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Energy Planning: The Case for a Less Prescriptive Approach

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Energy Planning: The Case for a Less Prescriptive Approach

On July 11, the Government of Ontario (Government) released a discussion paper[1] and related data[2] on a new long term energy plan (LTEP). This launched the third round of provincial electricity planning since 2007, when the Ontario Power Authority (OPA) filed an Integrated System Planning (IPSP) with the Ontario Energy Board.

Although this most recent round was described as a "tweak" of the last LTEP (released in November 2010),[3] it does suggest at least the potential for some fairly dramatic potential course corrections, particularly with respect to the role of renewable power, new nuclear facilities and conservation. The previous LTEP had specific quantifiable goals for each of those resources. In the data provided with the current LTEP, they are treated as options that presumably will have to compete among each other to meet the Province's capacity and energy needs. In addition, the resources with which they may compete have been expanded to include consideration of options that were largely absent in previous planning exercises, specifically, using gas generation to meet base load requirements and imports to meet capacity requirements.

This open-mindedness reflects a welcome development for the Province, which, in the past, has adopted a much more prescriptive approach to choosing generation technologies. One hopes that it will be the beginning of a new approach, one that puts a premium on adaptability and flexibility over the rigidity that marked previous system planning initiatives. Specifically, this new approach would allow the Government[4] to treat planning exercises as policy-oriented goal setting, as opposed to the creation of a rigid supply mix to be implemented within a fixed schedule. Policy-oriented goal setting involves the creation of economic, social and environmental outcomes that the energy system should achieve, not the means to achieve those goals. In other words, the Government would not dictate technological choices reflected in a supply mix that dictates specific quantifiable targets for each type of generation technology. Although dictating specific supply mixes may have been necessary to get through the coal phase-out transition starting in 2005, the completion of that transition, and the dramatic changes to the technological, social and economic climate for energy projects since that time, have made that approach unnecessary and unproductive. In today's environment, developing

[1] Ontario Ministry of Energy, *Making Choice: Reviewing Ontario's Long-Term Energy Plan*.

[2] OPA, *Status, Outlook and Options for Electricity Service*, 2013.

[3] http://www.thestar.com/business/2013/04/16/ontarios_longterm_energy_plan_gets_shortwterm_tweak.html.

[4] I am using the term "Government" in this context to include both the Ministry and government agencies, including the IESO, OPA and OEB. The challenges respecting forecasting demand, technological development and societal expectations apply to all institutions, not just the political and bureaucratic components of the Ministry or the Premier's office.

plans to implement a Government-dictated supply mix is required neither by legislation[5] nor by good policy. To the contrary, there are strong technical and social arguments in favour of a more flexible approach. [6]

If nothing else, the difficulty of settling on a Province-wide demand forecast demonstrates the folly of trying to dictate with any precision the quantity of generation types that should be used to meet that forecast. However, even apart from the challenges of forecasting demand, technologies and demographic changes can arise surprisingly suddenly, quickly making central assumptions out of date. The shale gas revolution, the reduction of solar production costs and the de-industrialization of Ontario over the last few years are cases in point. Equally important, social values are dynamic and will inevitably be taken into account by political leaders. It was once thought that siting gas-fired generation plants was easy and that environmentalists would support the wind facilities required to "green" the electricity grid. If those assumptions were ever true, they are clearly not true today.

The reality is that technologies and facility-siting preferences can change quickly and dramatically. The real challenge for planning is how to manage the cost and consequences of that change while maintaining the broader and more enduring economic, social and environmental goals of energy policy.

If instead of committing to technologies, facilities and locations, the Government sets strategic goals and outcomes, then those goals and outcomes may be enduring while allowing greater flexibility over specific technologies, facilities and locations. The Government should establish the goals for that exercise – economic, environmental and social – and mechanisms that allow those goals to be taken into account in processes aimed at meeting reliability requirements in a manner that is consistent with those goals. Those processes can include load-serving entities, capacity markets or other methods that are common throughout North America to acquire new resources. In this way, the Government can focus on the ends, not the means, of energy policy.

This comment has two Parts. Part I compares the 2013 LTEP with previous planning exercises. Part II outlines an approach to electricity planning that is less prescriptive than previous approaches.

