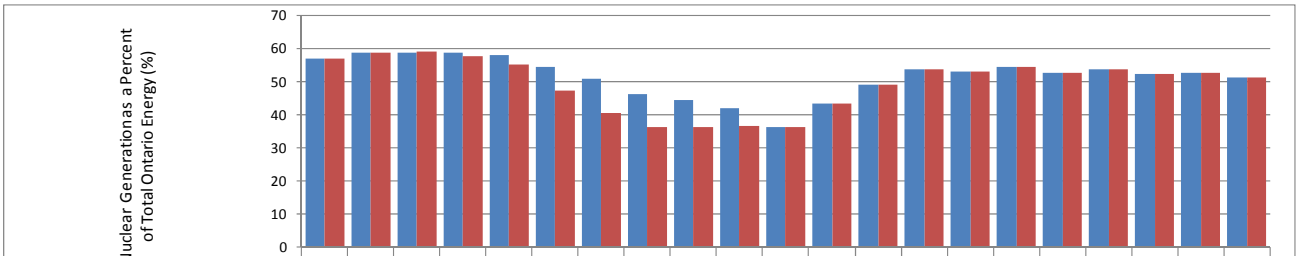
- The OPA shall continue to plan for nuclear generation to account for approximately 50% of total Ontario electricity generation;
- The IPSP shall provide for the refurbishment of 10,000 MW of existing nuclear capacity at the Bruce NGS and the Darlington NGS;
- The OPA shall continue to work with OPG, Bruce Power and the Ministry of Energy to ensure that the IPSP contains an updated coordinated refurbishment schedule; and
- The IPSP shall provide for the procurement of two nuclear generating units (approximately 2,000 MW) at the Darlington site.

Q. How does the IPSP meet the Directive requirement for nuclear generation to account for approximately 50% of total Ontario electricity generation?

A. Nuclear energy in the IPSP accounts for approximately 50% of total Ontario energy generation by 2031, as shown in Figure 5. The maximum value is about 60% in the

period when Pickering units are in service and is reduced to less than 50% in the mid-term while units at Bruce NGS and Darlington NGS are being refurbished.

Figure 5: Annual Nuclear Generation as a Percent of Total Ontario Energy Generation



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
With Pickering Continued Operation	56.9	58.7	58.5	58.6	57.7	54.4	50.8	46.1	44.3	41.9	36.1	43.4	49.1	53.6	52.9	54.3	52.5	53.8	52.1	52.5	51.1
Without Pickering Continued Operation	56.9	58.7	58.8	57.7	55.0	47.3	40.3	36.0	36.2	36.5	36.0	43.4	49.1	53.6	52.9	54.3	52.5	53.8	52.1	52.5	51.1

Source: OPA

Q. How does the IPSP provide for the refurbishment of 10,000 MW of existing nuclear capacity at the Bruce Nuclear GS and the Darlington GS?

A. The IPSP includes approximately 10,000 MW of refurbished nuclear capacity. This consists of eight units at Bruce NGS (totalling about 6,300 MW) and four units at Darlington NGS (totalling about 3,500 MW).

Q. How did the OPA work with OPG, Bruce Power and the Ministry of Energy to ensure that the IPSP contains an updated coordinated refurbishment schedule?

A. Since 2009, the OPA has been working with OPG, Bruce Power and the Ministry of Energy as part of the Nuclear Refurbishment Coordination Working Group ("NRCWG") in developing a coordinated nuclear refurbishment schedule. The objective of this group is to develop a schedule that maximizes the concurrent availability of the nuclear fleet during those periods of highest value to the system, based on refurbishment planning being performed at each of OPG and Bruce Power, and with consideration of each of their units' respective end of life. This is an ongoing process that facilitates plan implementation, monitoring, and adjustment as necessary to reflect changing

conditions. As part of the activities of this group, an updated coordinated refurbishment schedule was developed for the IPSP.

Q. What is the coordinated nuclear refurbishment schedule and how was it determined?

A. The coordinated nuclear refurbishment schedule is a schedule for the refurbishment of Bruce Units 3 to 8 and Darlington Units 1 to 42 that maximizes the concurrent availability of the nuclear fleet during those periods of highest value to the system. This is accomplished by minimizing the overlap of refurbishment outages and allocating the remaining operating hours to high-value periods.

