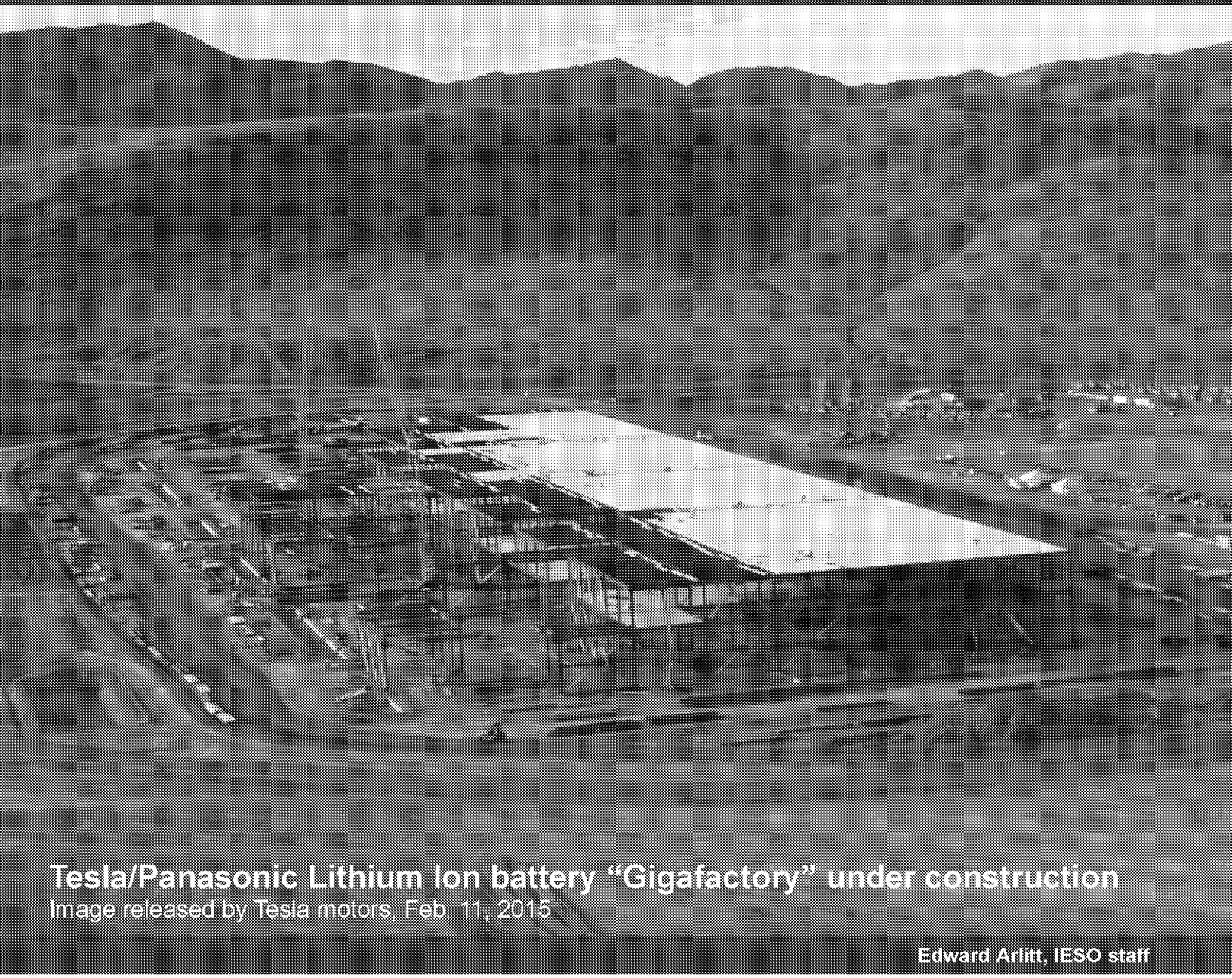
ieso
Independent Electricity System Operator

Reading of the World
2015



Tesla/Panasonic Lithium Ion battery "Gigafactory" under construction
Image released by Tesla motors, Feb. 11, 2015

Edward Arlitt, IESO staff

June 5, 2015

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PURPOSE OF THIS DOCUMENT

The *Reading of the World* document is intended to support the strategic deliberations of the IESO Board of Directors by providing a contextual overview of the IESO's external environment. Over the past several years, *Reading of the World* has served as an annual primer document for the predecessor IESO Board of Directors' annual strategy meeting. As such it is not intended to be a strategic paper in and of itself, but rather it seeks to inform the IESO Board's annual strategy development process, complementing the subject matter that may be deliberated upon in the Board's discussions. *Reading of the World* connects broader global trends to prominent topics in the Ontario electricity industry, though it is not meant to provide a comprehensive update on all activities and projects being carried out by the IESO.

This year's edition draws from trends and events spanning the timeframe from early 2014 to early 2015. As some of the forecasts and predictions presented in this paper originate from various public sources, they do not necessarily reflect the opinions or positions of the IESO.

All information contained in this report is derived from publicly-available sources.

SECTION 1: OVERVIEW

As 2015 unfolds, the newly merged-IESO enters the stage at a moment where the world's energy landscape is exhibiting a greater degree of interconnectedness than ever before. This is an important consideration for a brand new company that has to stitch together so many responsibilities ranging from planning, to system operations, to markets, to resource development, to promoting energy conservation. None of these issues are completely compartmentalized from one another, and yet they each deserve unique and special attention in their own right. To help understand the interconnections between the IESO's wide range of responsibilities, this year's *Reading of the World* will examine the relationship between various energy issues in our broader environment. Consider, for example, the following four energy-related events from the recent past:

- **In the province of Ontario**, as this document was being finalized, the provincial government articulated its intention to change its 100-year ownership relationship with a significant portion of the province's transmission and distribution infrastructure (see Crosscutting Issues section).

- **In the Nevada desert,** the Tesla Motors/Panasonic "Gigafactory" which aims to achieve massive economies of scale in Lithium-Ion battery production for electric cars and stationary energy storage begins to take form (see cover photo, and "In Summary" section).

- **In Beijing China**, the presidents of the United States and the People's Republic of China met in early November to reach a bilateral agreement on climate change that takes aim at reducing and halting the growth of Greenhouse Gas emissions in their respective countries (see Crosscutting Issues section).

- **In Vienna Austria**, the 166th meeting of the Organization of Petroleum Exporting Countries (OPEC) concluded in November with a stalwart refusal to lower their 30 million barrel/day production target – which helped solidify an oil price slump that is sending a ripple effect through the world economy in general, and the energy industry in particular (see also, Macroeconomics section).

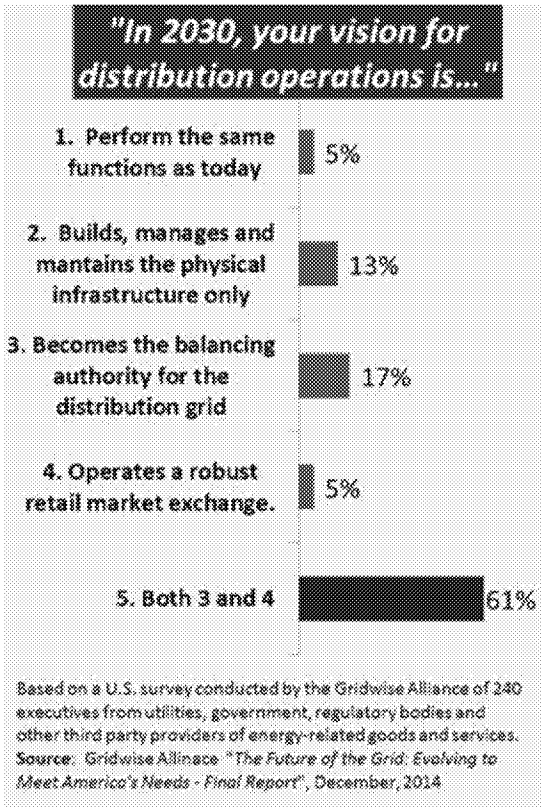
These recent events in disparate parts of the globe might, at first glance, seem to be both geographically and causally isolated from one another. The premise of this year`s *Reading of the World* however, is that a second glance at events such as these in fact reveals a close interrelationship. For one thing, they all intersect on energy prices paid by the consumer. Second, they underscore the trade-offs between societal goals for our energy system and the

bottom line costs that consumers ultimately see. Third, they highlight the growing interchangeability of various forms of primary energy – whether it comes from fossil fuels or renewable sources. And finally, they show a glimpse of a new era of empowered energy consumerism where technology not only yields the opportunity to choose one`s energy source, but also how and when to substitute it with something else.

In the "**Crosscutting Issues**" section of this year's *Reading of the World*, is an examination of the potential transformative effects of these issues that are now being evidenced by tangible industry developments in Ontario around the world:

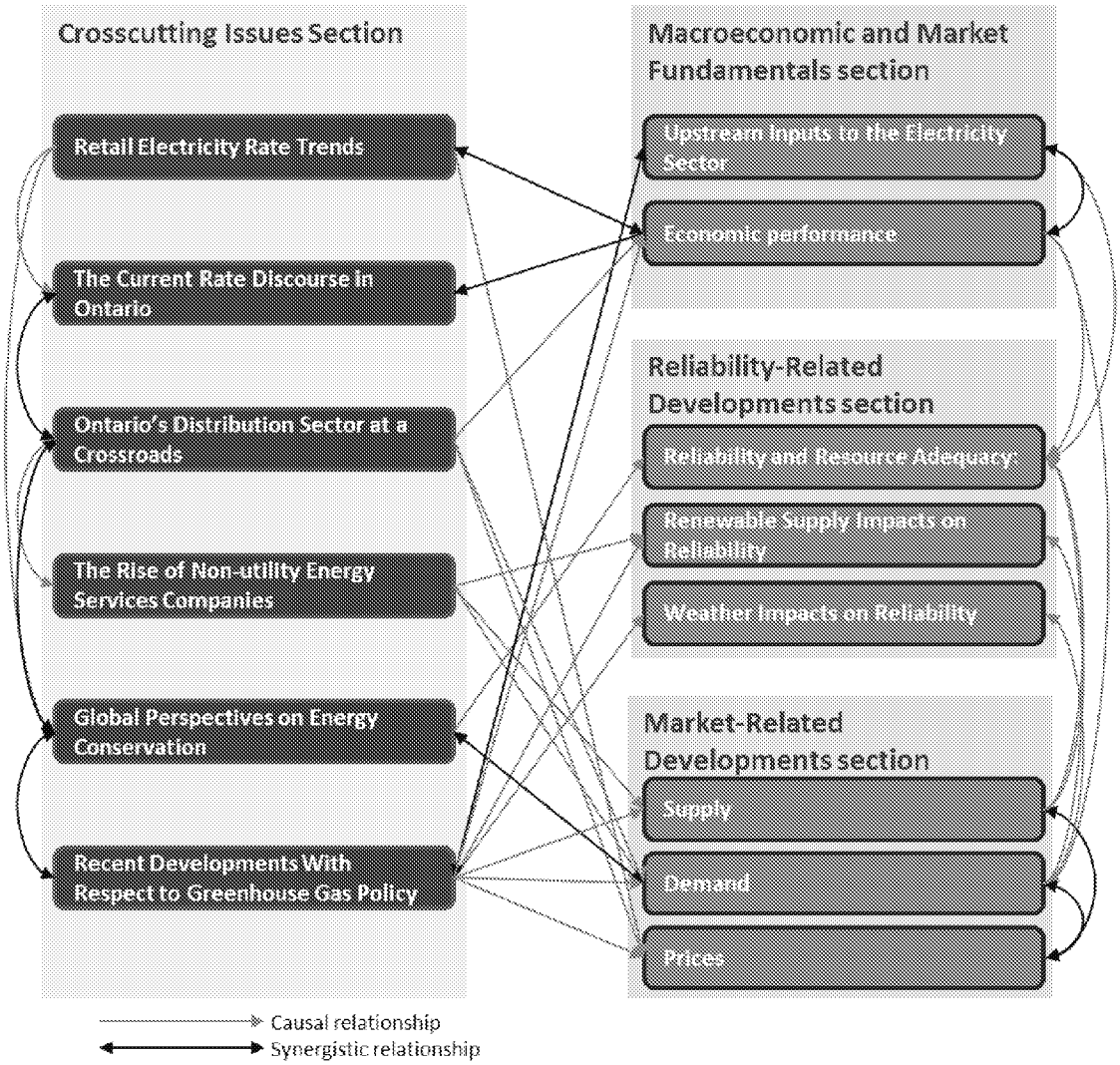
- **Retail pricing trends:** In this year's edition we will examine the state of Ontario's retail pricing trends relative to other jurisdictions around the world. The divergence between commodity prices and other costs of the electricity system is increasingly being portrayed as a symptom of a much larger discussion of the transformative impacts of new technologies, greater energy efficiency and alternatives to the traditional delivery model. Overall electricity costs to the consumer may be a crucible for this debate, though the connections between these issues are often overlooked.
- **New entrants**: A new class of energy services companies are emerging that are exploiting the transformative potential of rising rates, a troubled distribution system and aggressive environmental and conservation goals. Again in 2014 new, concrete examples have emerged of non-regulated companies filling a space that is largely unreachable by most regulated, traditional utility companies.
- **Prospects for energy efficiency:** The latest edition of Ontario's *Long-Term Energy Plan* puts forward aggressive conservation targets for the province. But how do the targets stack up to other efficiency goals around the world and what are our prospects for meeting them?
- **New impetus for environmental change.** In April, 2015 the government of Ontario announced its intention to introduce a "cap and trade" greenhouse gas emissions trading system to Ontario. This is part of a reinvigorated climate debate that began to gain momentum in 2014. In addition to the overview of climate change policy trends in the **Crosscutting Issues** section, this paper will also highlight the impacts of already being seen in the near-term renewable generation capacity additions anticipated across the North American continent in the coming year.

- **The overall effect on Ontario's local distribution companies (LDC's)**: 2014 ended with Ontario contemplating the future of the transmission and distribution arms of Hydro One – and by April of 2015, the stage for a partial privatisation was set along with a significant merger transaction at the distribution level. How will this significant transaction affect the development on Ontario's distribution sector? Ontario is not alone in asking this question. As shown in a recent survey of U.S. energy sector professionals (see illustration, right), there are few who feel the distribution sector can remain rooted solely in the one-way distribution of electricity.



These issues also permeate the traditional standing topic areas of *Reading of the World*. In the **Macroeconomics section**, we will see how the recent drop in oil prices is changing the economic prospects of various jurisdictions around the world – including the Canadian provinces. In the **Reliability section**, is an examination of the effects that environmental regulation are already having on the resource adequacy outlook for the Eastern Interconnection. And in the **Markets section**, the impact of the North American electricity industry's increasing reliance on the fortunes of natural gas as a primary energy supply is making its presence felt. Connect these themes and one can see the ripple effect that a change in policy in one area of the energy system will have on all of its constituent parts. As one will note in the diagram on the next page, there is a complex array of causal and synergistic relationships to the various major issues presented *Reading of the World, 2015.*

***Figure – some of the prominent relationships between the major topics discussed in Reading of the World 2015*:**

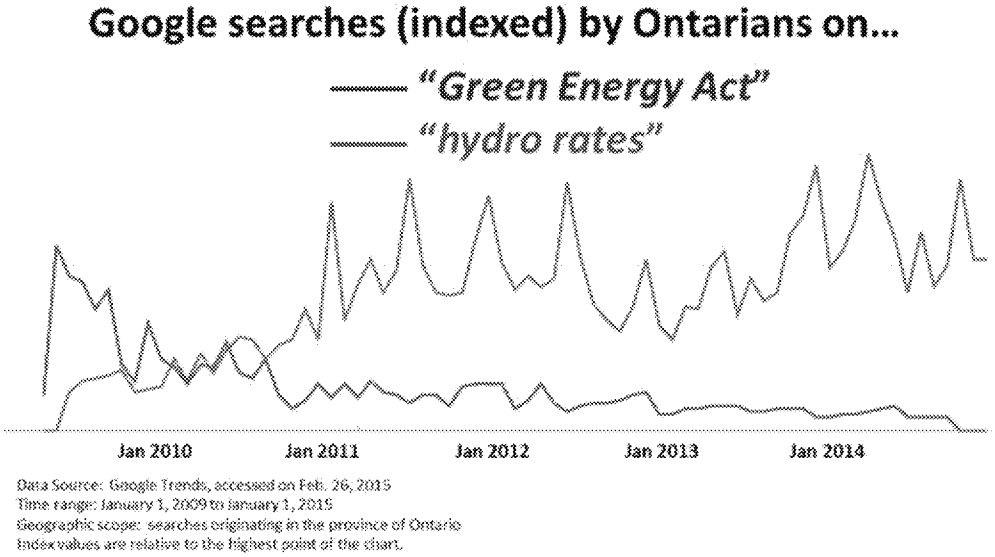


As we will see in the coming pages, these connections are arguably as important as the issues themselves.

SECTION 2: CROSSCUTTING ISSUES

RETAIL ELECTRICITY RATE TRENDS

A recent examination of Ontarians' Google search trends suggests that interest in the *Green Energy Act*, (which has had a profound influence on the recent developmental history of Ontario' electricity system), has receded well into the background since it received Royal Assent in 2009. Meanwhile interest in "hydro rates" endured and even surpassed the interest that Ontarians ever seemed to express in this pivotal piece of legislation. There are a number of possible explanations for this trend, but the underlying subject of the all-in costs of the retail consumer is an important one.



In this year's *Reading of the World*, retail electricity rate trends have been elevated to the front of the **Crosscutting Issues** section. Around the world, the size and structure of electricity rates are becoming a major force of change in this industry. From political conjecture, to the financial viability of the regulated distribution sector, to opening up new business opportunities, electricity rates are having both intended and unintended consequences. Over the course of this year's **Crosscutting Issues** section, we will explore several of the consequential effects of rising electricity rates and declining demand on industry structure, new

2015 Projected growth rates of residential electricity prices	
United States	1.0%[1]
Ontario	5.8%[2]

[1] Source: U.S. Energy Information Administration, "*Today in Energy*", March 16, 2015
[2] Source: Ontario Ministry of Energy, "*Long-Term Energy Plan*", December, 2013

entrants into the industry, and the global prospects for realizing even greater conservation and energy efficiency.

The diagram on the next page shows Ontario's all-in residential electricity costs (i.e. including taxes, global adjustment and all other charges) relative to other jurisdictions around North America[3]. The North American continent however, still enjoys relatively low residential electricity costs compared to other jurisdictions around the world. The question is which benchmark is the correct one? Certainly electricity prices have always been held up as a comparator of relative economic competitiveness for as long as Ontario has had a public power industry.

More recently, progress on environmental issues and the development of renewable energy have figured prominently into the plans of both nations and local jurisdictions. Finding a relationship between the costs paid by the consumer and development of renewable energy is far from a clear exercise however. This is perhaps most strikingly illustrated in the graph which appears on the next page. As one will note, a selection of international comparisons using 2013 data shows a high degree of correlation between the bottom-line costs consumers pay in each of those countries, and the amount of non-hydro renewable electricity generation in that country (specifically, a correlation factor of 0.72). However, across all of the provincial and state jurisdictions in North America, this correlation breaks down entirely. What are the reasons for this? Certainly in North America various jurisdictions on the continent are at different developmental stages when it comes to renewable energy. One will also find vastly different starting points with respect to supply mix, taxation policy, industry structure, environmental policy and proximity to natural gas supply – just to name a few other factors.

Identifying an over-arching driver for all-in electricity costs paid by the consumer may be a daunting, or even impossible task. Nonetheless there are some trends emerging in the electricity sector that most certainly connect to bottom-line costs and their importance appears to be growing. Factors affecting overall system usage such as growth of distributed generation, and conservation are relevant to both consumer costs and the profitability of the utility company. With the help of technology, these factors seem to transcend jurisdictional boundaries and differences in local policies. Also of emerging importance, is the structure of the distribution sector which supports these activities. Local distribution structures can create barriers or incentives to new entrants into the growing market for behind-the-meter products and services that can also affect a consumer's bottom line – and those of utilities. These are among the issues that will be explored in this Crosscutting Issues section, and as we shall see, are of significant relevance to the recent discourse in Ontario.