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[5] The ongoing relevance of the legal treatment of the Integrated Power System Plan (IPSP) is uncertain. In any event, an IPSP is commenced by a government directive to the OPA. There is no legal requirement that an IPSP fix a supply mix. Rather, the obligation is on the Province to provide a directive to the OPA that "set[s] out the goals to be achieved during the period to be covered by an integrated power system plan." While these goals may "include" a supply mix, they are certainly not required to. See *Electricity Act, 1998* ss. 25.30(2).

[6] As for current nuclear facilities, the data accompanying the LTEP contains refurbishment schedules that are assumed for planning purposes. Nuclear refurbishment is a unique case in that it forms the centre piece which other supply and conservation activities must work around. The argument in this commentary for a smaller role for government decision making in supply does not include nuclear refurbishment, which is probably a special case and needs to remain within the government's decision-making authority.

PART I — 2013 LTEP and Previous Planning Exercises

1.Comparing planning alternatives

Planning exercises require the forecasting of energy and capacity needs and identifying the types of resources that can meet those needs. Although this has the appearance of a technical exercise, there is a large element of judgment and it is particularly sensitive to changes in government policy.

Government policy determines the constraints within which a plan must operate: the tighter the constraints, the more limited are the choices for resources. If the Government's goals are more open-ended, a number of options can open up. The availability of options to meet resource requirements differed dramatically in Ontario's three recent planning exercises. This is illustrated in Figure 1 below:

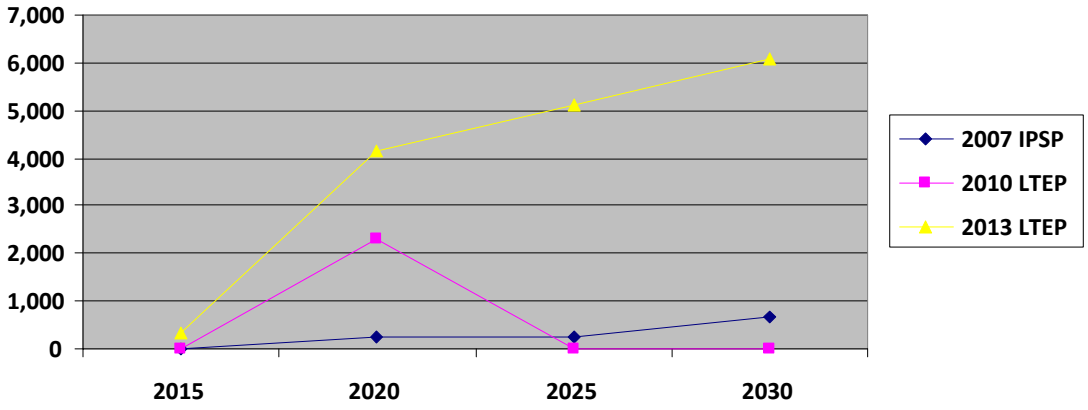

Figure 1: Uncommitted[7] Resource Requirements (MW)

Figure 1 identifies the capacity requirements that have not been planned for in terms of specific commitments to types of resources. Comparing this uncommitted capacity in each of these planning exercises yields some interesting information.

First, what is most striking is the shape and size of the slopes – the remaining capacity that may be filled both differs dramatically under each of the three plans and is currently larger than ever.

[7] I use the term "uncommitted" in this paper to describe capacity that is not yet in service or under contract. Previous planning materials used the term "directed" to describe capacity that, though not "committed" (as that term is used here), were the subject of government directives. The term "directed" is not used in the materials accompanying the 2013 LTEP document.

The 2007 IPSP shows all capacity requirements being met until later in the plan term, when a small amount – 250 MW – could be required, depending on future demand. Because the need arose late in the plan term, there was no requirement to identify a specific resource that would meet it.[8] As a result, the Government's supply mix that underlay the 2007 IPSP left virtually no room for different options or opportunities to be considered.

The 2010 LTEP had a "capacity gap" of 1,000 MW to 3,000 MW for the period 2018 to 2022, with no need for resources after that time. The capacity gap, which reflects the timing of nuclear facilities being taken out of service for refurbishment, would be in place for only a short period.[9] Further, the Government left little room for considering how that gap would be filled – the choices were effectively restricted to converting coal facilities to natural gas and re-contracting existing non-utility generation (NUG) contracts when they expired.[10]

In comparison to both of these earlier plans, the data accompanying the 2013 LTEP is very open-ended. It shows uncommitted capacity requirements of 4,000-6,000 MW starting in 2020 that may be met through a range of resources. The range of potential resources is thus large and growing over time.