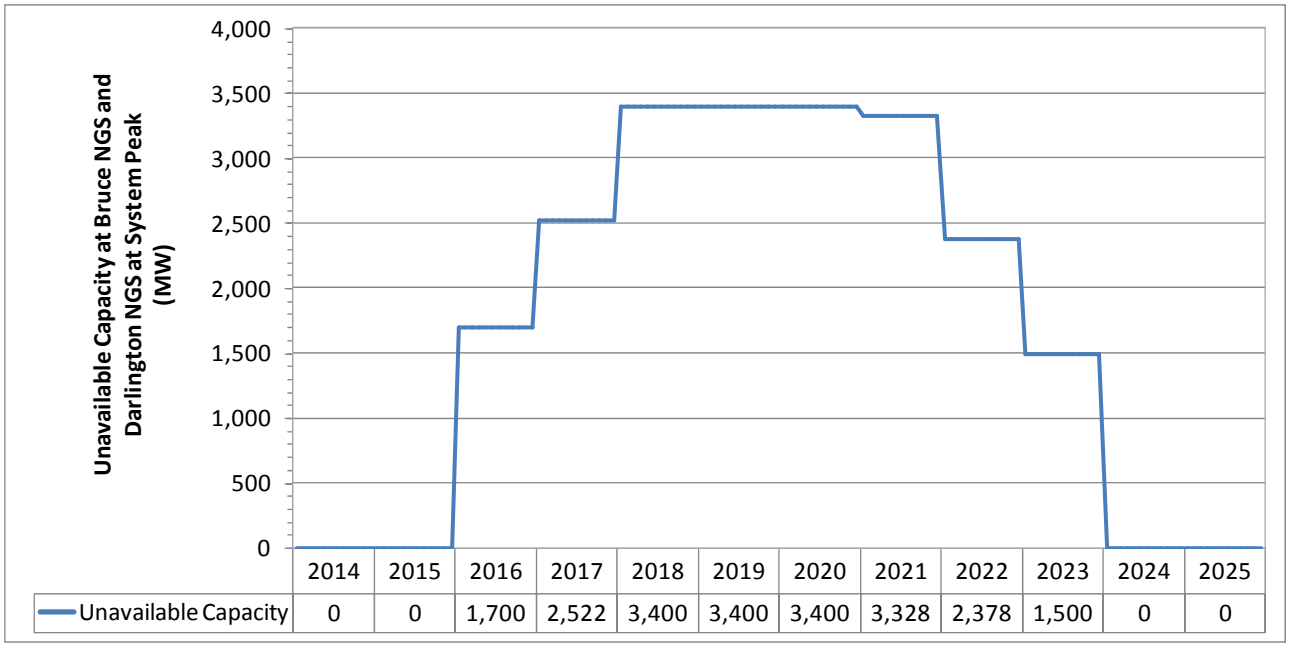
The NRCWG used two criteria in developing the refurbishment schedule: 1) there should be no more than two concurrent outages at each site, and 2) there should be no more than four concurrent outages at any point in time. These criteria reflect the limitations on the availability of resources and a skilled workforce that constrain the number of units that can be concurrently refurbished. To maximize the availability of nuclear units while minimizing idle time,3 it is necessary to begin refurbishing some units in advance of their end-of-service life. In this case, the refurbished units would be available earlier to meet resource requirements while other nuclear units are being refurbished.

The assumed duration of individual refurbishment outages ranges from 30 months to 36 months and results in the profile of unavailable nuclear capacity shown in Figure 6.

[2] The units at Bruce NGS and Darlington NGS came into service beginning in the late 1970s through the early 1990s and most are expected to reach their end-of-service life between 2016 and 2020. Currently, refurbishments are underway at Bruce A units 1 and 2, and their expected commercial operation date is 2012.

[3] Idle time occurs during periods when units are not operational because they have reached their end of-service life but cannot be refurbished because of workforce constraints.

Figure 6: Total Unavailable Nuclear Capacity at Bruce NGS and Darlington NGS in IPSP at System Peak



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Unavailable Capacity	0	0	1,700	2,522	3,400	3,400	3,400	3,328	2,378	1,500	0	0

Source: OPA

Q. How does the IPSP provide for the procurement of two nuclear generating units at the Darlington site?

A. The IPSP provides for the addition of two nuclear units totalling 2,000 MW, to be placed in service at the existing Darlington site in 2022 and 2023 respectively. OPG is currently in the process of completing the environmental assessment and obtaining a site preparation license at Darlington.

The 2022 in-service date for the first unit is considered to be the earliest feasible in-service date based on a 10-year lead time requirement for new nuclear generation. New nuclear generation contributes to meeting the Capacity Gap created by nuclear refurbishments during the period 2022 to 2023 and addresses the Capacity Gap that would otherwise exist during the period from 2024 to 2027 under the medium-load growth scenario. The Capacity Gap is discussed more fully in Exhibit F-1-1.

The actual in-service date will be determined by the government based on its procurement activities. Given the long-term nature of energy infrastructure investments, delaying the in-service date for these facilities will not have a material impact on the choice respecting alternative facilities which generally have shorter lead time requirements. Accordingly, the 2022 in-service date is relied on for planning purposes only.

7.3 Coal-Fired Generation

Q. What are the Directive requirements with respect to coal-fired generation?

A. The Supply Mix Directive notes that since 2003, Ontario has shut down eight coal-fired generating units. These include the Lakeview GS and two units each at OPG's Nanticoke and Lambton GS. It also notes that the shutdown of two additional units at Nanticoke GS will take place before the end of 2011, and reaffirms that the government's commitment to replace all coal-fired generation by the end of 2014 will be met.

The Supply Mix Directive requires the OPA to:

- Negotiate with OPG for a contract for biomass-fuelled generation from the 201 MW Atikokan GS in northwestern Ontario (this is addressed in a procurement directive);
- Work with the IESO and OPG to determine opportunities for advancing the closure of additional units;
- Plan for two units at OPG's Thunder Bay GS to be converted to run on natural gas over the period leading up to 2014; and
- Assess the conversion of some or all of the remaining units at Lambton and Nanticoke GS to natural gas under a range of different scenarios for nuclear generation and system peaking requirements.