[3] See also, figure "Ontario residential electricity unit costs – jurisdictional comparison"

Ontario residential all-in electricity prices – jurisdictional comparisons

The World (2013 data)

Country	Electricity all-in costs (per kWh) for Households - 2013	% of 2013 domestic energy production from non-hydro renewables
Denmark	$0.39	35.1%
Germany	$0.35	13.0%
Italy	$0.31	13.2%
Ireland	$0.29	15.1%
Portugal	$0.28	23.6%
Austria	$0.27	4.3%
Belgium	$0.26	6.0%
Netherlands	$0.26	5.4%
Japan	$0.24	1.7%
Slovak Republic	$0.24	2.4%
Sweden	$0.23	0.3%
United Kingdom	$0.23	6.0%
Greece	$0.22	8.5%
Slovenia	$0.21	1.1%
Luxembourg	$0.21	2.6%
Czech Republic	$0.21	3.2%
Switzerland	$0.20	0.3%
Finland	$0.20	1.1%
Poland	$0.20	3.2%
France	$0.19	3.6%
Turkey	$0.19	2.9%
Hungary	$0.18	2.4%
Estonia	$0.17	4.0%
Chile	$0.17	0.6%
Ontario	$0.16	4.2% (2013)
Israel	$0.15	0.9%
Norway	$0.15	1.1%
United States	$0.12	4.2%
Korea	$0.10	0.4%
Mexico	$0.09	3.1%

North America (2014 data)

North American jurisdiction	Electricity all-in costs (U.S. cents per kWh) for Households - August 2014	% of 2014 domestic energy production from non-hydro renewables
Alaska	$0.20	3.4%
Connecticut	$0.20	2.4%
New York	$0.19	4.8%
Rhode Island	$0.18	3.7%
California	$0.18	21.9%
Vermont	$0.18	11.4%
Massachusetts	$0.18	5.9%
New Hampshire	$0.17	10.2%
Ontario	$0.17	4.6% (2014)
New Jersey	$0.16	2.5%
Prince Edward Island	$0.16	See note 1
Nova Scotia	$0.15	4.7%
Maine	$0.15	35.2%
Michigan	$0.15	6.3%
Saskatchewan	$0.15	3.3%
Wisconsin	$0.14	5.4%
Delaware	$0.14	1.6%
Pennsylvania	$0.14	2.8%
Maryland	$0.14	2.7%
New Mexico	$0.14	8.8%
Ohio	$0.14	1.5%
Iowa	$0.13	28.8%
Alberta	$0.13	3.7%
Minnesota	$0.13	18.9%
Colorado	$0.13	14.3%
Kansas	$0.13	21.8%
District of Columbia	$0.13	0.0%
Nevada	$0.13	12.0%
Georgia	$0.13	3.4%
South Carolina	$0.12	2.3%
New Brunswick	$0.12	4.2%
Arizona	$0.12	3.4%
Missouri	$0.12	1.4%
Nebraska	$0.12	7.1%
Texas	$0.12	9.5%
Virginia	$0.12	4.8%
Florida	$0.12	2.3%
Illinois	$0.12	5.3%
Newfoundland	$0.12	0.2%
Alabama	$0.12	2.2%
Mississippi	$0.12	2.7%
Indiana	$0.12	3.5%
Utah	$0.12	2.9%
North Carolina	$0.11	2.6%
South Dakota	$0.11	25.3%
Wyoming	$0.11	8.9%
North Dakota	$0.11	17.6%
Montana	$0.11	6.5%
Oregon	$0.11	14.9%
Idaho	$0.11	22.5%
Tennessee	$0.10	1.4%
Oklahoma	$0.10	17.3%
Kentucky	$0.10	0.5%
Arkansas	$0.10	2.6%
Louisiana	$0.10	2.6%
West Virginia	$0.10	1.3%
British Columbia	$0.09	0.0%
Washington	$0.09	7.8%
Manitoba	$0.08	1.3%
Quebec	$0.07	0.3%

Is there a relationship between renewable energy output and costs to the consumer?

When one looks at selected international comparisons (above), it might be easy to quickly draw such a conclusion. However, a similar comparison of North American jurisdictions (right) shows that this relationship is far from clear. As will be seen in this year's *Reading of the World*, there are a wide range of factor by which might affect the all-in costs ultimately paid by the consumer including:

- Tariff structures (see Crosscutting issues and Markets sections)
- Supply mix (see Markets section)
- Environmental policies (see Crosscutting issues section)
- Conservation measures (see Crosscutting issues section)
- Resource adequacy (see Reliability section)

Data sources:
International Energy Agency, *"IEA Key World Energy Statistics"*,
International Energy Agency, *Monthly Electricity Statistics*, January, 2015,
U.S. Energy Information Administration, *Electric Power Monthly* data for August 2014 Release Date: October 24, 2014,
Hydro Quebec, *"Comparison of electricity prices in major North American Cities - Rates in effect April 1, 2014"*
Statistics Canada Data Series CANSIM 127-0002 *Electric power generation, by class of electricity producer*
IESO summary supply data for 2014
BP Statistical Review of World Energy, June 2014,
Note 1: PEI excluded due to the outlier nature of its data and high reliance on its electrical connection to the mainland. According to Statistics Canada, wind power accounted for 97.3% of its domestic energy generation in 2014.
Note 2: This graph relies on data from a different timeframe from a similar dataset regarding retail prices presented to the IESO Board, and some values may vary slightly from those previous figures.

Another pressing question is **how are these costs changing over time?** There have certainly been moments in Ontario's past where individual year-over-year rate increases certainly stand out. For example, between 1977 and 1978 Ontario residential electricity rates jumped by 15.4% in a single year – even after adjusting for the relatively high inflation rate of that period. [4] From 1991 to 1992 rates also jumped by 9.8% (also accounting for inflation) during a year of comparatively lower inflation.[5] In other individual years during the past four decades, rates failed to keep pace with inflation and have actually fallen in real terms. Given the sporadic nature of Ontario's electricity cost levels on a year-to-year basis, taking the longer-term view becomes important in order to discern an overall trend.

Determining the trajectory of Ontario's all-in electricity costs relative to other components of consumer expenditures is an important measure of the prospective value of the electricity sector relative to other components of our economy. Certainly the issue of direct supplements or outright substitutes to electricity from the utility grid is an issue of growing concern (see also, the "grid parity" discussion further on in this section). So too are the linkages between the supply mix and changing environmental policies, which will also be examined in this section.

While there are no shortage of short-term comparisons being drawn between Ontario electricity prices and those of other jurisdictions, what is perhaps more pressing to understand is how and why the rate of change has been altered over the previous decade. And here, a change from 20th century norms has most certainly taken place.

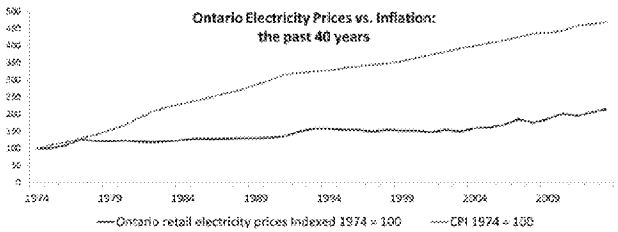
If one examines the series of charts on the following page, it can be seen that historically Ontario electricity prices have not risen as fast as other consumer price indicators over the long-term. However, this trend has clearly changed in more recent times. Each pair of graphs on the next page provides this comparison on a 40-year and 10-year timeline.

[4] Source: Statistics Canada CPI index and Ontario Hydro, *1981 statistical yearbook*
[5] Source: Statistics Canada CPI index and Ontario Hydro, *1992 statistical yearbook*

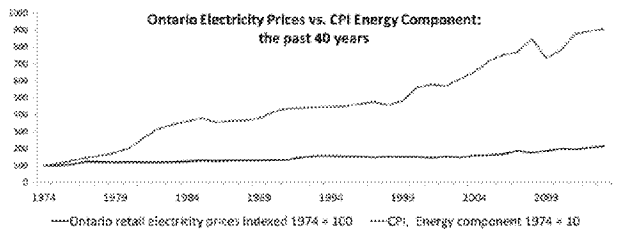
Ontario residential price trends: the longer view…

The past 40 years..

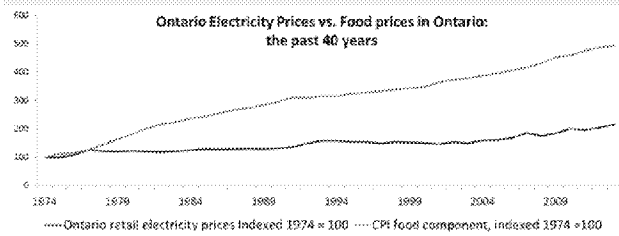
Ontario Electricity costs vs. Inflation:



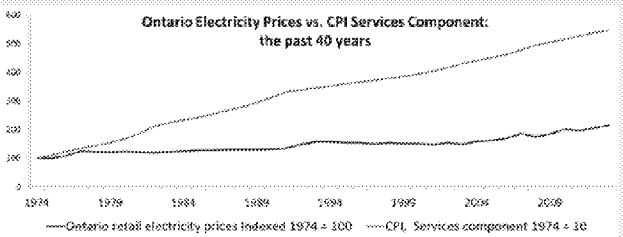
Ontario Electricity costs vs. Energy component of the CPI index:



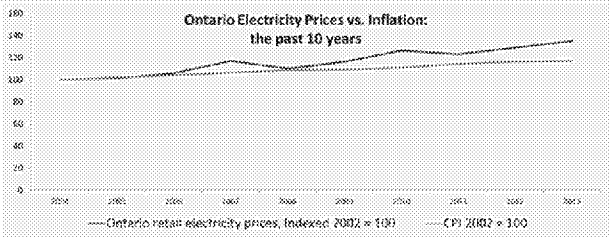
Ontario Electricity costs vs. Food prices:

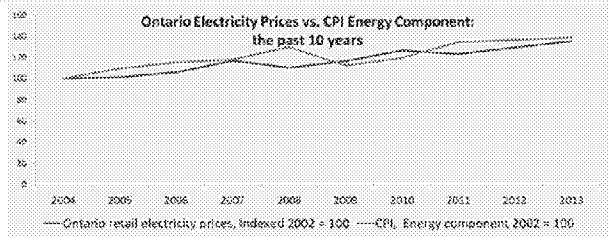


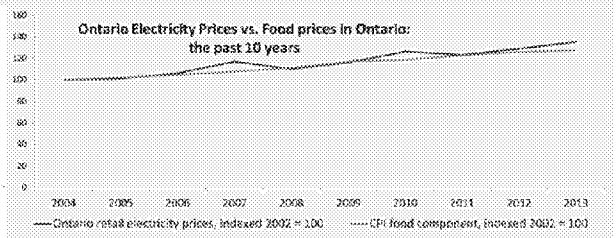
Ontario Electricity costs vs. services component of CPI index

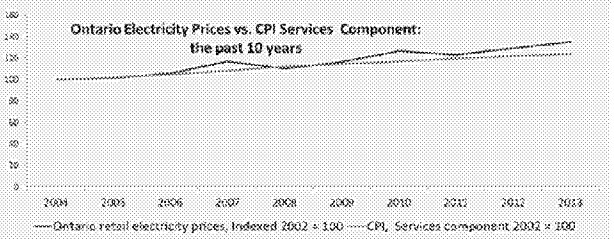


The past 10 years…









Notes:
Ontario electricity prices adjusted for Canadian CPI indexed before being indexed to the applicable reference year.
Data Source – CPI index: Statistics Canada, CANSIM data table, 326-0020
Data Sources – electricity unit costs (residential):
1974 - 1996: Ontario Hydro, various annual reports and statistical yearbooks
1997-2006: Statistics Canada, "Electric Power Generation, Transmission" Catalogue no. 57-202-XIB
2007-2012: OEB Distributors Yearbooks
2013 and 2014: Estimate and forecast contained in *Ontario Long-Term Energy Plan*. December, 2013, pg. 15

Spotting a Trend – the importance of timeframe:

Each of the four pairs of graphs above compares the indexed value of Ontario residential electricity costs to various components of the Consumer Price Index. The graphs in the left-hand column illustrate the indexed value of Ontario electricity costs and the CPI component indexed to the year 1974. On the right-hand side: the same comparison, except the index year is 2004. Together, all four comparisons show that the past decade has seen a much faster rise in electricity costs relative to the 40-year trend.

Ontario's past 10 years looks very different than the longer trend of the past fourty. Over the past 10 years, Ontario electricity prices have caught up with Canada's overall Consumer Price Index (CPI) inflation rate and in some years, exceeded it. This is a far cry different from the rate trends of the previous 40 years as depicted in the figure, "*Ontario residential price trends – the longer view*". As indicated on the same diagram, the same break in the long-term trend appears in other, individual components of the CPI such as energy in general, food prices and general services. As indicated in the table below, the past ten years are particularly noteworthy as being the first decade in Ontario's history in which there was an overall decline in energy use. The growing disconnection between energy use and system costs is coming to the forefront of the electricity discourse in Ontario and in many other jurisdictions in the developed world. As we will see in the remainder of this Crosscutting Issues section, this trend will be further reinforced by revenue decoupling, the province's energy conservation ambitions, and potentially, future environmental policies.

Average Ontario energy use: 10-year Compound Annual Growth Rates[6]

1974-1984	1984-1994	1994-2004	2004-2014
3.81%	1.36%	1.34%	-1.15%

Change in Ontario all-in electricity prices: 10-year Compound Annual Growth Rates

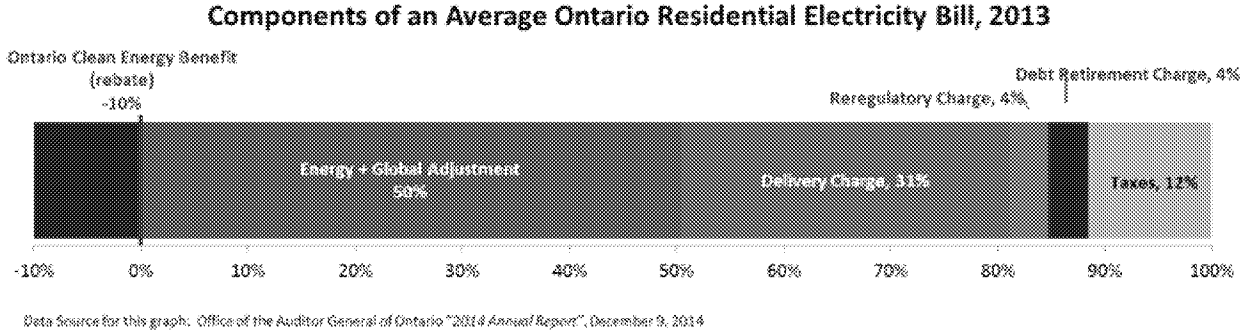
1974-1984	1984-1994	1994-2004	2004-2014
2.25%	2.37%	0.09%	3.25%

Overall, the data points to an accelerated increase in the bottom line costs for most Ontario residential electricity consumers. Consumer bill impacts have always been front and centre in Ontario's electricity sector dialogue. As we shall see in the coming section however, the debate in 2015 is rapidly moving towards several factors affecting the consumer's electricity bill. The potential knock-on effects of Ontario's electricity pricing policy on various IESO-administered programs could be significant.

[6] Data Sources: **1974 - 1996:** Ontario Hydro - various annual reports and statistical summaries **1997 – 2014:** IESO, various compendium documents to the *18-month Outlook* and IESO website
Data Sources: **1974 - 1996:** Ontario Hydro, various annual reports and statistical yearbooks **1997-2006**: Statistics Canada, "Electric Power Generation, Transmission" Catalogue no. 57-202-XIB **2007-2012:** OEB *Distributors Yearbooks* **2013 and 2014**: Estimate and forecast contained in Ontario *Long-Term Energy Plan*, December, 2013, pg. 15

THE CURRENT RATE DISCOURSE IN ONTARIO:

In Ontario the composition of electricity rates has been the focus of several reports in 2014 including Ontario's Office of the Auditor General, the Fraser Institute, and the Ontario Energy Board. As of the end of 2014, there are several changes to the residential consumer's bottom line that are under close scrutiny at the moment…



Confirmed changes by end of 2015:

- **Removal** of the **Ontario Clean Energy Benefit,** a 10% rebate on residential bills is currently scheduled to occur at the end of 2015.
- **Removal** of the **Debt Retirement Charge**: Removal of this change charge from residential bills is also scheduled to occur on December 31st 2015.
- Implementation of the **Ontario Electricity Support Program (OESP)** as of January 1, 2016 with the stated purpose of "*…on-bill, rate assistance for low-income electricity consumers in Ontario*" [7] According to a Ministry of Energy news release, the demarcation point would be an income of $28,000 which would entitle the customer to a $38/month credit.[8]

Confirmed change to be implemented 2016 to 2019:

- Implementation of **Revenue Decoupling:** On April 2nd, 2015, the Ontario Energy Board confirmed that the manner in which distribution charges are applied will be changing from using energy as a cost drive to a fixed charge. This will affect between 20% and 25% of the residential consumer's total electricity bill. These changes have profoundly important implications for the future development of new smart grid technologies and the distribution system at large and are discussed in further detail further in this section.

[7] Webiste of the Ontario Energy Board, accessed on April 21, 2015
[8] Ontario Ministry of Energy, news release, "*Ontario to Remove Debt Retirement Charge and Launch Low-Income Electricity Support Program*" March 26, 2015

Under regulatory scrutiny:

- **Energy + Global Adjustment** line item: Recently the Ontario Auditor General recommended greater transparency in separating the electricity price from the Global Adjustment component, and to reconsider the design of Time of Use rates applicable to residential and small General Service customers[9]. In response to this report, the OEB committed to conducting such a review during their 2014/15 fiscal year.[10]
- **Size of delivery charges** in this province are now just beginning to feel the impact of the OEB's *Renewed Regulatory Framework for Electricity*, which has been instated over the past two years. The Renewed Regulatory Framework allows LDCs a wider leeway in choosing the type of investments needed for their infrastructure. The impact of smart metering on these delivery charges has also been the subject of the Auditor General's recent report on smart metering. In addition, the OEB is in the midst of a review of revenue decoupling (see next section).

Will any of these proposed changes have a material bearing on the future of the retail electricity sector?

Despite the intensified scrutiny being given to each line item on the customer bill, only one regulatory effort listed on the previous page seems to directly address the issue of ensuring that the costs of the Ontario's electricity infrastructure are recoverable in the face of declining consumer demand. The notion of "decoupling" distribution company revenues from energy use is a longstanding topic of debate which was given new life on March 31, 2014 with the Ontario Energy Board's release of a Board report stating its intent of moving in this direction.[11] In April, 2015 the OEB confirmed that these changes will be implemented as LDCs renew their rate filings between 2016 and 2019.[12]

Revenue Decoupling – a concise definition:

"In the electricity and gas sectors, "decoupling" (or "revenue decoupling") is a generic term for a rate adjustment mechanism that separates (decouples) an electric or gas utility's fixed cost recovery from the amount of electricity or gas it sells."[13]

[9] Office of the Auditor General of Ontario "*2014 Annual Report*", Chapter 3.11, *'Smart Metering Initiative'*, pg. 385-386

[10] Ibid. It should be noted that the OEB had previously committed to conducting a comprehensive review of TOU rate structures at the end of 2013 and had already commissioned a study on such rates as was examined in *Reading of the World, 2014*.