The initial question is why has this range opened up?

One explanation, which can be summarily dismissed, is that new capacity is required to serve demand growth. Demand has dropped since the 2007 IPSP and, more importantly, every new demand forecast is lower than the last one.

Figures 2 and 3 below show the peak demand and energy forecasts for five-year intervals in the 2007 IPSP,[11] the 2010 LTEP[12] and the 2013 LTEP.[13] In addition, to put these forecasts into some context, Figure 1 also shows forecasted Ontario peak demand that is used for North American Electric Reliability Corporation (NERC) reliability purposes[14] (none of these forecasts include conservation or reserve requirements).

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[8] For planning purposes, the IPSP stated that the potential short-fall that would be met by "proxy gas"; i.e., a resource that has the characteristics of a gas-fired generator.

[9] OPA, *IPSP Planning and Consultation Overview*, May 2011, pp. 3-20 – 3-21.

[10] OPA, *IPSP Planning and Consultation Overview*, May 2011, p. 3-21.

[11] OPA, 2007 IPSP, Demand Forecast, EB-2007-0707, Exhibit D, Tab 1, Schedule 1, Tables 1 and 2, pp. 2-3.

[12] OPA, *Status, Outlook and Options for Electricity Service*, 2013, Appendix A.

[13] OPA, *Status, Outlook and Options for Electricity Service*, 2013, Appendix B.

[14] NERC, *2012 Long-Term Reliability Assessment*, November, 2012, NERC-Wide Summary Tables (2013-2022), pp. 68-77.

Figure 2: Peak Demand Forecasts (MW)

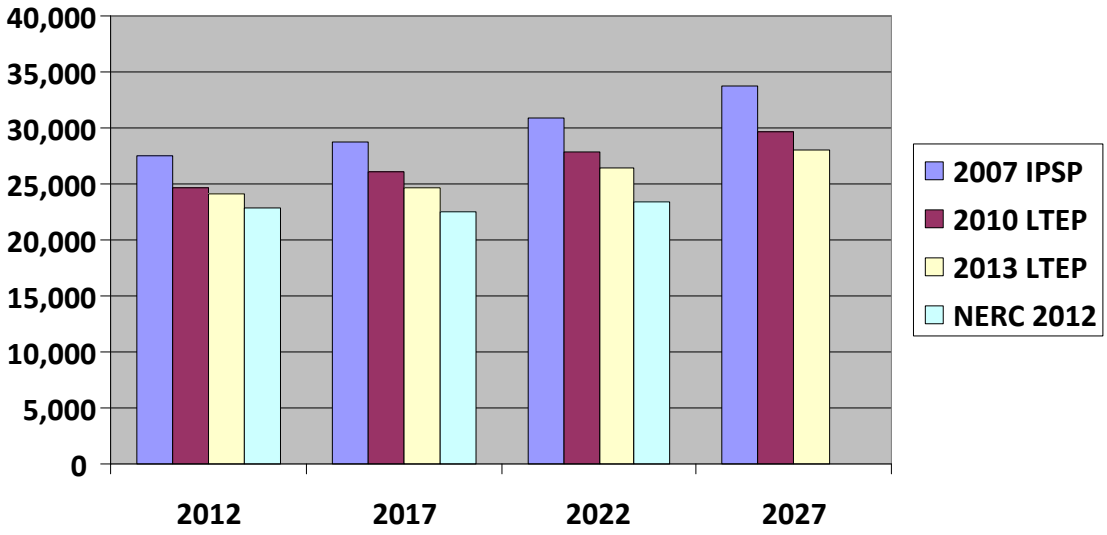
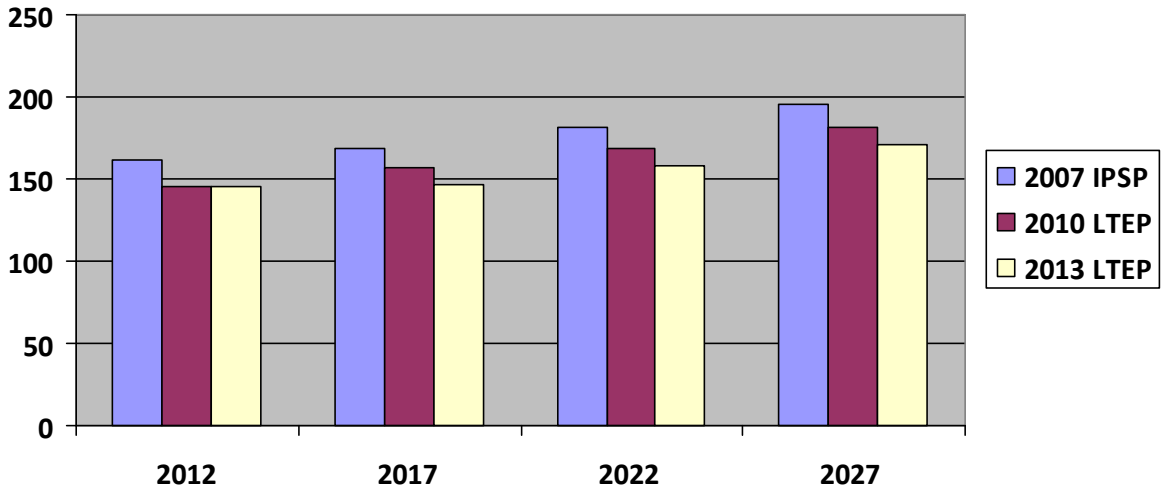