The Thunder Bay Generating Station Conversion Directive (August 17, 2011) requires the OPA to:

- Negotiate and execute an Agreement with OPG by December 31, 2011 whose financial terms are “commercially reasonable for a facility being converted from coal

to natural gas of the size and location of the Thunder Bay Generating Station".

Q. How does the IPSP provide for the conversion of Atikokan GS to biomass?

A. The IPSP assumes that Atikokan will be converted to biomass operation in 2013 as specified in the Supply Mix Directive with a capacity of approximately 200 MW and an annual production of approximately 140 GWh.

Q. How has the OPA worked with the IESO and OPG to determine opportunities for advancing the closure of additional units and converting some of the Lambton and Nanticoke coal units to natural gas to meet peaking requirements?

A. The OPA has coordinated studies by the IESO and OPG to determine opportunities for advancing the closure of additional units and the optimal timing of converting some of the remaining units to natural gas, if a government decision is made to do so.

At the OPA's request, the IESO (with input from OPG) conducted a study to determine the earliest feasible dates for the closure of Lambton and Nanticoke as coal-fired units, based on reliability considerations. The study also examined feasible schedules for the conversion of Lambton GS and Nanticoke GS to natural gas considering plant-specific lead-time requirements provided by OPG and system operation impacts identified by the IESO. The IESO study was based on operational planning considerations to ensure adequacy of supply under a range of different scenarios for nuclear generation and system peaking requirements, and recognizing the potential unavailability of other generating units due to ongoing planned maintenance and unforeseen events. Additional details can be found at Exhibit D-1-4.

The IESO report concludes that for system reliability the earliest coal closure dates are as follows:

Earliest Coal Closure Dates

Lambton: Unit 3 - Q3 2013; Unit 4 - Q4 2013

Nanticoke: Unit 5 - Q2 2014; Unit 6 - Q3 2014; Unit 7- Q4 2014; Unit 8 - end of Q4 2014

The IESO report also concludes that the optimal completion dates for gas conversion based on system reliability and plant-specific considerations are as follows:

Gas Conversion Completion Dates

Lambton: Unit 3 – Q3 2015; Unit 4 – Q1 2016

Nanticoke: Unit 5 – Q1 2015; Unit 6 – Q1 2015; Unit 7 – Q2 2015; Unit 8 – Q3 2015

Q. What system reliability and plant-specific factors influence the timing of gas conversions?

A. As indicated, the government will determine whether to convert some or all of the remaining coal facilities to gas-fired operation in 2012. This timeframe will allow government to consider whether and to what extent these facilities should contribute to meeting the Capacity Gap described in Exhibit F-1-1.

The timing required to achieve the conversion schedule above as identified in the IESO study requires that a decision on Nanticoke and Lambton conversion be made by the first quarter of 2012. However, due to the long lead-times associated with a natural gas supply to Nanticoke, technical and environmental studies for a pipeline have already commenced.

Should the government determine that the coal facilities should be converted to natural gas, input from OPG and the IESO indicates that:

- conversion outages require careful coordination in order to ensure that system reliability can be maintained;
- shutting down coal units and delaying their conversion to natural gas could result in:
    - Risk and cost of equipment degradation due to layup and disuse;
    - Cost and schedule challenges from de-staffing and re-staffing hundreds of employees; and

- Environmental assessment requirements and associated costs if units are shut down without immediate conversion to a new fuel.

Q. How does the IPSP reflect the requirement for two units at Thunder Bay Generating Station to be converted to run on natural gas over the period leading up to 2014?

A. The IPSP is based on Thunder Bay Unit 3 being available for operation on natural gas approximately three years after receiving a conversion directive. A directive for the conversion of Thunder Bay GS units to gas-fired operation was received on August 17, 2011. Accordingly, preliminary information provided by OPG indicates that the Unit 3 conversion outage would start at the beginning of Q2, 2014 and would be complete by the end of Q3, 2014. The Unit 2 conversion outage would start at the beginning of Q1, 2015 and would be complete by the end of Q2, 2015. These dates are conditional on timely project contracts and approvals being obtained. They are consistent with IESO requirements to maintain reliability of supply to the northwest system following the closure of Thunder Bay GS and Atikokan GS as coal-fired generation stations by 2014 (see Exhibit D-1-3).

7.4 Hydroelectric Resources

Q. What is the Directive requirement with respect to hydroelectric resources?

A. The Supply Mix Directive notes that new hydroelectric developments are underway by OPG including the Niagara Tunnel and the 440 MW Lower Mattagami redevelopment, as well as additional private sector developments. It directs the OPA to:

- Plan for installed hydroelectric capacity to reach 9,000 MW by 2018;
- Continue to explore cost-effective opportunities for further hydroelectric development and maximize existing hydroelectric resources; and plan to provide for hydroelectric generation to account for approximately 20 to 25% of total Ontario electricity generation.

Q. How does the IPSP address the requirement for installed hydroelectric capacity to reach 9,000 MW by 2018?

A. The IPSP includes approximately 9,000 MW of hydroelectric capacity, consisting almost entirely of Existing Resources. The 123 MW Pump Generating Station ("PGS") at Sir Adam Beck is included to meet the hydroelectric target. These are summarized in Table 4.

