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Omitted Costs, Inflated Benefits: Renewable Energy Policy in Ontario

Parker Gallant[1] and Glenn Fox[2]

Abstract

The government of Ontario has adopted wind energy development as an alternative energy source. It enacted the Green Energy and Economy Act, May 2009, with the intention to fast track the approval process regarding industrial wind turbines. The Act legislated a centralized decision making process while removing local jurisdictional authority. Throughout this process, the government reassured the public of inexpensive and reliable electricity. This article explores the costs and benefits related to the renewable energy policy established in Ontario, Canada.

Keywords

electricity costs, wind energy, Green Energy and Economy Act, renewable energy policy, inflated benefits

Introduction

Ontario's Long-Term Energy Plan (LTEP), announced by the Liberal Party on November 23, 2010, states,

> Over the next 20 years, prices for Ontario families and small businesses will be relatively predictable. The consumer rate will increase by about 3.5% annually over the length of the long-term plan. Over the next five years, however, residential electricity prices are expected to rise by about 7.9% annually (or 46% over five years). (Ministry of Energy, 2010)

This announcement came just 19 months after former Energy Minister George Smitherman, at the time of the enactment of the Green Energy Act, stated, "I have been very clear about it. One percent per year, incremental on the cost of a person's electricity bill, with corresponding capability through investments in conservation for people to lessen their use of electricity" (Hansard, 2010).

Figure 1 compares the projected annual electricity costs with that projected by Smitherman (for 2010, 2015, and 2030).

Our analysis shows that the electricity rates the LTEP anticipates are substantially lower than those that Ontarians will in fact face. The LTEP projects that an average household's electricity costs will be about $2,500 per year by 2015 (a 47% increase) and about $3,400 per year by 2030 (a 100% increase) compared with about $1,700 per year currently. Our projections indicate that cost per household will rise to at least $2,800 per year by 2015 and to over $4,100 per year by 2030, which would result in increases of 65% and 141%, respectively.

For average users consuming 1,000 kWh (kilowatt hour) per month, the omitted costs represent $344 per year by 2015 and $731 per year by 2030, sums in addition to the estimates in the LTEP. The average residential user's annual bill will exceed $2,800 by 2015 and be over $4,100 by 2030, compared with the current $1,700. We have included the forecasts of former Energy Minister George Smitherman, which, had they played out, would have seen the average household bill reach approximately $2,100 by 2030.

The increases in residential electricity costs projected in the 2010 LTEP, specifically a 7.9% annual increase until 2015 and a 3.5% average annual increase over the period from 2010 to 2030, are projected in nominal dollars—that is, they were not adjusted for the effects of future inflation. In figure 15 of the LTEP (see Ministry of Energy, 2010, p. 60), price increases are plotted in nominal and real terms. The implication of the figure is that inflation eventually will whittle away the price increases in constant dollars. But simple consumer price index (CPI)-based adjustments of nominal price increases, such as those presented in LTEP figure 15, are incorrect because many cost categories driving the nominal price increases are indexed to the CPI. So, nominal electricity costs will rise with inflation. Part of our estimation of omitted costs reflects this effect. This issue will be particularly important for households on fixed incomes or on incomes that are only partially indexed.

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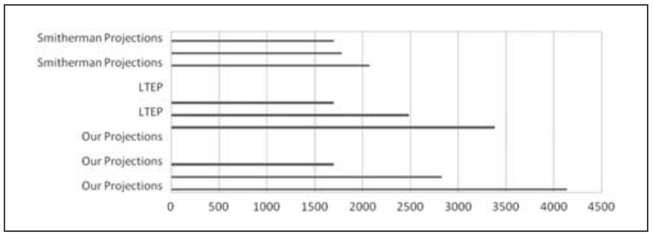

Figure 1. Comparison of average Ontario annual electricity cost projections 2010, 2015, 2030 ($/household/year)

The bulk of the additional costs highlighted in this article will take place by 2018, based on the directive from Energy Minister Brad Duguid to the Ontario Power Authority (OPA) of February 17, 2011, which established this target date for the bulk of the LTEP's capital cost builds. In highlighting the omission of certain costs in the LTEP, we have used conservative estimates. The actual omitted costs may well be significantly higher than those shown in our projections.