Figure 3: Energy Forecasts (TWh)



Thus, from 2007 to 2013, forecasted demand for 2027 dropped 17%, while forecasted energy dropped 12%. To put these numbers in some context, in the last six years, forecasted demand for 2027 was reduced by some 5,636 MW, which is almost half of the current size of the Province's entire nuclear fleet.

This forecasted demand is net of conservation. So, in addition to reduction of demand, since 2005, another 1,900 MW of consumption was reduced through conservation.[15]

As well, the reduction in forecasted demand was accompanied by major new additions. During the period of 2007 to 2012, about 10,000 MW of new and refurbished capacity was put in service.[16]

There are two points that can be taken from this. First, it is very difficult to forecast provincial demand, even over a very short period – actual demand for 2012 was approximately 2,500 MW less than was it was forecasted to be in 2007.[17] This means that making resource decisions based on long term demand forecasts is a high-risk activity. I will return to this point in the Part II. Second, to return to the more immediate point, growth in net demand is not what is driving the creation of new opportunities for capacity.

The main driver is the extent to which the Government continues to be committed to specific resource types, mainly, conservation, renewable power and new nuclear facilities. The data accompanying the 2013 LTEP allows for a much more open-ended consideration of how these resources can fulfill capacity requirements and – perhaps even more importantly – how other resources may contribute.

This open-mindedness is welcome both for the value of flexibility as outlined above, and due to the fact that a fundamental reconsideration of targets is necessary. As indicated, the 2007 IPSP and the 2010 LTEP completely filled forecasted demand through planned new resources. Forecasted demand is now much less than was thought. There is therefore simply no room for all the capacity that was planned for in 2010, unless the plan is to build more and more excess supply, which will exacerbate the Province's current challenge of surplus base load. There can be no doubt that the older targets are no longer appropriate. The question is whether the Government should simply set new targets by prescribing a new supply mix or take advantage of the current planning process to move away from a supply mix approach to an approach that is more goal oriented.

The 2013 LTEP data shows that there is considerable room to manoeuvre with respect to the main resources of conservation and nuclear and renewable power.

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[15] Ontario Ministry of Energy, *Making Choices, Reviewing Ontario's Long-Term Energy Plan*, 2013, p.5.

[16] OPA, *Outlook for Electricity Demand and Supply in Ontario*, November 6, 2012, APPrO 2012 Conference Presentation.

[17] There is also good reason to believe that the current LTEP forecast is too high. The NERC, which uses demand forecasts to meet binding reliability requirements, has Ontario's summer peak demand increasing by a total of .07% from 2013 to 2022. During that same period, the LTEP forecast has peak demand increasing approximately 1% *per year.* So while NERC forecasts suggest an increase in peak demand of a total of 629 MW during the 2013-2022 time frame, the LTEP forecasts an increase of over 2,300 MW during the same period – close to four times as much.