[11] Specifically, Ontario Energy Board,"*EB-2012-0410, Draft Report of the Board Rate Design for Electricity Distributors*" March 31, 2014

[12] Ontario Energy Board, "EB-2012-0410 – Board Policy: A New Distribution Rate Design for Residential Electricity Consumers" April 2, 2014, page 24

[13] National Association of Regulatory Utility Commissioners, "Decoupling For Electric & Gas Utilities: Frequently Asked Questions (FAQ)", pg. 2

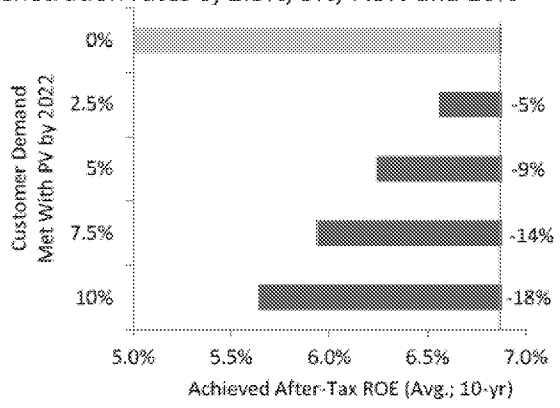
Perspectives on revenue decoupling:

"{Green Energy Coalition} GEC is concerned that the proposed move to a 100% fixed charge for electricity distribution rates will undermine the Conservation First agenda, reducing CDM effectiveness and/or increase its costs of delivery and unfairly subsidize larger, wealthier customers at the expense of smaller, less affluent ratepayers." [14] ***"... It is absolutely unavoidable from this perspective to see a single residential customer charge or a single customer charge for small business customers up to 50 kW as anything other than "Robin Hood in Reverse.""*** [15]	***"The CLD {Coalition of Large Distributors} supports the Board's intention to decouple a distributor's revenue from consumers' consumption of Energy. A fixed rate design allows consumer to be focused on the commodity portion of their bill and furthers consumers' understanding of the fixed nature of distribution systems' infrastructure"*** [16]

Greater energy efficiency and levels of distributed generation have been eroding the revenues of distribution companies in Ontario and around the world. In 2013 the amount of installed solar capacity around the world rose by 36.8%, and 64.8% in North America. In Ontario by early 2016 the IESO expects 85% of its solar capacity to be embedded within distribution systems. Last year, the Edison Electric Institute postulated that up to $170 billion in U.S. distribution revenues could be at risk in the face of these trends.[17] Basing the revenues of LDCs on the basis of a fixed charge would hypothetically insulate distribution companies from a significant loss of revenues implied by these trends. In 2014 the U.S. Department of Energy's Lawrence Berkeley National Laboratories decided to put these questions to the test in a rigorous financial model of a vertically integrated utilities and an investor-owned distribution utility with a business model very similar to an Ontario LDC[18]. The results of the study were striking. The study examined various penetration levels of embedded solar photovoltaic generation, and also the potential implications of various policy options – including revenue decoupling. Overall, the model's base case results showed a disturbing tendency of many potential policy options to pit the interests of consumers against the returns of the utility shareholder, when that utility is already facing revenue erosion due to distributed generation.

[14] Green Energy Coalition submission to the Ontario Energy Board, "Re: EB-2012-0410 – Rate Design for Electricity Distributors – GEC submission" June 3, 2014, pg. 1
[15] Ibid. pg. 5
[16] Coalition of Large Distributors, submission to the Ontario Energy Board "*Rate Design for Electricity Distributors, Submission of the Coalition of Large Distributors, Board File No. EB-2012-0410*," June 6, 2014 pg. 1
[17] Edison Electric Institute (EEI), "Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business" pg. 4
[18] With reference to: .S. Department of Energy, Lawrence Berkeley National Laboratories, "*Financial Impacts of Net-Metered PV* on Utilities and Ratepayers: A Scoping Study of Two Prototypical U.S. Utilities*" September, 2014

The Lawrence Berkeley National Laboratories study: 1-year impacts on utility Return on Equity for solar penetration rates of 2.5%, 5%, 7.5% and 10%



Indeed, virtually all of measures studied by the Lawrence Berkeley National Laboratories seemed to indicate that most policy measures designed to save the rate of return for the LDC shareholder will download some or all of the revenue erosion back on to the customer. The dynamics behind the mathematical model are intuitive: fixed distribution rates will ultimately be borne by all customers, save for those that choose to leave the system entirely. Ontario's recent decision to adopt revenue decoupling (a measure that will, by the OEB's estimate, take four years to implement) may help resolve some of the near-term revenue erosion issues faced by Ontario's LDCs. However, the Lawrence Berkeley Labs study raises a much more fundamental problem that may manifest itself in the coming years. It is noteworthy however, that one option in the Berkeley study seemed to help the resolve the dilemma of fixing a charge for a system that will inherently be used less: an overhaul of the role of the distribution company itself.

Is Ontario ready for such a discussion? To date, the main near-term focus of the regulator seems to be the implementation of revenue decoupling. However, as will be seen in the next section, other events taking place in Ontario may force a more fundamental debate about the role of the distribution company and the types of activities it may be prompted to engage in.

ONTARIO'S DISTRIBUTION SECTOR AT A CROSSROADS:

1922:

"The plan of governmentally-owned and operated electric utilities grew out of the belief by seven municipalities lying within transmission distance of Niagara Falls, that power therefrom could be generated and transmitted to them at a cost far less than that being paid for the supply received from private companies, and then later, the scheme spread throughout the Province of Ontario, and today, instead of seven of the municipalities receiving Hydro-Electric power, the number has increased to over two hundred."

Murray, S, *"Government Owned and Controlled compared with Privately Owned and Regulated Electric Utilities in Canada and the United States"* National Electric Light Association, Pgs. 7 to 8
1922

2014:

"We have concluded, as did the 2012 report from the Ontario Distribution Sector Review Panel, that economies of scale enabled by further consolidation would lead to a favourable impact on rates."

Premier's Advisory Council on Government Assets, final report, page 33

April, 2015

The year 2014 saw Ontario moving once again towards a fundamental debate regarding the structure of its electricity distribution system. This culminated in the government's April 2015 announcement of its partial divestiture of Hydro One, and a major merger transaction between four of the province's larger LDCs. This is the latest chapter in a debate over the structure of province's distribution sector which, over the past 15 years, has slowly departed from the hundreds of individual municipal boundaries which once defined its overall topology for most of the previous century.

The advice taken from the **Premier's Advisory Council on Government Assets** has potentially far-reaching implications beyond the fate of Hydro One. In 2012, a previous report commissioned by the Ontario government recommended a drastic reduction in the number of distribution companies across the province in order to achieve economies of scale, access to cheaper capital and to avoid a fragmentation of service levels enjoyed by urban and rural

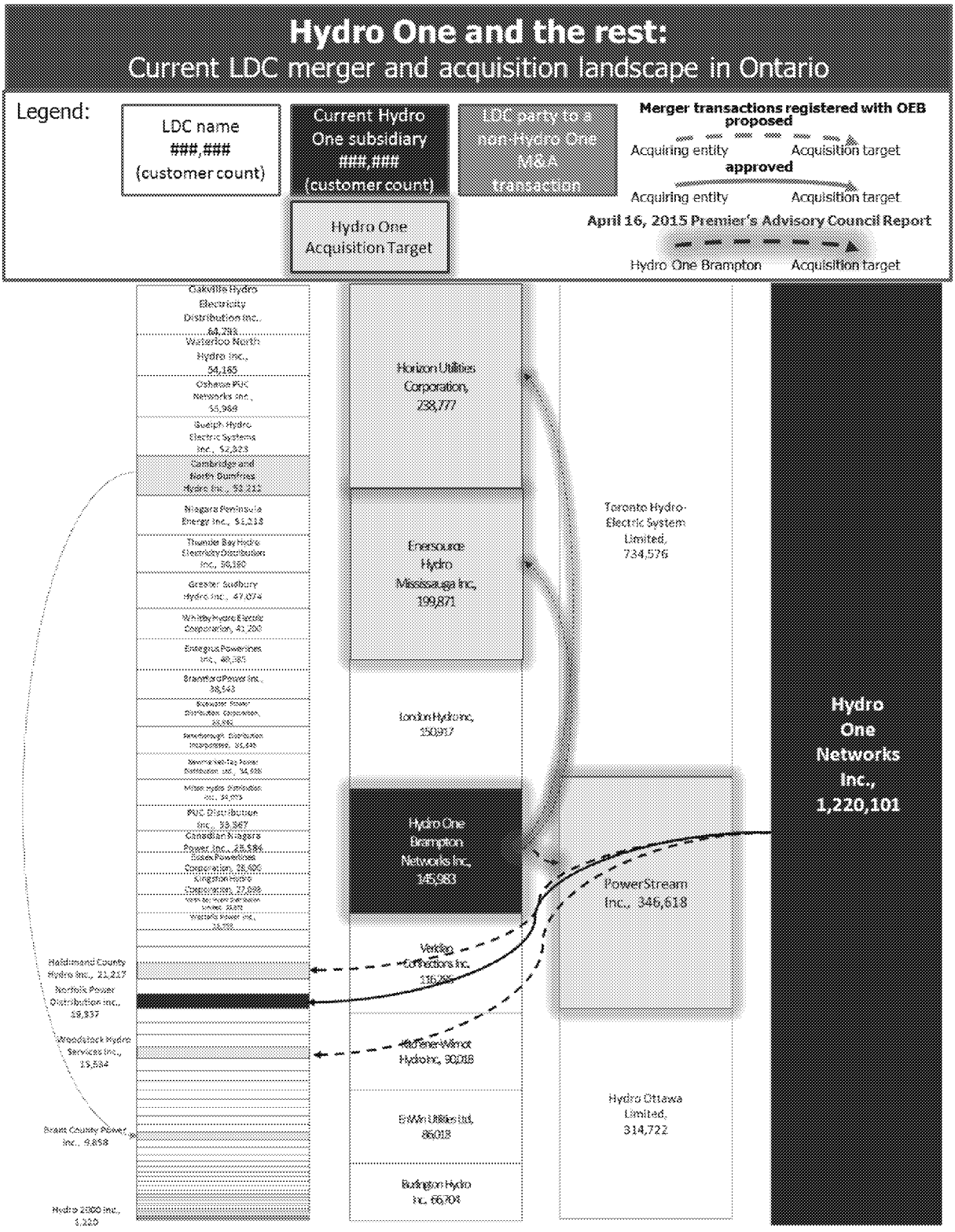
customers.[19] In the intervening time since that report, there has been relatively little merger/acquisition activity in the LDC sector compared to the measures called for in that report. As noted in the figure on the next page, most of what little activity that took place in 2014 was instigated by Hydro One. In both its 2014 and 2015 reports, the Premier's Advisory Council sees the divestiture[20] of the distribution arm of Hydro One as a potential crucible to further LDC consolidations. However, the overall value of this transaction could be affected by a wide variety of factors including those discussed earlier in this **Crosscutting Issues** section such as distribution rate design (i.e. "revenue decoupling"), the impact of the OEB *Renewed Regulatory Framework for Electricity* , and the province's overall policy towards consolidation. On this latter point, the Ontario government's task force report into the Distribution sector in 2012 cited several other barriers to future consolidation which would not be directly addressed merely by the sale, or retention of, of Hydro One's distribution arm – some of which were reiterated in the Premier's Advisory Council's April, 2015 report.[21]

In the near term, the Ontario government's response to the Premier's Advisory Council on Government Assets and the Distribution sector panel report may provide some impetus for further consolidation. In the next section however, is an example of a much more fundamental change to the distribution sector of New York State which seeks to address some of the pressing issues that Ontario's LDCs will most likely face in the coming years.