To some extent, the province has attempted to ameliorate the cost increases through the use of general tax revenues. The province's 10% electricity benefit will cover the 8% harmonized sales tax increase and a small portion of the rate increase for 2011. However, significant rate increases, amounting to a significant multiple of the inflation rate, will restart in 2012. Additionally, the 10% electricity benefit will shift some of the burden of higher electricity costs to taxpayers through increased borrowing requirements over its 5-year span.

The Wind Omission

The LTEP has included $14 billion in capital costs for wind turbines, which will reputedly produce 10%, or 19.8 million megawatt hours (MWh), of Ontario's forecast consumption by 2030.

The estimated capital cost of 1 megawatt (MW) of wind power falls in the range of $1.9 million to $2.3 million (Burt & Mullins, 2010) and is based on "rated capacity"—that is, wind turbines running at 100% of their maximum capacity. Because turbines operate at an estimated 27% of their capacity, the effective capital cost amounts to $7.4 million/MW.

The LTEP anticipates an increase in renewables of 9,043 MW without specifying the wind, solar, and biomass components. In this study, we assume that wind power will represent 80% of this mix, or 7,200 MW of new capacity in addition to the approximately 1,200 MW presently in place.

The operators of onshore industrial wind parks will be paid $135 per MWh. (Some participants—Samsung, Community, and Aboriginal—will also receive adders of $10 to $15 per MWh, bringing the price to $145 to $150 per MWh. Because we don't have access to these contracts, all our calculations assume the lower $135 per MWh.) The OPA (n.d.-a) feed-in-tariff (FIT) contracts are "take or pay"—the generators are paid whenever they produce electricity, even if the power is not used—and they include rate increases, for the contract term, tied to the Ontario CPI to a maximum of 20%. Sales tax (the former 8% Ontario sales tax now included with the harmonized sales tax) applicable to the OPA's payments on these contracts is the responsibility of the OPA (n.d.-a). A CPI of 1.5% per annum compounded to reach the 20% limit will add $27 to $30 per MW by 2020. Assuming the supply to be 170 million MWh (per the 2030 forecast), this increases what Ontarians will pay for wind power by $4.11:

Inflation costs omitted in the forecast for wind power per MWh	$3.80
Plus sales tax paid by OPA	$0.31
Additional costs per MWh[1]	$4.11

The Solar Omission

The LTEP has included $9 billion in capital costs for solar panels to produce 1.5% or 2.97 million MWh of forecast consumption by 2030. The FIT and microFIT contracts for solar panels range from a low of $443 per MWh to a high of $817 (with Aboriginal adder) per MWh. However, without the breakdown of the contracts in place, we have not assigned any additional costs. We are aware that the OPA has signed several "rooftop" contracts with various parties such as IKEA and the Municipality of Markham that are over 10 kW that pay rates of $713 per MWh.

Solar power has the highest capital cost of any of the renewables, with estimates ranging from $3.2 to $6 million (Burt & Mullins, 2010) per MW of "rated capacity." Solar energy produces power at 12% to 14% of rated capacity, making the capital cost per MW of electricity close to $35 million. The 2.97 million MWh provided to the grid by 2030 will need an installed capacity of 2,600 MW to provide an output of 340 MW (at 13% of rated capacity). The LTEP prices solar power at $26 million per MW based on the $9 billion contained in the plan. We have not included these additional costs in expenditures for solar power as they will be the responsibility of the investor(s). Should prices of solar photovoltaic panels decline, the benefit will accrue to the developer, not to the ratepayer.

Additional costs per MWh	N/A

The Transmission Omission

The LTEP anticipates a capital spending of $9 billion on transmission builds without any further detail. The plan mentions "smart grid" as a part of the transmission build along with "smart homes" and connects these references to "storage technology." These "smart" initiatives are not presently available anywhere, and should this plan envisage their creation, their potential costs are unknown. The only costs we are aware of related to the projected "smart grid" are costs provided directly by the Independent Electricity System Operator (IESO), which has estimated the costs (over 5 years) at $1.6 billion.