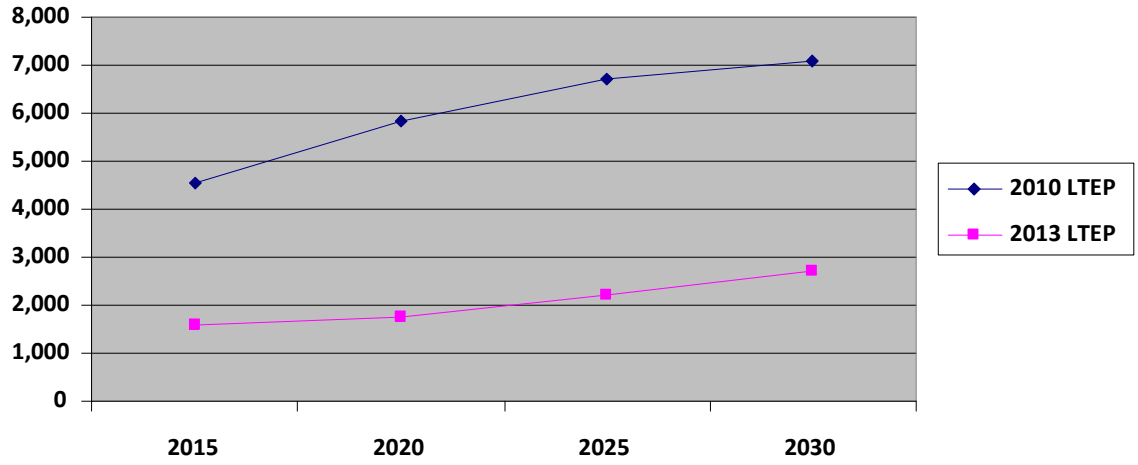
2. Conservation

In the 2007 IPSP, the OPA stated that "[c]onservation takes priority over supply resources in that the IPSP first applies all economic and feasible Conservation to meeting resource requirements before applying supply resources."[18] The primacy of conservation was repeated in the Government's recently released policy paper on conservation where it announced that "Ontario's vision is to invest in conservation first, before new generation, where cost-effective."[19]

In light of this, it is surprisingly difficult to understand the role of conservation in the current LTEP. Unlike previous planning documents, the LTEP does not state a conservation goal, and the data on conservation is difficult to understand.

The LTEP data addresses conservation by making an adjustment to gross resource requirements to result in a number representing "net resource requirements after conservation." These net resources appear to contain both an increase due to reserve requirements and a reduction due to conservation. This is perhaps what explains the anomaly that the 2012 net resource requirements after conservation are *higher* than the gross resource requirements before conservation. In any event, and apart from this singular anomaly, in subsequent years the adjustments that are apparently attributable to conservation are a fraction of what they were in the 2010 LTEP. These are illustrated in Figure 4. [20]

Figure 4: Peak Reductions Attributable to Conservation (MW)



[18] OPA, 2007 IPSP, EB-2007-0707, Exhibit B, Tab 1, Schedule 1, p. 6.

[19] Ministry of Energy, *Conservation First: A Renewed Vision for Conservation in Ontario*, 2013, p. 4.

[20] From OPA, *IPSP Planning and Consultation Overview*, May, 2011, p. 4-1 and OPA, Status, Outlook and Options for Electricity Service, 2013, Appendix B.

Another important consideration that is not addressed in the 2013 LTEP data is the relationship between reduced demand forecasts and conservation. While (as discussed above) reduced demand forecasts should have an impact on all potential resources, conservation may be particularly impacted. When demand is reduced, so is the opportunity to reduce the residual demand through conservation – there is less slack in the economy. Part of the challenge here is that measuring conservation potential and conservation results with any precision will be made extremely difficult by the dramatic changes in demand forecast. It involves both predicting and measuring the amount of energy that *would have* been consumed if not for the conservation programs. Forecasting demand is challenging enough; forecasting how demand may be reduced by attributing a portion of that non-consumption to conservation, as opposed to economic decline or deindustrialization, is even more challenging. Little information is provided in the LTEP materials to assist in this regard.

The LTEP documentation notes that conservation is being addressed in a parallel consultation.[21] However, that consultation largely addresses the institutional arrangements and policy tools that may be used to achieve conservation. It does not include specific targets for conservation. It is unclear how mandatory conservation targets fit into the Government's policy goals. Assuming that mandatory targets will be reduced suggests, at the very least, that conservation will be one of several options to meet resource requirements. The most obvious consequence of reducing conservation targets is that more future capacity requirements will be met by new supply. Changes in supply planning assumptions are addressed below.