[19] Ontario Distribution Sector Review Panel, Elston, Murray et. al., "*Renewing Ontario's Electricity Distribution Sector: Putting the Consumer First",* December 2012

[20] It should be noted that the Premier's Advisory Council has suggested a number of avenues by which such a transaction should be conducted, including a potential secondary sale of hydro One Brampton, and potential retention of a 40 – 45% public ownership stake in the distribution arm. See also, Premier's Advisory Council on Government Assets Initial Report "*RETAIN & GAIN: Making Ontario's Assets Work Better for Taxpayers and Consumers*" pg.8 for details

[21] Particularly in regards to taxation measures. See also, Premier's Advisory Council on Government Assets, "STRIKING THE RIGHT BALANCE: Improving Performance and Unlocking Value in the Electricity Sector in Ontario" pgs. 18 - 22


Hydro One and the rest:
Current LDC merger and acquisition landscape in Ontario
Legend:
LDC name
###,###
(customer count)
Current Hydro One subsidiary
###,###
(customer count)
LDC party to a non-Hydro One M&A transaction
Hydro One Acquisition Target
Merger transactions registered with OEB
proposed
Acquiring entity
Acquisition target
approved
Acquiring entity
Acquisition target
April 16, 2015 Premier's Advisory Council Report
Hydro One Brampton
Acquisition target
Oakville Hydro Electricity Distribution Inc., 64,293
Waterloo North Hydro Inc., 54,165
Oshawa PUC Networks Inc., 55,969
Guelph Hydro Electric Systems Inc., 52,923
Cambridge and North Dumfries Hydro Inc., 53,215
Niagara Peninsula Energy Inc., 51,218
Thunder Bay Hydro Electricity Distribution Inc., 50,180
Greater Sudbury Hydro Inc., 47,074
Norfolk Power Distribution Inc., 18,837
Woodstock Hydro Services Inc., 13,534
Brant County Power Inc., 9,858
Haldimand County Hydro Inc., 21,217
Hydro 2000 Inc., 1,220
Horizon Utilities Corporation, 258,777
Enersource Hydro Mississauga Inc., 199,871
London Hydro Inc., 150,917
Hydro One Brampton Networks Inc., 185,983
Veridian Connections Inc., 116,295
EnWin Utilities Ltd., 86,018
Burlington Hydro Inc., 66,704
Toronto Hydro-Electric System Limited, 734,576
PowerStream Inc., 346,618
Hydro Ottawa Limited, 314,722
Hydro One Networks Inc., 1,220,101

DISTRIBUTION SECTOR OVERHAUL – THE NEW YORK STATE EFFORTS:

Ontario is not the only jurisdiction that is undertaking some degree of soul-searching on the future of its distribution sector. In April 2014, the **New York State Public Service Commission** launched the "***Reforming the Energy Vision***" **(REV)** initiative. The REV has two major work streams, the first being a fundamental examination of the role of the distribution company – particularly insofar as facilitating market-based approaches to load management and meeting over-arching energy efficiency goals. The second work stream will examine the types of tariffs and market incentives structures that are appropriate to drive those goals.

Of particular interest in the New York REV process, is the conceptualization of common ***distributed system platform*** (DSP). The DSP concept extends beyond the conventional discussion of merely separating a utility from its 'wires' business. It is intended to afford the opportunity for distributed generation, storage, and controllable load to participate in a marketplace in a uniform manner that spans the state, and the boundary between different distribution companies. In so doing this, the DSP concept reflects a growing recognition that distribution companies increasingly have the same type of commercial and operating challenges as a system operator such as the IESO for example. This includes a need to balance generation, load and storage capabilities on a continuous basis, and ensure these resources are fairly compensated for the localized benefits they provide to the distribution system.

In essence, the REV seeks to redesign the distribution system, accounting for several emerging trends including:

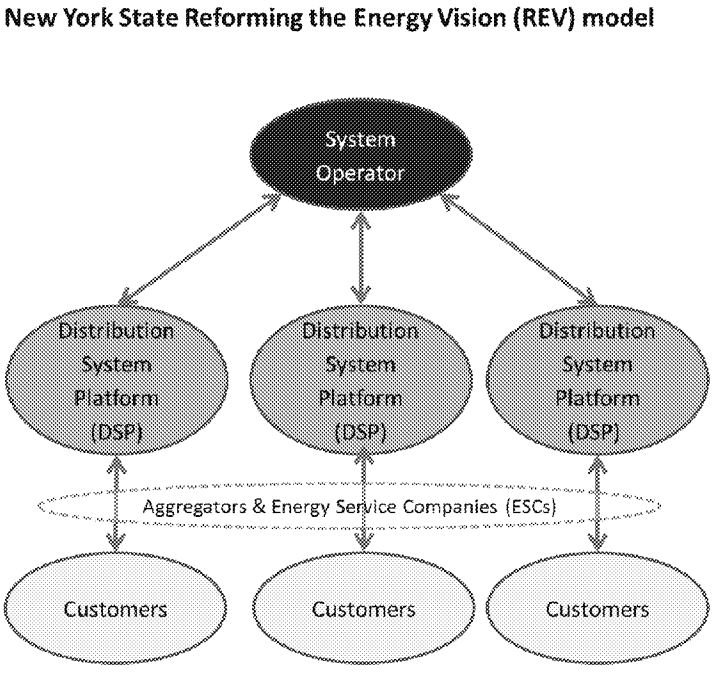
- higher growth of the distributed energy resources;
- falling demand from the traditional electricity system;
- greater need for local resiliency; and,
- an emerging need for a market-based approach to optimizing generation, load and storage assets at the distribution system.

What appears to be emerging from the New York State discourse, is a new hierarchy in which optimization, now takes place at different levels of abstraction across the entire electricity system. This new topological concept of optimization taking place at the transmission and distribution levels is illustrated in the diagram on the next page.

Examining the topological concept of New York's concept of a Distribution Platform as depicted in the diagram below, there are some interesting takeaways from a System Operator's standpoint:

- From a commercial standpoint, the wholesale market is no longer the one and only location where generation, load and storage are optimized.
- From an operational standpoint, the distribution system increasingly performs a similar function to a system operator.
- A system operator's relationship with the distributor system as a one-way consumer of energy from the Bulk Electricity System becomes much more complex. This is a similar dynamic to that which is already taking place between customers and their utility.

Figure: New York State REV – conceptual overview of proposed distribution structure



In many ways the DSP can be seen as the next step in reforms to the distribution sector beyond the revenue decoupling and public ownership debate taking place in Ontario. On its own, re-basing an LDC's revenue through revenue decoupling does not necessarily create new public value. Providing a platform for new entrants into the marketplace however, does take direct aim at new value creation. The notion of transforming the traditional electricity system to a "platform" enabling the participation of new third party service providers is already showing signs of traction across the private sector. Already in 2014 is a growing array of examples of the types of new entrants that may fill the new competitive spaces of a restructured distribution

sector. In the next section, this document examines some of the major developments in this front over the past year.

THE RISE OF NON-UTILITY ENERGY SERVICES COMPANIES

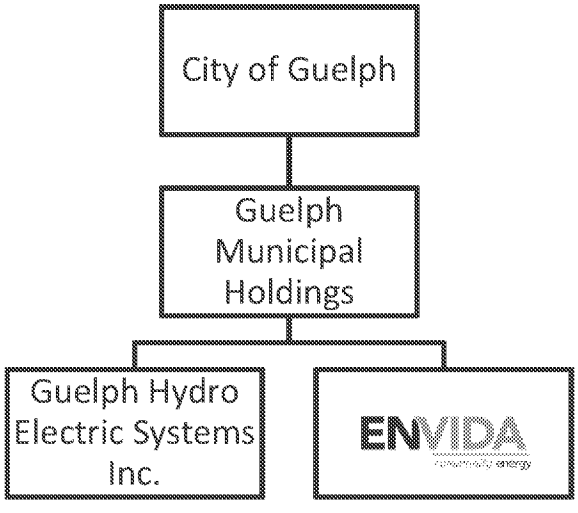
WHAT DOES IT MEAN TO BE IN THE ELECTRICITY INDUSTRY IN 2015?

As energy efficiency and distributed generation trends continue to emerge, technology presents new alternatives to electricity from the utility grid. As a result, concerns abound regarding the relative financial health of the regulated utilities sector around the world and right here in Ontario. Some of the challenges include revenue erosion, an aging asset base, the prospects of solar grid parity, and an array of new technologies which may reduce a customer's reliance on the traditional electricity system. Over the course of 2014, virtually all of these challenges have persisted. The year has also seen further examples of the side-effects of an industry sector in state of change – well beyond the near-term issues regarding the ownership of Hydro One.

All of these issues affect the success of the IESO's various initiatives as well. LDCs are conduits for the province's Conservation First Framework. On the other hand, new capacity arising from distributed generation, demand response and other novel technologies may be provided by new, third party aggregators. The nature of competition, and even the power balance, between regulated utilities, their affiliates and third party energy service providers is now beginning to become an important issue.

Existing public utilities redefining themselves: Across Ontario are examples of some municipal shareholders of LDC`s looking to exploit the emerging opportunities that lie in the realm of `behind-the-meter` products and services. While LDCs themselves may currently be constrained by the confines of current regulation and restrictions on business activities, they are sometimes part of a portfolio of companies owned by the municipality that exploit various portions of value spectrum. For example the city of Guelph has an energy services company (ENVIDA) that provides all manner of services in regards to Combined Heat and Power, technology development, distributed solar power and energy storage. While such

Below: on example of one of many municipalities in Ontario that see their LDC as part of portfolio of regulated and unregulated electricity services.



activities do not necessarily resolve the long-term viability of the regulated distribution system, it does provide an important risk hedge to the parent shareholder. As indicated in Guelph Municipal Holding's most recent annual report, their intention is to place ENVIDA directly within their ownership structure - separate and distinct from Guelph Hydro Inc. entirely.[22] This could be seen as a prudent move for a municipal shareholder hedging itself against an uncertain future for Ontario's distribution sector.