This would presumably provide IESO with better control of the grid to prevent blackouts or brownouts but provide no new generation capacity. Extracting IESO's needs from the $9 billion, leaves $7.4 billion for transmission builds, infrastructure improvements, and the local distribution companies' (LDCs') "smart grid" and "smart homes" initiatives. On the latter, Hydro One's pilot in Owen Sound has budgeted approximately $8,500 per customer. The "smart grid" envisages things such as smart appliances—local distribution control of electric heat and air conditioning—all the while ensuring privacy and hacker prevention. With approximately 4.5 million smart meters in Ontario, the latter initiative alone could fully use the bulk of the capital allocated to this segment, leaving little, if any, for the other transmission initiatives. Although the LTEP has not properly accounted for these capital expenditures, without specifics we are unable to ascribe any omitted costs to this "smart" initiative.

To get electricity to the grid from wind and solar facilities entails transmission lines and associated spending. For example, Hydro One, the provincially owned transmission and distribution company, is increasing transmission capacity for the Bruce to Milton line at a cost of $700 million, to accommodate nuclear power coming from Bruce nuclear plants as well as the Samsung contract for 2,000 MW of wind power and 500 MW of solar power. This is the only transmission build where cost estimates are known and available in the public domain. We are aware that George Smitherman, when Minister of Energy, ordered Hydro One to build seven enabler connection lines for renewables and three "Bulk Transmission Capability for FIT program" access systems.

500 MW of one Bruce to Milton 500 kilovolt (kV) line has been reserved for the use of Samsung through ministerial directives (OPA, 2009, 2010). This line will deliver electricity below its rated capacity and will be underused, since it must be partially reserved because of the volatility of power generation from wind.

The LTEP plan identifies five major transmission builds apart from Bruce to Milton but fails to attach any individual dollar values.

Unforeseen expenses are also a factor, as seen in a February 12, 2011, announcement disclosing that Hydro One had advised 1,000 microFIT solar-contracted parties that it was experiencing technical problems in hooking them up to the grid. The Minister of Energy issued a directive on February 17, 2011, ordering the transmission investments for those hookups. Costs of these "technical problems" are unknown and have not been included in this report.

The process of bringing renewable power to the grid has created additional problems for Hydro One related to excessive voltage, overvoltage, and transformer problems. The $90 million costs of these problems surfaced in a recent application to the Ontario Energy Board for new generators that have completed their builds of renewable power and are connecting to the grid. Without any specific information on the other areas we see as leading to potential additional costs, the $90-million item is the only transmission omission we can point to.

The additional 9,043 MW that the LTEP anticipates could result in a minimum of $500 million in capital costs[2] that have not been included in the LTEP. Amortized over 20 years this represents the following:

Additional costs per MWh[2]	$0.17

The Backup Omissions

Because the sun does not always shine and the wind does not always blow, renewable electricity requires backup. This backup can amount to 90% of the rated capacity for renewable energy (Milner, 2008). Ironically, the backup will overwhelmingly be fossil fuel and increasingly natural gas, thus negating a prime rationale for the LTEP—that is, the province's desire to reduce CO_2 emissions (Trebilcock & Wilson, 2010).

The costs of balancing the system to accommodate the entry of renewables are also unclear and potentially very expensive because of the intermittent nature of wind and solar power. The combined forecast result of 83%[3] base load (nuclear, run of river hydro, and intermittent wind and solar power) will make balancing very difficult. No costs have been ascribed to load balancing in this study, although the IESO expenditures on the "smart grid" will presumably include at least a portion of that expense.