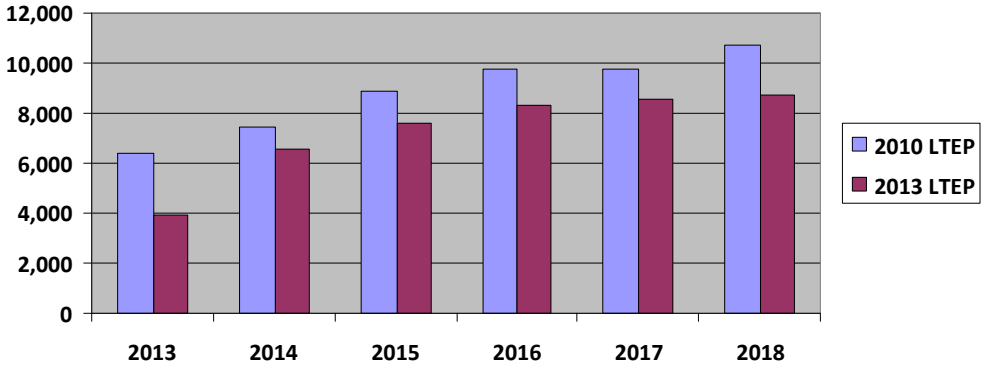
3.Supply

The most dramatic change on the supply side is that the LTEP data has vastly reduced planned capacity for renewable and nuclear power. The planned capacity for non-hydro renewable power specifically in the 2010 and 2013 LTEPs is illustrated at figure 5.[22]

[21] The consultation relates to: *Ministry of Energy, Conservation First: A Renewed Vision for Conservation in Ontario*, 2013.

[22] From OPA, *IPSP Planning and Consultation Overview*, May, 2011, Figure 8, p. 3-17, and OPA, Status, Outlook and Options for Electricity Service, 2013, Appendix C.

Figure 5: Planned Wind, Solar and Bioenergy (MW)



The 2010 LTEP was prepared on the basis of having 10,700 MW of installed capacity of wind, solar and bioenergy by 2018; the 2013 LTEP data reduces the amount of planned non-hydro renewable capacity by approximately 2,000 MW – a reduction of almost 20%. The largest divergence in planned non-hydro renewable capacity is in the early part of the plan: in 2013, installed non-hydro renewable capacity is approximately 1,300 MW (15%) less than was planned in 2010. This raises the question of whether forecasted non-hydro renewable capacity targets further out in the future will be achieved.

Similarly, the 2010 LTEP assumed 2,000 MW of new nuclear facilities to be installed in around 2023. That capacity is not included in the 2013 LTEP.

Like conservation, new renewable and nuclear facilities may still end up making a large contribution. However, the Government has opened the possibility of a course correction with respect to how these resources may contribute to future requirements and, even more importantly, how alternative resources can also compete to meet this.

4.New alternatives

The 2013 LTEP entertains the option of two new types of resource contributions – natural gas fired generation for base load supply and imported power.

The role of natural gas has changed dramatically since earlier planning documents.

In 2005, in advising the Government on the role of natural gas in the provincial supply mix, the OPA identified a "smart gas" strategy, which it described as follows:[23]

> Gas-fired generation will play a targeted, but critical role:
>
> - Gas-fired generation has a number of attractive features; it can be built quickly, can be located to relieve transmission bottlenecks, and can be used for district energy and cogeneration. It can complement wind generation in meeting demand, particularly in summer.
> - The price of natural gas has increased four-fold in the past five years and is expected to remain high and volatile. Residential and commercial space heating and industrial processes compete for supply and several nearby jurisdictions also rely heavily on gas, all of which puts its availability at a premium or even at risk.
> - Gas-fired generation is not recommended for base-load generation because in that role it presents risks across all three dimensions of cost, environmental impact and financial risk.

A lot has changed since 2005. It turns out that gas may not be located as easily as the OPA assumed – we have seen this with controversy over gas plant locations.

As well, the price of natural gas has not, as the OPA expected, "remain[ed] high and volatile." The supply mix advice used a gas cost assumption ranging from $8 to $12 /MMBtu;[24] current gas cost forecasts are approximately $4/MMBtu.[25] The one factor that continues to be a challenge is the environmental consequences of using gas for base load. However, this is now one factor among many. Gas for base load is presented as an option in the 2013 LTEP.[26] It was not an option in previous planning exercises.