New Entrants and Restructuring: Ontario has yet to see a material impact from new entrants in terms of directly eroding the revenue base of the traditional LDC. However, the experiences of the U.S. and other jurisdictions point to a much larger impact to come. Non-utility entities are playing a bigger role in the electricity sector – particularly on the customer side of the meter. These trends are particularly noteworthy given the IESO's current reliance on LDCs to deliver or assist many of its programs such as conservation and Feed-in-Tariffs for example. 2014 has seen impressive growth in all manner of products and services on the consumer side of the meter, and in the long-run, this could have a significant impact on how the IESO interfaces with retail customers in the future. Consider some of the recent examples from 2014 that point to the rising prominence of non-utility actors in the electricity sector – and the technological developments that are adding further fuel to this change:

Global Trend:

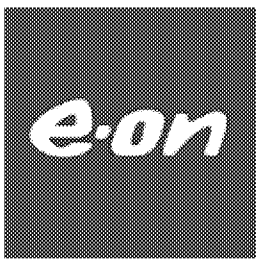
$75 billion in mergers and restructurings in the clean energy sector in 2014.[23]

Local implications:

- Regulated electricity distributors in Ontario are still highly compartmentalized from other lines of business (e.g. natural gas, behind-the meter services, internet, etc.), but recent moves to increase the share of private ownership may spur future debate.
- The proposed merger between Hydro One Brampton and three other utilities only partially resolves the degree to which regulated utilities interact with new,

For many Germans, E.ON, the country's biggest utility, is a symbol of stability. But on November 30th it surprised by announcing it would split itself up."

The Economist,
December 6, 2014



[22] Guelph Municipal Holdings Inc. *2013 Annual Report* pg. 3
[23] Bloomberg New Energy Finance, "*Global Trends in Clean Energy Investment*" January 9, 2015 and LG Chem press release, "*LG Chem officially breaks ground for China EV battery plant*" October 30, 2014.

unregulated entrants for behind-the-meter products and services.

Global Trend:

Based on committed projects in 2014, world battery storage production capacity is expected to more than double by 2020[24]

Local implications:

- Aggregated electric vehicle and stationary battery capacity may become sizeable participants in IESO demand response and capacity markets.
- The combined cost of distributed generation plus storage may eventually reach grid parity allowing Ontario customers to drastically reduce their dependency on the utility grid.

"Yet Musk's so-called gigafactory may soon become an existential threat to the 100-year-old utility business model. The facility will also churn out stationary battery packs that can be paired with rooftop solar panels to store power. Already, a second company led by Musk, SolarCity Corp. (SCTY), is packaging solar panels and batteries to power California homes and companies including Wal-Mart Stores Inc. (WMT)"

Bloomberg, **December 5, 2014**

Global Trend:

The number of devices connected to the Internet is expected to rise from ~ 15 billion in 2014 to between 30 billion and 50 billion by 2020.[25]

Local implications:

- A growing source of demand response and ancillary services coming from devices owned by Ontario consumers.
- New areas of business opportunity and value-added activity, largely out of reach by Ontario's LDCs under the current regulatory environment.

"We agree that an internet-based economy opens up the doors to many applications that we have not even imagined before and it is possible to expect similar innovations for the electricity services. Currently, integration of distributed energy resources and creation of a platform for peer-to-peer energy sharing is described as the AirBnB for the grid."

California Public Utilities Commission,
"Transactive Energy: A Surreal Vision or a Necessary and Feasible Solution to Grid Problems?"
October, 2014

[24] Data sources: Tesla Motors, presentation attached to blog posting, February 26, 2014 and LG Chem press release, "*LG Chem officially breaks ground for China EV battery plant*" October 30, 2014.
[25] Data sources: McKinsey, "The Internet of Things: Sizing up the opportunity", December 2014 and CISCO Systems, Internet of Everything device counter.

Global Trend:

Telecoms, home security services, and other third parties are beginning to enter the Smart Home arena by using internet access as a conduit to deliver services.

Local implications:

- Home energy management services may continue to grow, with or without the involvement of Ontario's electricity sector.
- New areas of value added services to the grid (e.g. ancillary services, demand response, energy conservation) may continue to be developed by non-utility players.

Rogers Communications Revenues, 2014: $ 12.9 billion[26]

Hydro One Revenues, 2014: $6.5 billion[27]

Taken together, the potential for new entrants into the retail-level marketplace is steadily growing, and relentlessly being fueled by technological change. As noted above, E-ON made an important decision to split itself in two in order to separate the declining profit margins of its traditional electricity utility business from a new company devoted to creating value in the renewables and energy services segment of the marketplace. This is an interesting example of how these trends challenge the strategies of the traditional utility company. Presently in Ontario, much attention has been paid to the future ownership structure of Hydro One. However, of equal (if not greater) importance will be the emerging relationship between utility companies and new entrants into the marketplace that will have a great deal of direct and indirect influence over how the electricity system is used and operated.

[26] Rogers Communications, 2014 Annual Report
[27] Hydro One, "Hydro One 2014 Year-End Financial Highlights" Accessed, April 25, 2015

GRID PARITY, FEED-IN-TARIFFS AND EMERGING TOPICS:

As Distributed Energy Resources continue to grow in prominence and fall in price, an important relationship is emerging between the relative costs of distributed generation, and the cost of power from the utility's power grid. This relationship sits at the heart of the various Feed-in-Tariff programs that the IESO administers. As we shall see in this section, Ontario is not alone in seeing a drop in Feed-in-Tariff prices. In some jurisdictions that do not have Feed-in-Tariffs other approaches to promoting renewables and distributed energy storage have begun to emerge, including third party financing and net metering which are also explored in this section.

GRID PARITY

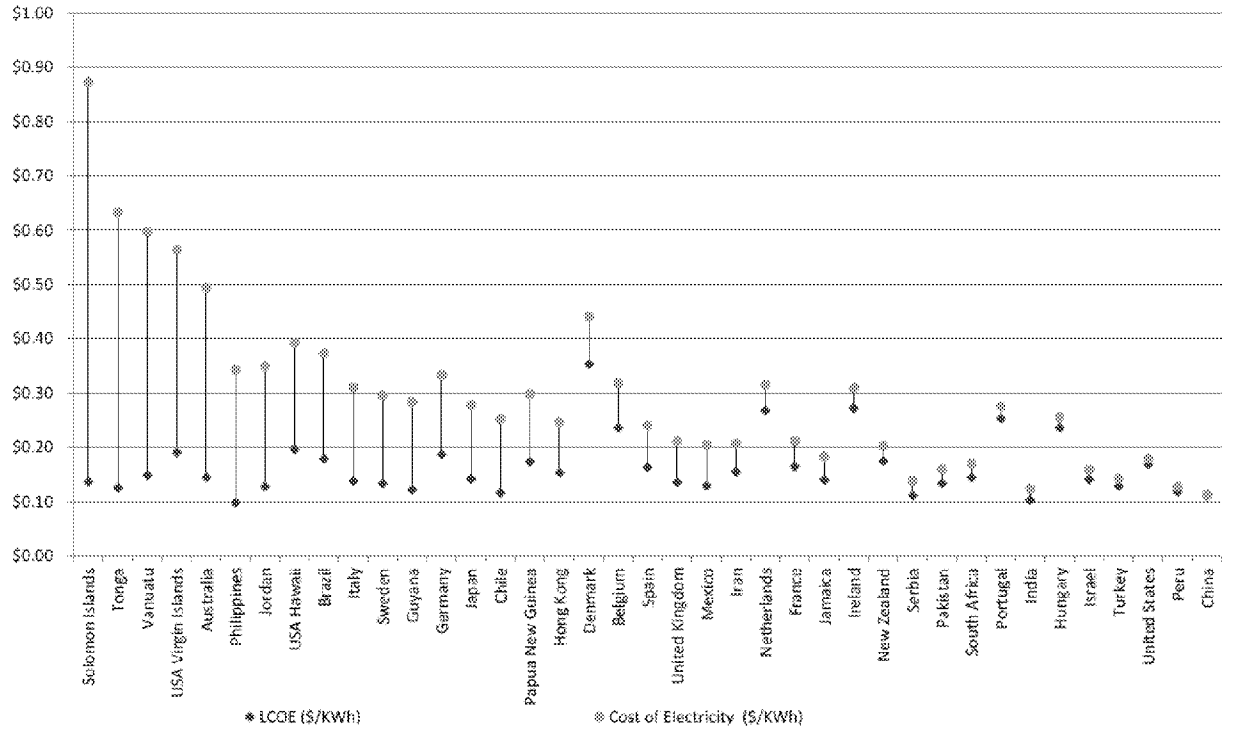
In 2014 evidence continued to mount regarding the longer-term viability of solar energy as the capital costs of solar modules continued to decrease. One measure of this progress, is the concept of "grid parity" – the point at which the cost of locally-generated power to the customer falls below the price paid from the utility's electricity grid. For solar power, grid parity is largely a function of the capacity factor of the solar panels, the solar irradiance in the retail costs of electricity in that region. As noted earlier, Ontario's all-in electricity costs have been rising at an accelerated rate over the past decade, making this a more pressing issue – particularly for the IESO which administers the Feed-in-Tariff programs for the province.

In 2012 the Bloomberg assessment of the Canadian grid parity point pegged this point at around 22 cents per kWh. In April of 2014, McKinsey consulting released its own assessment of Canadian grid parity prices[28] which suggests that this value has fallen to around 15 cents per kWh.[29] While it is debatable whether or not Ontario specifically has yet crossed the grid parity point, several jurisdictions around the world have most likely already reached this milestone (see figure on next page for examples).

[28] McKinsey Quarterly, David Frankel, Kenneth Ostrowski, and Dickon Pinner, "*The disruptive potential of solar power*" April 2014

[29] McKinsey's study does not factor in the cost of attendant storage costs in order to utilize such power at times other than when the sun is shining – which is consistent with the scope of other grid parity studies. It should also be noted that McKinsey's study treated Canada in aggregate, and therefore does not account for certain local consideration unique to Ontario.