Based on the LTEP, Ontario will need 9,600 MW of backup power by 2030 to support 10,700 MW of renewables. Because Ontario has banned coal, Ontario's backup will come from natural gas plants, which are the least expensive to build. The capital costs for simple cycle plants range from $700,000 to $1 million per MW and for combined cycle plants from $800,000 to $1.5 million. The benefit of simple cycle generators is that they can be ramped up quickly when demand requires almost immediate power. However, simple cycle plants have a lower efficiency level, generally producing electricity at a 40% efficiency level. Combined cycle plants are more efficient, producing at a 60% level; however, they require a longer start-up time and are therefore less useful in meeting immediate demand. If one assumes Ontario will select a mix of simple and combined cycle plants at an average cost of $1 million per MW, the capital costs to back up wind and solar power will be $9.6 billion. The LTEP forecasts capital spending on gas plants of $1.8 billion, which creates a shortfall of approximately $8 billion. Amortized over 20 years, the backup capital costs for ratepayers represent the following:

Additional capital costs per MWh[3]	$2.74

Annual Feed Costs

Additional to the capital costs, gas plants must be available to supply power to the system whenever the wind isn't blowing. As the capital costs are borne by the private sector and there is no guarantee of actual production, the contracts contain a requirement for the ratepayers to pay a fixed annual feed cost[4] of $135,000 per MW to the gas generators. With an estimated installed capacity of 9,600 MW to backup wind and solar renewable energy, that cost will represent the following:

Additional feed costs per MWh[4]	$8.88

Variability Costs

Winds variability also adds an additional element to the mix as it produces power 32.7% (Aegent Energy Advisors, 2011) of the time when it will not be needed. This variability in the future is likely to be "constrained" or "dispatched off" power, meaning industrial wind turbine operators will be paid for not producing power when they actually have the ability to do so. By the time 8,400 MW of installed wind capacity is operational, it could result in 6.5 million MWh per annum of wind power being constrained at a cost of (2010 contract price) $135 per MWh resulting in a cost to ratepayers that would represent the following:

Additional costs of constrained power per MWh[5]	$6.00

Gas Generation Costs

The contracted rate paid to produce gas generated power, will, on average, be somewhere in the region of 6.1 cents per kWh or $61 (Aegent Energy Advisors, 2011) per MWh. This is $21 more per MWh than the $40 per MWh used in this article. Assuming that gas backup will be required to provide the power when wind and solar power are not producing (73% of the time) will result in a further additional cost to ratepayers that will represent the following:

Additional costs per MWh of gas power–generated backup[6]	$7.70
Total additional backup costs	$22.58

The Export Omission

The cost of subsidizing exports can be substantial—it was $52.8 million in December 2010 (Butler, 2011). During that month, Ontario often had a surplus base load and intermittent power that IESO was required to export at low and even negative hourly prices, causing a net loss to Ontario consumers. The OPA contracts pay fixed prices for wind and solar power, which at all times exceeded the wholesale market prices. On a few occasions, Ontario actually paid neighbouring jurisdictions as much as $128.12 per MWh to take our power. Wind also affects the hourly Ontario energy price (HOEP) in that if it's windy the HOEP declines and therefore the value in the market for exported electricity becomes less. Denmark, which generates 20% of its electricity from wind, exports 13% of its generation to Sweden and Germany at a substantial loss (Sharman, 2009)

With wind and solar power being delivered to the Ontario grid when not needed, a case could be made that the actual *useful* power delivered to the grid is less than the 27% of capacity estimate, and for that reason, additional backup power would be required. We have taken the position that the power delivered when not needed was in fact destined partially for export. Ontario's net exports (netted for imports or "intertie") in December 2010 was 2,147 MW per hour and wind generation set a new record for the month. Assuming that the exports in December 2010 were unusually high and that any re-occurrence coupled with the "constrained" (refer Backup Omissions) wind production would be better represented by a 10% offload (export) factor, Ontario ratepayers face a cost, over a 12-month period, of $327 million by 2030 when wind power capacity will be 8,400 MW. The additional export costs by 2030 represent the following:

Additional export costs per MWh[7]	$2.24

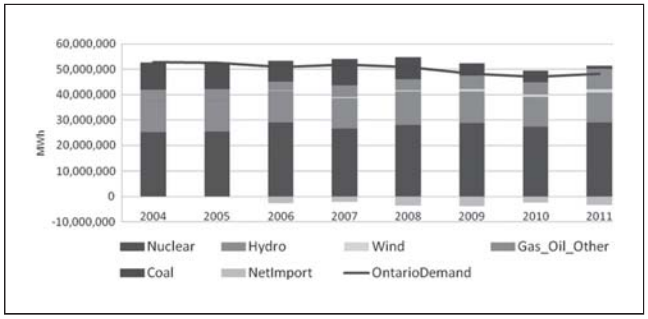

Figure 2. January-April Ontario electricity generation

Figure 2 covering the January to April generation by power type for the past 8 years supports the increasing need to export our surplus production as noted by the negative imports—that is, exported power, of over 4.6 million MWh in the first 4 months of the current year. Exports have grown with the decline in Ontario's demand and the corresponding increase in wind and gas production levels, whereas coal generation has fallen.

The Revenue Displacement Omission

Ontario Power Generation (OPG) is one of the entities obligated to repay the Ontario Electricity Financial Corporation's "stranded debt," placed there when Ontario Hydro was split into OPG, Hydro One, and IESO. All electricity consumers are still paying for this "stranded debt."

The “first-to-the-grid” rights of wind and solar power cause OPG to forgo electricity production from nonstorable hydro or even nuclear power, causing OPG to lose revenue and delaying repayment of the “stranded debt.” The first-to-the-grid rights of wind and solar power also increases borrowings for Big Becky and Mattagami, two large hydro projects with capital costs of about $4 billion.

If the anticipated 23 million MWh produced from wind and solar power in 2030 displaces just 30% of OPG’s hydro power (average output of 56% of rated capability over the past 8 years), lost revenue will be $408 million per annum at an HOEP of $40 per MWh. While hydro power production has averaged 56% over the past 8 years, it was only 50% in 2010 and is running at the same level in the current year (refer Figure 2) despite a better then average spring freshet—that is, a great rise of a stream caused by heavy rains or melted snow. Based on the average annual reduction in the Ontario Hydro “unfunded liability” (also referenced as “stranded debt”) over the past 10 years, the “Displacement Omission” will extend the payout from 19 years to 39 years. Displacement costs do not include interest on the unfunded liability or interest costs of debt on new borrowings for hydro or nuclear power by OPG. The displacement costs will add by 2030:

Additional costs per MWh[8]	$2.80

The Dividend Reductions Omission

Hydro One, which is responsible for virtually all transmission-related expenses in the province, has been directed (OPA, n.d.-b) by the Ministry of Energy to connect all renewables to the grid. Hydro One borrows externally, and it is required to maintain debt/equity ratios by its lenders. Because of the extensive capital budget to connect renewables and the resulting borrowing needs, Hydro One has considerably reduced its dividend payments to the province, affecting the province’s cash flow and its ability to reduce the provincial debt. The province will need to borrow funds lost through nonpayment of the dividends, raising the taxpayer-related debt.

Hydro One’s average income for the 5 years—2004-2008—was $467 million, and the average dividend payment to the province was $298 million, or 64% of earnings. In 2009, the dividend payment was reduced to 40% of earnings, and for the first 9 months of 2010, the dividend payment was less than 5% of the earnings. If one assumes that Hydro One will continue to generate income at an average of $467 million per annum and that dividend payments are reduced to 5% per annum, the shortfall will be almost $1.4 billion over just 5 years. (Net income for 2010 was $591 million, and dividends paid were $28 million, or 4.7%.) The taxpayer will need to make up the difference. If we allocate just 5 years of low-dividend payments on a cost per MW basis, the difference will amount to the following:

Additional costs per MWh[9]	$9.59

The Conservation Omission

For the past several years, monies spent on conservation promotion have exceeded $1 billion per annum. These monies have been recovered on the “electricity” line of power bills. The LDCs use the promotion monies to promote consumption reduction by their residential and commercial clients as well as by municipally owned consumers such as arenas, schools, and street lighting. The theoretical concept associated with consumption reduction is that it will result in less investment in generation, transmission, and distribution, ultimately lowering costs for consumers. The LTEP does not lead us to believe that this concept is valid, given an estimated spending forecast of $87 billion without any *real* increase in supply. The LTEP makes projections of electricity-generating capacity for Ontario up to 2030. Normally, capacity projections represent estimates of how much electricity could be produced by various modes of production, for example, from hydroelectric, nuclear, natural gas, wind, and solar power. The LTEP, however, adds conservation together with these supply side magnitudes in its projection of capacity, counting a reduction in the overall demand from conservation as part of electricity supply. In point of fact, if “conservation” is deducted from the 2030 installed capacity projections and wind and solar power is adjusted for their actual expected generation, the Ontario power system will actually have less electricity generation capacity in 2030 than at the end of 2010.