The other option, which is now open for the first time, is relying upon imports to meet capacity requirements.[27] While Ontario relies upon imports of power to meet energy requirements on a commercial basis, it has not, in previous planning exercises, used imports to contribute towards meeting capacity requirements for planning purposes. In this way Ontario is unique. North American and European jurisdictions use firm capacity imports to meet capacity requirements. For some reason, Ontario has, until now, insisted upon electricity self-sufficiency. Just as the LTEP is showing open-mindedness on many other resource decisions, it appears that the Government is now open to allowing imported power to compete with domestic supply to meet resource requirements.

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[23] *OPA Supply Mix Summary*, December 2005, http://www.powerauthority.on.ca/integrated-power-system-plan/supply-mix-summary-december-2005.

[24] OPA, *Supply Mix Resources and Impacts*, Volume 2-7, p. 185.

[25] See, for example, National Energy Board, 2013 forecasts, http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgytlk/tlksmmr2013/ntrlgs-eng.html#s2).

[26] Ontario Ministry of Energy, *Making Choices, Reviewing Ontario's Long-Term Energy Plan*, 2013, p. 14.

[27] Ontario Ministry of Energy, *Making Choices, Reviewing Ontario's Long-Term Energy Plan*, 2013, pp. 14 and 22.

To conclude on this Part, the 2013 LTEP's data demonstrates how the Province may show greater flexibility than it has in earlier planning exercises. It no longer appears bound by precise amounts and timing for electricity resources. It also entertains resources that were not seriously considered in previous planning exercises. It is not clear whether this reflects a new approach or whether the LTEP consultation will nonetheless result in a new supply mix that has different components than earlier supply mixes but is no less prescriptive. In the next part of this comment, I propose a less prescriptive approach.

PART II – Towards a Less Prescriptive Electricity Plan

As discussed in Part I, the 2013 LTEP has the potential for much more flexibility than previous planning exercises. I believe that the Province should take the opportunity presented by the 2013 LTEP to take a much less prescriptive approach. The outcome of this exercise should set the economic, environmental and social goals of the electricity system. It should not produce a supply mix. At the outset, it is helpful to provide some context by looking at why the Government has, in the past, taken a more prescriptive approach.

Modern electricity planning came of age in Ontario with the recommendations of the 2004 Report of the Energy Conservation and Supply Task Force (ECSTF). That report identified a combination of economic and reliability challenges that created an urgent need to plan and procure new supply. According to the ECSTF Report: [28]

> Ontario faces a looming electricity supply shortfall in the years ahead as coal-fired generation is taken out of service and existing nuclear plants approach the end of their planned operating lives. Current projections suggest that, without new supply and substantial conservation efforts, Ontario could have insufficient power to meet its peak requirements by 2006. By 2014, the province would have only half the generation capacity it needs to ensure adequate and reliable electricity service.

In addition to the coal and nuclear plants coming out of service, two macro-economic challenges made it necessary for the Province to immerse itself in the energy sector: the collapse of the merchant generation investment model (which was brought about most dramatically with the bankruptcy of Enron) and the determination that gas prices "have risen dramatically and continue to be volatile."[29]

In the face of these challenges, the imperative for the Government and the sector was to acquire new facilities as quickly and forcefully as possible. To meet that challenge, the Province essentially took over the entire reins of electricity supply decisions through the central procurement and central planning mechanisms of the newly created OPA. These were drastic measures that may have been called for at the time; it is not clear whether they are still required.

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[28] ECSTF, *Tough Choices: Addressing Ontario's Power Needs, Final Report to the Minister*, January, 2004, p. 1.
[29] ECSTF, *Tough Choices: Addressing Ontario's Power Needs, Final Report to the Minister*, January, 2004, pp. 3-4.

From a facilities perspective, far from facing "a looming electricity supply shortfall," the Province is in surplus and likely to remain there for some time. As well, the macro-economic challenges of 2004 are no longer present.

With respect to the financial issues around procuring power, energy sectors throughout the world have adopted different methods of how to deal with the collapse of the Enron model of energy traders funding the construction of new facilities. In fact, almost all jurisdictions that rely on private investment to fund energy infrastructure have developed tools to attract investment that do not rely upon central planning and procurement. As Harvard Professor William Hogan has recently observed, while Ontario has used a central planning and procurement mechanism to acquire new facilities, many other markets have taken different approaches, such as "capacity markets and requiring ratepayers to pay additional capacity charges for their share of required levels of capacity, to meet resource adequacy requirements and provide the additional compensation to generators."[30] In addition to capacity markets, load serving entities – which have an obligation to provide reliable supply in accordance with criteria, such as cost and environmental standards – have also been successfully used as a less intrusive and prescriptive approach to meeting reliability requirements. Even the OPA, which is the Province's procurement and planning agency, endorsed, along with the Independent Electricity System Operator (IESO), endorsed considering how an "outcomes-based supply mix directive" and increased reliance on capacity markets and load-serving entities could be used to replace central planning and procurement.[31]

Further, as described above, gas prices, which were reported to have "risen dramatically and continue to be volatile" have considerably decreased.