Table 4: Summary of Hydroelectric Resources to Meet Target of 9,000 MW by 2018

Resource	Status	Commitment	Project	MW
Hydroelectric	Existing	--	Various	8,379
	Committed	Renewable Energy Supply II	Island Falls	20
		Hydroelectric Energy Supply Agreement	Lower Mattagami	438
		Feed-In Tariff	Various	141
		Hydroelectric Contract Initiative	Various	4
	Directed	Other	Various Upgrades	17
Total				**9,000**

Source: OPA

The FIT Program projects included in Table 4 are those that can be connected to Existing transmission and Committed transmission projects. The IPSP assumes that over 8,800 MW of non-FIT Existing and Committed hydroelectric resources would remain in service or proceed to commercial operation by 2018. It is assumed that contracted and future FIT projects will contribute to meeting the 9,000 MW hydroelectric generation target, after taking attrition into consideration.

Q. What cost-effective opportunities exist for further hydroelectric development and maximizing existing hydroelectric resources?

A. In addition to the 9,000 MW target, potential cost-effective opportunities for hydroelectric development may arise from a number of sources including:

- Projects that are currently under consideration including Little Jackfish (73 MW) and New Post Creek (25 MW). These projects involve an equity partnership between OPG and First Nations.

- FIT Program projects under 50 MW that are not included in Table 4 and are not counted towards meeting the 9,000 MW target.
- Additional potential projects include:
    - the redevelopment or upgrade of existing facilities;
    - greenfield projects in the pre-development stage;
    - active First Nation-led projects in proximity to the Ring of Fire;
    - new projects enabled by the connection of remote communities; and
    - sites that may become available as a result of the deregulation of certain parks and protected areas.

An advisory group to the OPA consisting of First Nations and Métis community representatives and stakeholders will be established to facilitate the development of non-FIT hydroelectric projects. This advisory group will identify and explore the cost-effectiveness of projects to maximize the capability of existing hydroelectric facilities and the cost-effectiveness of potential new hydroelectric projects - such as Little Jackfish, New Post Creek, and other hydroelectric projects that are currently in the development stage.

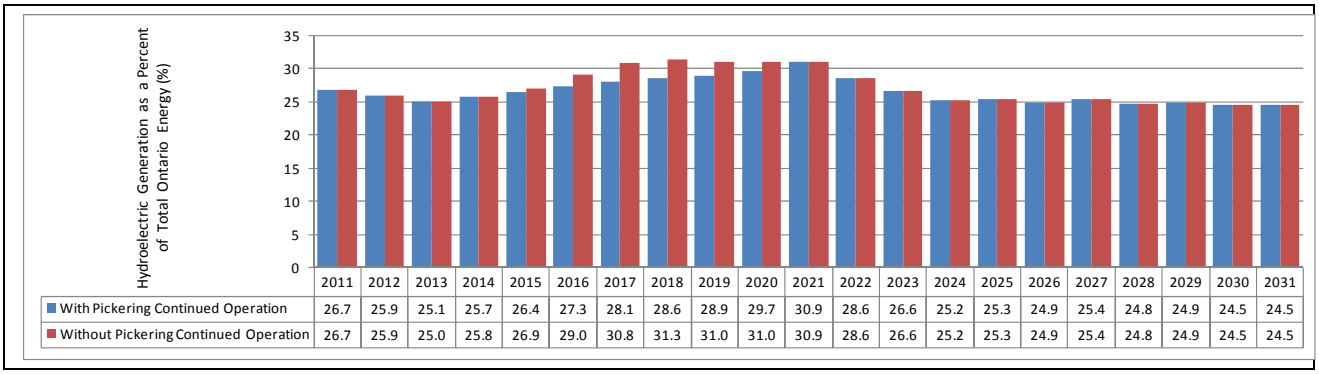
Initially, terms of reference will be established which will include developing guidelines for evaluating project cost-effectiveness and developing a process by which potentially cost-effective hydroelectric resources will be identified and assessed by the OPA. Cost-effectiveness will be determined on the basis of all-in life-cycle costs, including transmission investments required to enable incorporation of future projects.

The work of this advisory group will be informed by, and will be consistent with, any revisions to the FIT program that result from the two-year review cycle. The results of this work will inform future IPSPs and advice to government.

Q. Does the IPSP provide for hydroelectric generation to account for approximately 20 to 25% of total Ontario electricity generation?

A. By 2018, total Ontario energy generation from hydroelectric resources during the period of nuclear refurbishment outages represents 28 to 31% of total generation as shown in Figure 7. By 2028, hydroelectric resources represent 25% of total generation.

Figure 7: Annual Hydroelectric Generation as a Percent of Total Ontario Generation



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
With Pickering Continued Operation	26.7	25.9	25.1	25.7	26.4	27.3	28.1	28.6	28.9	29.7	30.9	28.6	26.6	25.2	25.3	24.9	25.4	24.8	24.9	24.5	24.5
Without Pickering Continued Operation	26.7	25.9	25.0	25.8	26.9	29.0	30.8	31.3	31.0	31.0	30.9	28.6	26.6	25.2	25.3	24.9	25.4	24.8	24.9	24.5	24.5

Source: OPA

7.5 Non-Hydroelectric Renewable Resources

Q. What are non-hydroelectric renewable resources?

A. Non-hydroelectric renewable resources are those facilities that generate electricity from natural resources other than water. These resources include wind, solar and bio-energy.