Although it is logical to expect that reduced consumption would reduce electricity bills, reduced consumption, in fact, will do nothing to reduce the bills of ratepayers as a whole. Instead of receiving a reward for reduced consumption, ratepayers will face a further increase for the conservation success of their LDC. Under Ontario’s system of regulation, the LDC will simply apply for a rate increase to the Ontario Energy Board for revenue “deterioration” caused by conservation, and the shortfall will be charged to ratepayers. By 2030, revenue deterioration (based on the additional 5,263 MW of conservation at $40 MWh) will represent $1.8 billion per annum in lost revenue**.** This $1.8 billion, plus the $600 million per annum planned for “conservation promotion” in the LTEP, will add to the costs of electricity consumption by 2030.

Additional costs per MWh[10]	$16.71
Grand total	$60.94 (see Table 1)

Samsung Adder

Our analysis did not include the “adder” (Adams, 2009; Samsung Renewable Energy, n.d.) that the single largest developer of renewables under the LTEP—Samsung—will receive. The adder amounts to $10 per MWh for Samsung’s

Table 1. Summary of Additional Costs

Category	Amount ($ per MWh)
Wind omission	4.11
Transmission omission	0.17
Backup omission capital costs	2.74
Backup omissions (all)	22.58
Export omission	2.24
Revenue displacement omission	2.80
Dividend reductions omission	9.59
Conservation omission	16.71
Total	60.94

2,000 MW of wind capacity and $30 per MWh for its 500 MW of solar capacity. Using the 27% wind output estimate and the 13% solar output estimate, this adder will pay Samsung approximately $1.3 billion at the end of the presumed contract period of 20 years. When this "adder" was originally announced, it carried a "net present value" estimate of $437 million. However, without access to the contract, we have assumed that the adder will be paid at the end of the contract. Assuming the contract was signed as noted in the media (Howlett, 2010), this payment will have a one-time impact on ratepayers/taxpayers in 2030.

Additional costs per MWh	$8.80
Plus sales tax paid by OPA	$0.70
Additional costs per MW[11]	$9.50

Presumed Employment and Social Benefit

On February 23, 2009, *Toronto Star* reported, "Ontario's Green Energy Act will create 50,000 new jobs in construction, trucking and engineering while laying the groundwork for developing projects more quickly, Energy Minister George Smitherman said today." (The Star, 2009). How the 50,000 number was arrived at, or whether it refers to net or gross jobs, has never been explained.

It should also be noted that under the FIT contracts, any CPI increase that Ontarians will face will especially affect those on fixed pension incomes, contract workers, and those earning minimum wage. In the United Kingdom, *fuel poverty*, which now affects 5.5 million households, has become a household term, largely because of electricity policies similar to those that are being pursued in Ontario.

To put the presumed employment benefits in perspective, the LTEP forecast for consumption in 2030 of 170 million MWh will generate additional billings to ratepayers in excess of the $10 billion per annum. At that rate, it would require less than 2 years to pay for the reputed $18 billion that the Government of Ontario has claimed the Green Energy Act has attracted in new investments. The additional billings are equivalent to approximately 85% of total revenues collected by the electricity sector (public and private generators, transmitters, and LDCs) in 2010. Put yet another way, the additional billings would represent a subsidy of $200,000 per annum for each of the 50,000 jobs that the LTEP claims will be created.