In short, the extreme circumstances of 2004, which led to the need for the Government to dictate central planning and procurement obligations, are no longer present. Instead, in today's environment, it is possible to have a much lighter handed approach to meeting supply requirements. These lighter handed alternatives can avoid some of the negative consequences of Government-prescribed supply mixes.

Ontario's experience in central planning illustrates the limitations of that model. As the Oxford dictionary of economics notes, "While in theory such a system should allow the use of all resources in an economy in the public interest, without wasteful duplication of effort, the amount of information required to achieve efficiency is too great, and the incentives to supply the centre with reliable information are too poor."[32]

The informational challenges that have plagued Ontario's planning process include the inability to produce a reliable load forecast described above.

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[30] William W. Hogan, *Overview of the Electricity System in the Province of Ontario*, December 21, 2011, p. 18.

[31] IESO/OPA, *Engaging Local Communities in Ontario's Electricity Planning Continuum*, August, 2013, p. 16.

[32] Oxford Dictionary of Economics, *Central Planning* http://www.oxfordreference.com/view/10.1093/acref/9780199237043.001.0001/acref-9780199237043?hide=true&page=30&pageSize=10&sort=titlesort&source=%2F10.1093%2Facref%2F9780199237043.001.0001%2Facref-9780199237043.

As well, disruptive technologies in shale gas production and solar power have made assumed costing models largely irrelevant. The same breakthrough is likely to happen in smart grid technologies, leaving investments and practices in current grids behind.

In addition, planning by reference to societal costs has the challenge that commercial developments will follow their own path without regard to societal costs. For example, in the 2007 IPSP, the OPA recommended the development of at least eight transmission lines to "enable" renewable power. This was based on identifying the optimal locations for wind facilities by reference to the societal costs of wind development. However, wind developers have chosen wind sites that bore virtually no relation to the sites that the OPA models thought were optimal.[33]

It should be noted that all of these factors have confounded the very qualified planning experts at the OPA. This is not surprising. The central components of supply mix decisions are inherently unpredictable – what is the forecasted load, how will technologies develop over time and how will commercial opportunities respect planning assumptions? Experts have not proven to be any better placed then well informed observers in any of these areas.[34]

The inherent uncertainty and accompanying challenges of these types of predictions should make one very reluctant to build a policy framework that puts them at their centre. In my view, the best way to managing the unpredictability of these events is to not design institutional models that rely upon sound predictions in these areas. This means moving away from prescribing a provincial supply mix.

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[33] This is consistent with international experience. A study of the Chilean experience with central planning concluded that that country's indicative planning system proved to be largely irrelevant in light of the commercial opportunities that presented themselves for investors, technological developments and changes in interconnections and dynamics in surrounding jurisdictions (See: Rudnick and Gener, *Power System Planning in the South American Electric Market Restructuring*, VI Symposium of Specialists in Electric Operational and Expansion Planning - VI SEPOPE, May 24-29,1998, Bahia, Brazil).

[34] Daniel Kahneman and others have studied the predictive powers of experts when addressing these types of issues and found that, not only are they not better than well informed people, they tend to be worse because their expertise creates a fatal over-confidence in their own conclusions. Kahneman describes the results of expert predictions about whether the future will have more, less or the same economic growth as the past:

> The results were devastating. The experts performed sores than they would have if they had simply assigned equal probabilities to each of the three potential outcomes…Even in the region they knew best, experts were not significantly better than nonspecialists.
>
> - Those who know more forecast slightly better than those who know less. But those with the most knowledge are often less reliable." (Daniel Kahneman, *Thinking, Fast and Slow* (Farrar, Straus and Giroux, 2011 at p. 261).
> - The reason why experts tend to do worse than non-experts is that experts' professional status makes them more committed to their predictions and less willing to change their minds. This phenomenon is reinforced by the political context of planning. Under the current planning process, governments (either directly or through their agencies) commit to technologies and facilities.

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