Q. What is the Directive requirement for non-hydroelectric renewable resources?

A. The Supply Mix Directive provides that:

- The OPA shall plan for 10,700 MW of non-hydroelectric renewable capacity by 2018; and
- The Plan shall provide for non-hydroelectric renewable energy to account for approximately 10 to 15% of total Ontario electricity generation by 2018.

The government will look for opportunities to incorporate additional capacity from renewable energy facilities into the Plan, taking into consideration cost-effectiveness for Ontario electricity consumers, planned transmission additions, and electricity demand growth.

Q. How does the IPSP meet the Directive requirement to plan for 10,700 MW of non-hydroelectric renewable capacity by 2018?

A. The IPSP includes approximately 10,700 MW of non-hydroelectric renewables by 2018. This consists of Existing, Committed and Directed solar, wind and bio-energy resources as shown in Table 5.

Table 5: Summary of Non-Hydroelectric Resources to Meet Target of 10,700 MW by 2018

Resource Type	Status	Commitment	Project	IPSP MW
Wind	Existing	Existing	Various	1,658
	Committed	Renewable Energy Supply III	Greenwich Windfarm	99
		Renewable Energy Standard Offer Program	Various	85
		Feed-In Tariff	Various	2,350
		Green Energy Investment Agreement	Various	2,000
	Directed	FIT and microFIT Forecast	Various	843
	Total			**7,035**
Solar	Existing	Existing	Various	288
	Committed	Renewable Energy Standard Offer Program	Various	278
		Feed-In Tariff	Various	953
		Green Energy Investment Agreement	Various	500
	Directed	FIT and microFIT Forecast	Various	1,100
	Total			**3,119**
Bioenergy	Existing	Existing	Various	185
	Committed	Combined Heat and Power III	Becker	15
			St. Mary's	30
		Renewable Energy Standard Offer Program	Various	31
		Feed-In Tariff	Various	36
	Directed	Combined Heat and Power III	Thunder Bay Condensing Turbine	40
		Atikokan Biomass Energy Supply Agreement	Atikokan	201
		FIT and microFIT Forecast	Various	8
	Total			**546**
Total				**10,700**

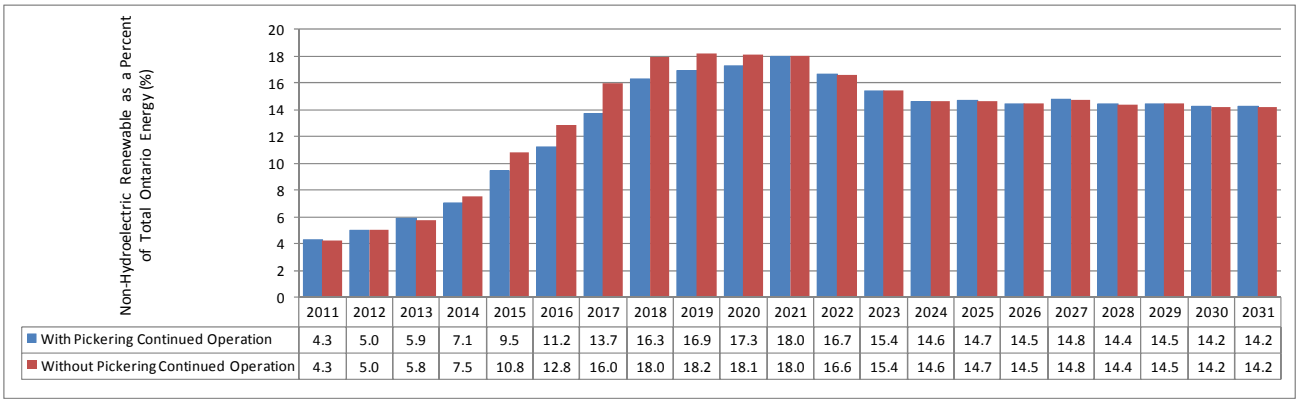
Source: OPA

The FIT projects shown in Table 5 are those that can be connected to Existing transmission and Committed and Directed transmission projects. The IPSP assumes that over 5,300 MW of non-FIT Existing, Committed, and Directed non-hydroelectric renewable resources will remain in service or proceed to commercial operation by 2018. The remainder of the 10,700 MW target is assumed to be met through a combination of contracted and future FIT generation, taking into account the potential for project attrition and the transmission capability afforded by the new Bruce to Milton transmission line and the Directed transmission projects. For IPSP planning purposes, the 10,700 MW target amount of non-hydroelectric renewables is assumed to be maintained for the remainder of the IPSP period. This is not meant to preclude the identification and development of future additional cost-effective non-hydroelectric projects.

Q. Does the IPSP provide for non-hydroelectric renewable energy to account for approximately 10 to 15% of total Ontario electricity generation by 2018?

A. During the period of nuclear refurbishment outages, total Ontario energy generation from non-hydroelectric renewable resources is expected to represent about 16% to18% of total generation as shown in Figure 8. As the nuclear units are refurbished and nuclear production is restored to the levels before refurbishment, the proportion of non-hydroelectric renewable generation settles at about 14% in 2024 and remains at that level for the remainder of the IPSP period.