The Potential for Significantly Higher Power Rates

Although we have identified the obvious omissions of the LTEP, we have not ascribed any costs to numerous worrisome areas. For example, we have included no factor for risk of overruns on the planned nuclear build and refurbishment, or for a shortened life expectancy of land-based wind turbines. According to the CEPOS report (Sharman, 2009), these turbines are lasting but 10 to 15 years in Denmark, in contrast to the 20-year contracts signed by the OPA under FIT contracts (Frondel, Ritter, Schmidt, & Vance, 2009). A shortened life would affect both the reliability aspect of electricity production and the need to plan for replacement power, presumably with added costs.

The recent cancellation of the Oakville gas plant will entail either litigation over the breach of the contract or alternately a payment that will be passed on to either ratepayers or taxpayers. However, without knowledge of the outcome, we are unable to include those costs in our calculations. Additionally, decommissioning wind and solar power will find their way to ratepayer bills. However, we have not included them either, since they are presently not significant.

Conclusions

We have been able to identify omitted costs in the province's LTEP of $60.94 per MWh. These omissions would raise power bills by 40% above the government's forecast. Other areas of possible omissions have not been quantified because the data are not public.

Assuming a continuation of current policies, the average Ontario residential user's annual bill will exceed $2,800 by 2015 and $4,100 by 2030, compared with the current $1,700.

Appendix A

Assumptions

1. Calculations are based on the current (nominal) HOEP price of $40 per MW.
2. Industrial wind parks are paid $135 per MW plus CPI of 1.5% and solar power of $443 per MW.
3. All contracts to purchase electricity from renewables will require OPA to pay the sales tax.
4. All capital costs are as stated in the reference material from knowledgeable sources.

5. All other assumptions are as noted in the text of this article.
6. Calculations for 2030 are based on the consumption of 170 terawatt hours (TWh) unless noted otherwise.
7. Sales tax is calculated at 8%.

Appendix B

Glossary

MWh	A unit of energy equal to 1,000 kilowatt hours or 1 million watts
MWA	unit of power equal to 1,000 kilowatts or 1 million watts
Rated capacity	The maximum capacity for which a boiler or power generator is designed
FIT	feed-in-tariff
MicroFIT	feed-in-tariff less than 10 kilowatts or less
kWh	1,000 watt hours
kV	1,000 volts
IESO:	Independent Electricity System Operator *has responsibility for managing the electricity grid within defined tolerances to prevent blackouts*
OPG:	Ontario Power Generation
HOEP:	Hourly Ontario Energy Price

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Notes

1. 8,400 MW × 8,740 hours [1 year] × 27% power delivered to grid × $135.00 per MW/146 million MWh per IESO report of 2010 consumption = $3.80
2. $90 million/1,600 MW of current renewables × 9,043 MW of additional renewables/20-year amortization $500 million/20 years + $25 million/146 million MWh per IESO 2010 consumption report = 0.17 cents
3. $8 billion/20 years/146 million MWh per IESO report of 2010 consumption = $2.74
4. 9,600 MW × fixed feed cost of $135,000 per annum = $1,296,000,000/146 million MWh per IESO consumption report for 2010 = $8.88
5. 8,400 MW × 27% × 32.7% × 8,740 hours × $135 = $875,485,800/146 million MWh per IESO consumption report for 2010 = $6.00
6. 8,400 MW × 73% × ($61-$40) × 8,740 hours = $1,112,547,000/146 million MWh = $7.70
7. 8,400 MW × 27% × 8,740 hours × 10% × $165 = $327,068,280/146 TWh per IESO consumption report for 2010 = $2.24
8. 6,963 MW of current hydropower owned by OPG × 8,740 hours × 56% × 30% × $40 per MW, which is approximate current price OPG received/146 million MWh per IESO 2010 consumption report = $2.80.
9. $1.4 billion/146 million MWh = $9.59
10. 5,263 MW conserved × 8,740 hours × $40 per MW + $600 million/146 million MW per IESO consumption report for 2010 = $16.71 per MW
11. 500 MW of solar power × 8,740 hours × 13% × 20 years × $30 adder per MWh = approximately $341 million. 2,000 MW of wind power × 8,740 hours × 27% × 20 years × $10 adder per MWh = approximately $944 million + solar adder of $341 million/146 million MWh per IESO consumption report for 2010 = $8.80

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Bios

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