Figure 8: Annual Non-Hydroelectric Renewable Generation as a Percent of Total Ontario Electricity Generation



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
With Pickering Continued Operation	4.3	5.0	5.9	7.1	9.5	11.2	13.7	16.3	16.9	17.3	18.0	16.7	15.4	14.6	14.7	14.5	14.8	14.4	14.5	14.2	14.2
Without Pickering Continued Operation	4.3	5.0	5.8	7.5	10.8	12.8	16.0	18.0	18.2	18.1	18.0	16.6	15.4	14.6	14.7	14.5	14.8	14.4	14.5	14.2	14.2

Source: OPA

Q. What opportunities exist to incorporate additional cost-effective non-hydroelectric renewables into the IPSP?

A. In addition to the 10,700 MW of non-hydroelectric renewables included in the IPSP by 2018, there may be potential opportunities to incorporate additional cost-effective non-hydroelectric renewables. These may include:

- FIT Program projects awaiting assessment; and/or
- Cost-effective renewable potential in resource rich regions of the province.

Following the Bruce to Milton allocation, over 7,000 MW of non-hydroelectric capacity allocation required ("CAR") FIT Program applications were awaiting Economic Connection Test assessment. It is anticipated that approximately 950 MW of non-hydroelectric CAR projects beyond current commitments could be accommodated on Existing, Committed and Directed transmission facilities and have been included in the IPSP to meet the 2018 target.

In the longer term, there is significant resource potential throughout the province for additional wind, bioenergy, and solar generation to be considered as options in meeting planning requirements. Previous studies have identified significant on-shore and off-

shore wind potential.[4,5] An assessment of small-scale distributed biomass electricity generation potential in Ontario has identified at least 1,000 MW of biomass power generation potential (see Exhibit D-1-2). Ontario's wide geography and relatively strong solar irradiance also provide for significant solar potential.

7.6 Gas-Fired Resources

Q. What is the Supply Mix Directive requirement with respect to gas-fired generation?

A. The Supply Mix Directive provides that the OPA shall continue to plan on natural gas to:

- Play a strategic role in Ontario's supply mix by complementing intermittent supply, meeting local and system requirements, and ensuring that adequate capacity is available as nuclear plants are modernized; and
- As indicated in the 2007 IPSP, meet adequate regional electricity supply in the Kitchener-Waterloo-Cambridge area.

Q. How does the IPSP meet the Directive requirements for gas to play a strategic role in Ontario's supply mix by complementing intermittent supply, meeting local and system requirements, and ensuring that adequate capacity is available as nuclear plants are modernized?

A. The IPSP includes the Greenfield South (280 MW CCGT)6, York Energy Centre (393 MW SCGT) and Kitchener-Waterloo-Cambridge (450 MW SCGT) projects. These projects meet system needs for flexible peaking capacity to meet reliability requirements as coal-fired generation is shutdown and nuclear plants are refurbished. They are also required to complement increasing amounts of intermittent wind and solar generation that are being added to the system. They are strategically sited in high-value locations that defer or replace the need for local area transmission enhancements.

---

[4] Analysis of Future Wind Farm Development in Ontario. Helimax Energy Inc. March 2006. http://www.powerauthority.on.ca/sites/default/files/page/4535_D-5-1_Att_1.pdf

[5] Analysis of Future Offshore Wind Farm Development in Ontario. Helimax Energy Inc. April 2008. http://www.powerauthority.on.ca/sites/default/files/page/6446_D-5-2_Att_1_Helimax_Analysis_FINAL.pdf

[6] The government announced in September 2011 that the Greenfield South plant, owned by Eastern Power Ltd., would be relocated.

7.7 Procurement Directives

Q. What other directive requirements relate to gas-fired generation?

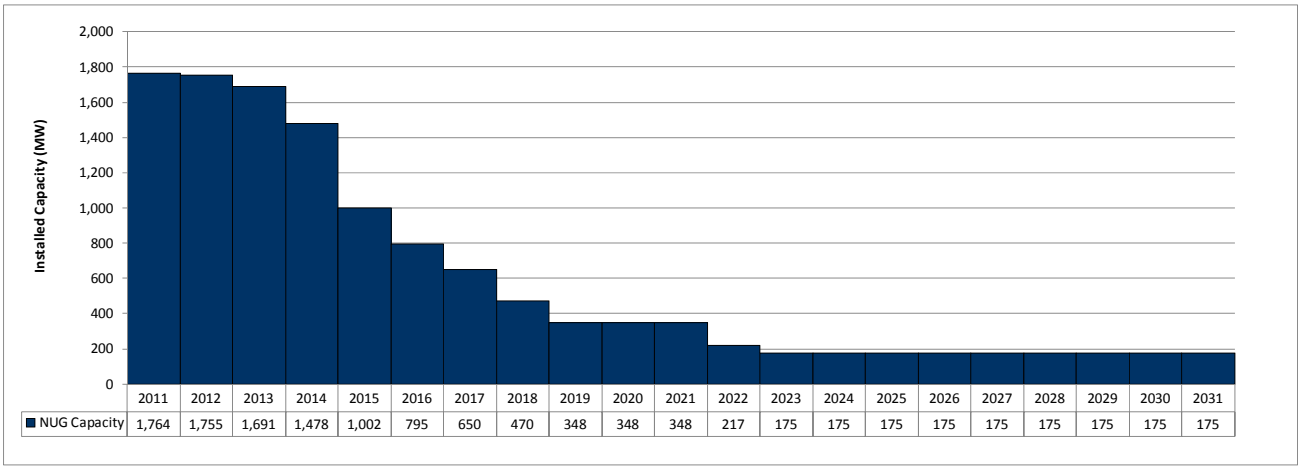
A. Two directives issued on November 23, 2010 relate to gas-fired generation:

- The NUG directive directs the OPA to negotiate for new contracts with the owners or operators of the NUGs where these would have cost and reliability benefits to Ontario electricity customers (these facilities mostly consist of natural-gas fired generation); and
- The CHP directive directs the OPA to procure up to a total of 1,000 MW of CHP projects. This would be inclusive of CHP projects procured to date, individually negotiated CHP contracts with projects over 20 MW and CHP projects 20 MW or less procured through a standard offer program.

Q. How does the IPSP reflect the NUG Procurement Directives?

A. The need for natural gas-fired NUG facilities will be determined in the context of the consideration of Other Potential Resources that are available to meet the mid-term Capacity Gap. As such, no NUG capacity is incorporated as Directed Resource capacity at this time. This is addressed in the context of the Capacity Gap described at Exhibit F-1-1. The amount of NUG capacity included in the IPSP is shown in Figure 9. The capacity of hydroelectric and biomass non-utility generators whose contract term expires after 2018 was assumed to be replaced so that the level of renewable resources achieved to meet the 2018 targets is maintained over the period of the IPSP.

Figure 9: NUG Capacity Included in the IPSP (MW)



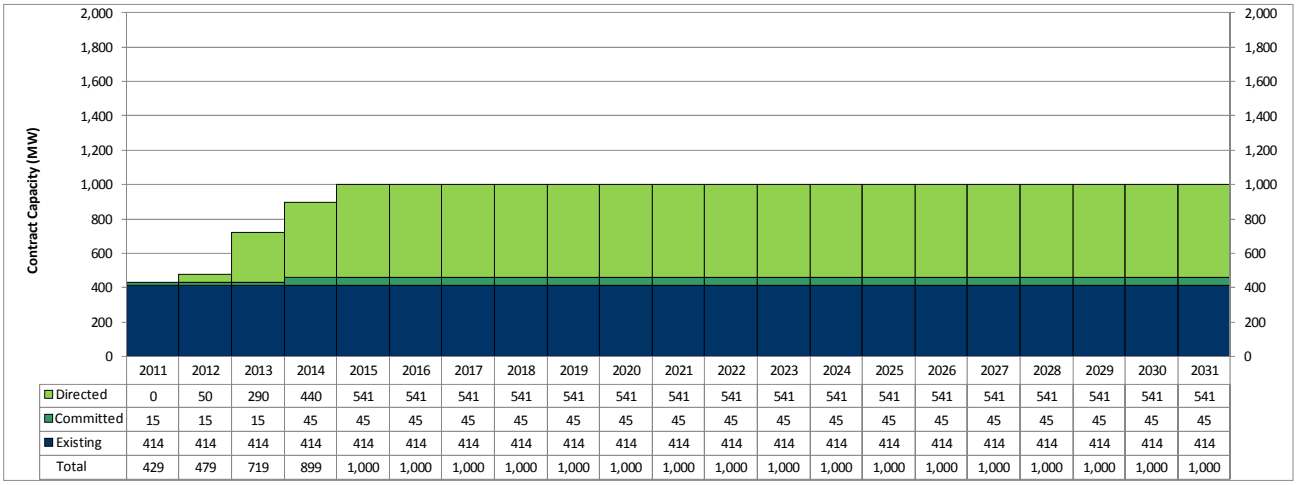
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
NUG Capacity	1,764	1,755	1,691	1,478	1,002	795	650	470	348	348	348	217	175	175	175	175	175	175	175	175	175

Source: OPA

Q. How does the IPSP reflect the CHP Procurement Directive?

A. As described above, the CHP Directive requires procurement of 1,000 MW of CHP resources. To date, the OPA has procured a contract amount of about 500 MW of CHP; there is therefore a requirement to procure approximately 500 MW of additional natural gas-fired CHP facilities to satisfy this directive. The Existing, Committed, and Directed CHP contract capacity is shown in Figure 10.

Figure 10: CHP Contract Capacity (MW)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Directed	0	50	290	440	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541
Committed	15	15	15	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Existing	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414
Total	429	479	719	899	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Source: OPA

Q. What other procurement directives relate to hydroelectric generation?

A. The Hydroelectric Contracting Initiative Directive ("HCI Directive") issued May 7, 2009 directs the OPA to enter into new contracts for hydroelectric facilities that are connected to the IESO-controlled grid but not currently owned by OPG. The hydroelectric facilities must not have been previously considered under any renewables RFP. Facilities with or without a current contract with a provincial government body or agency, for any part of the generation output, may participate. A new contract for a currently contracted facility will not start until after the existing contract expires.

Q. How does the IPSP reflect the HCI Directive?

A. The IPSP includes 1,055 MW of Existing hydroelectric generation procured under the HCI Directive.

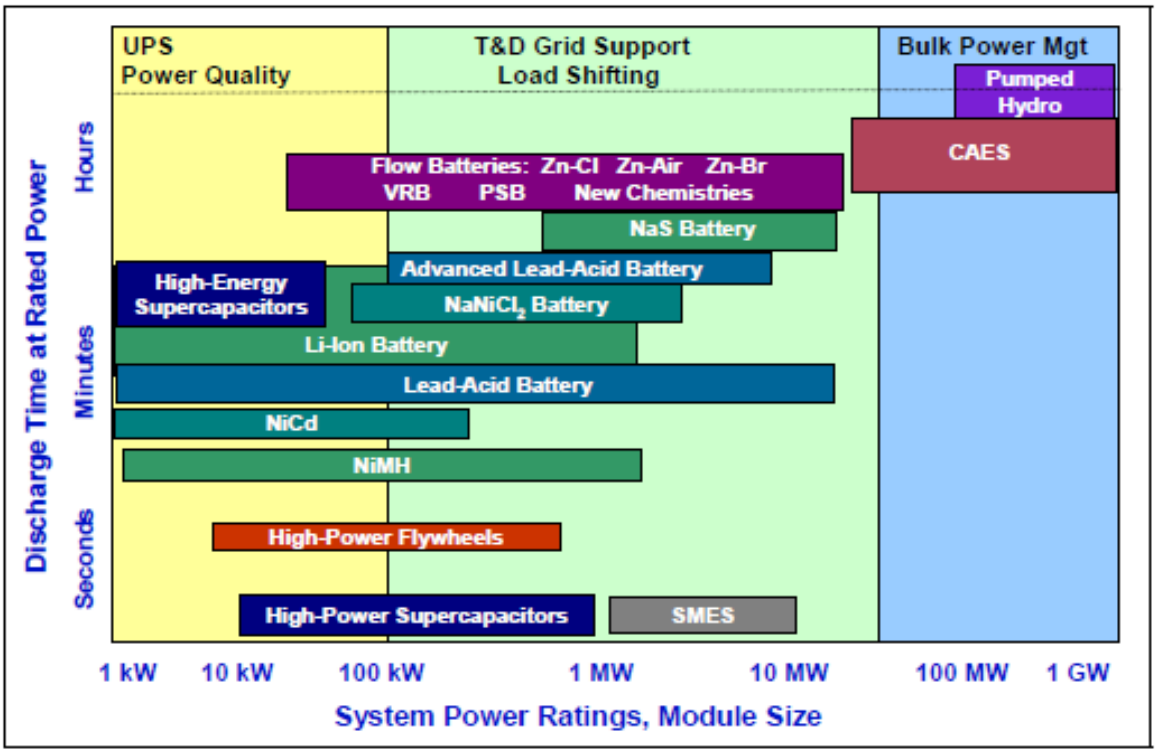
7.8 Electricity Storage

Q. How does the IPSP consider electricity storage?

A. The IPSP assumes that the pumped storage facility at Sir Adam Beck PGS rated at 123 MW of generating potential will continue to operate throughout the Plan period.

Pumped storage can provide several benefits to the electricity system; it can shift lower cost electricity to higher value periods (a specific example is the mitigation of periods of potential surplus energy), it can provide peaking capacity, and it can provide ancillary services including frequency regulation and ramping. Exhibit D-1-5 outlines various storage technologies that can be used in electricity systems and their potential applications. They are summarized in Figure 11 below.

Figure 11: Overview of Storage Technologies



Energy Storage Acronyms and Abbreviations					
CAES	Compressed Air Energy Storage	NiCd	Nickel-Cadmium	VRB	Vanadium Redox
Li-ion	Lithium Ion	NiMH	Nickel-metal hydride	Zn-Air	Zinc-Air
$NaNiCl_2$	Sodium Nickel Chloride	PSB	Polysulfide Bromide	Zn-Br	Zinc-Bromide
NaS	Sodium Sulfur	SMES	Superconducting Magnetic Energy Storage	Zn-Cl	Zinc-Chloride

Source: EPRI

At this point, the economics do not support the addition of electricity storage at the bulk system level. Many storage technologies are still in the development lifecycle phase. As the benefits of electricity storage evolve it is anticipated that individual customers, load aggregators, and possibly local distribution companies will find opportunities for development of electricity storage systems at the local level. The OPA continues to recommend a strategy for storage that maximizes value from existing storage facilities and to build on our understanding of its benefits as well as its role in meeting system needs before any new major capital investments are made. The strategy is based on managing risk for the ratepayer. It recognizes that storage tends to require high up-

front capital investments and long lead times to build as well as to yield a net positive contribution to customer rates.

Given that Existing, Committed, Directed and Other Potential Resources are sufficient to meet the identified needs, the IPSP does not include any additional electricity storage facilities.

8.0 SCHEDULES

The following exhibits are associated with this Supply evidence:

- Exhibit D-1-2: Assessment of Small-Scale Distributed Biomass Electricity Generation Potential in Ontario;
- Exhibit D-1-3: Northwest Coal Conversion Reliability Assessment;
- Exhibit D-1-4: Southwestern Ontario Coal: Advance Shutdown/Conversion Assessment; and
- Exhibit D-1-5: Electricity Storage.