Figure: a recent (January, 2015) study by Deutsche Bank indicating several regions in the world which are estimated to have already reached the grid parity point[30]



Source: Deutsche Bank Estimates

The most likely cause of this shift is the remarkable fall in solar panel prices in recent years – fast enough to cause several significant bankruptcies in the solar manufacturing sector in the past year. There are a number of costs that the McKinsey and Bloomberg grid parity figures do not account for however – most notably the costs of energy storage.[31] To be economically practical for the customer, energy storage costs would have to fall much further before a self-contained system could provide affordable independence from the electricity system. As noted earlier, significant strides are being made to both expand worldwide battery production capacity and reduce their costs. In the meantime, another trend reflecting on falling solar prices is a commensurate fall in Feed-in-Tariff rates in various jurisdictions around the world (including Ontario) – a topic explored further in the **Markets section** of this document.

Reaching grid parity alone does not mean that the customer will immediately have an incentive to turn away from the utility grid entirely – particularly with today's energy storage prices. However the trends observed regarding falling solar module prices, falling technology costs and

[30] Deutsche Bank, "*Deutsche Bank's 2015 solar outlook: accelerating investment and cost competitiveness*" January 13, 2015 LCOE = "Levelized Cost of Energy" from solar.
[31] Ibid.

rising all-in energy costs to Ontarians connect to point to a powerful force of change in the distribution sector. Beyond the question of grid parity, the longer-term implications of customer capabilities to generate, store and better manage their electricity supply is arguably the far more important discussion.

THE DECLINE OF FEED-IN-TARIFF RATES

"When Ontario launched the FIT Program, pricing was designed to reflect capital costs, attract investment capital and kick-start the development of a domestic renewable energy industry. A number of considerations were incorporated including: value for ratepayers, reasonable rates of return on investment, unique aspects of the Ontario market and prevailing international FIT rates."

Ontario Ministry of Energy, "Ontario's Feed-in Tariff Program: Building Ontario's Clean Energy Future - Two-Year Review Report", March 2012

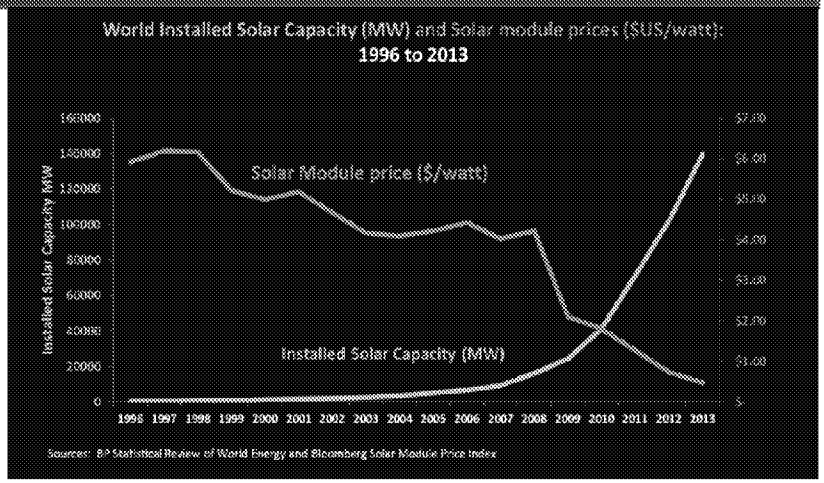
As illustrated on the next page, the latest worldwide data for solar panel installations in 2013 showed a 36.8% growth worldwide and 64.8% on the North American continent over the preceding year[32]. Between 2013, and 2014 Ontario's solar capacity expanded by approximately 89% when one includes embedded generation in that figure. During this time, the average price of solar modules has also declined. According to the U.S. Department of Energy National Renewable Energy Laboratory (NREL), the latest range of analyst cost projections for 2020 has fallen 50% in just the past five years.[33] NREL has also been tracking the steady and relentless gains in solar panel efficiency ratings over the past 40 years which is further compounding these effects.

Not surprisingly, these trends have combined to put Feed-in-Tariffs under the microscope in 2014. As the graph on the next page illustrates, Feed-in-Tariff rates have been falling in several jurisdictions that were among the first in the world to adopt these policies in the first place.[34] Ontario is no exception. As of the end of 2013, 100 countries around the world still had feed-in-tariffs in place. As the IEA so aptly noted in their 2014 report, "*A major policy challenge is to balance the affordability of support schemes with effectiveness and the need for investor certainty in order to drive deployment.* "[35]

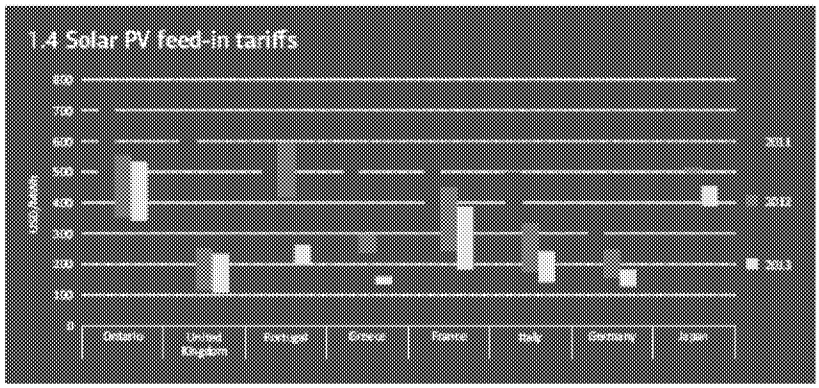
[32] BP, '*Statistical Review of World Energy*', June 2014
[33] U.S. Department of Energy, National Renewable Energy Laboratory, Sunshot initiative, "*Photovoltaic System Pricing Trends - Historical, Recent, and Near-Term Projections 2014 Edition*" slide 28.
[34] Graph source: International Energy Agency, "*Tracking Clean Energy Progress, 2014*", Data is current to the year 2013. pg. 23
[35] Ibid. pg. 22

Feed-in-Tariffs: Trends and Alternatives

Falling solar module costs

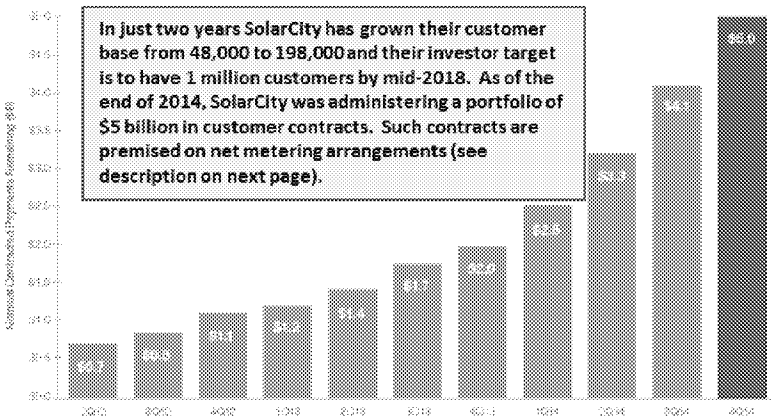


Falling Feed-in Tariffs around the world



Source: IEA, "Tracking Clean Energy Progress, 2014" (data is for 2011 - 2013)

Third party financing based on net metering arrangements



SolarCity Corp. Investor presentation, "FY 2014 & Q4 2014 Review," February, 2015

According to the U.S. Solar Energy Industries Association (SEIA) net metering policies existing in various forms across 43 U.S. states. In their simplest form, net metering policies allow customers to only pay for the energy they draw from the utility's grid, net of the generation provided from their own sources. The incentives of net metering can be augmented or diminished by a wide range of policy options include:

- The price at which the customer's self-generated energy is netted out of their energy usage from the utility grid;
- Distribution rate structures;
- Grid exit fees and standby rates.

OTHER APPROACHES – THIRD PARTY FINANCING:

To a certain extent, Ontario's use of Feed-in-Tariff pricing gives it a closer affinity to many European jurisdictions where such an approach is used. However developments south of the border warrant close consideration – particularly where some third party energy services companies are involved.

The example illustrated on the previous page is from the energy services company '**SolarCity**'. Perhaps the most interesting aspect of the SolarCity business model is the way it finances its customers to purchase solar panel systems for their homes and businesses. SolarCity effectively provides the panels to the customer at no upfront costs – either through a lease agreement or purchase loan. The customer effectively enters into a purchase power agreement with SolarCity to purchase power from SolarCity, which in turn offsets the amount they purchase from the utility company.[36] This is of course predicated on a net metering regime whereby the solar output from the customer's solar panels is assumed to offset the retail purchase from the utility company – giving the customer a savings stream to pay SolarCity. SolarCity also offers a 20-year protection and servicing plan for the panels themselves further reducing the customer's investment risk. Overall, a radically different concept from Ontario's FIT program whereby the customer often faces a significant financial commitment to install the panels at the outset of the contract.

Several competitors such as NRG, American DG Energy Inc. and Vivint Solar, for example, have similar offerings as SolarCity. It should also be noted that the revenue streams available to share between the customer and SolarCity are supplemented by a 30% federal tax credit, and various state-level incentives. Presently, the viability of some of SolarCity's offerings could be affected by the extent to which these incentives are maintained, how fast solar panel prices continue to fall, and cost of capital. However, once solar generation costs fall below the grid parity point in a given region, there is still the potential for a price arbitrage between the cost of power from the grid and customer's location – and room for a business model such as this, even if subsidies are removed.

OTHER APPROACHES – NET METERING

Third party financing such as the example cited in the previous section is premised on a different approach to providing revenue streams for distributed renewable generation: net metering. Variations on certain net metering features are the subject of intense debate and scrutiny in some jurisdictions as they can drastically change the level of incentives that net metering provides to the customer. In Ontario, net metering has been an option for renewable

[36] Source: Solar City.com, accessed March 17, 2015

generation sources under 500 kW since 2005.[37] However, in recent years, this option has of course been overshadowed by the province's various Feed-in-Tariff programs. Should Feed-in-Tariff prices continue their downward trajectory in Ontario (along with other jurisdictions in around the world) the debate over Ontario's net metering policies are intensifying. Along with that intensification could come greater customer interest in third party financing options such as those offered by SolarCity for example.

Another area of interest is the creation of new incentives for distributed energy storage. Unlike FIT programs, net metering provides more options for the customer to have a larger energy storage system that injects power and ancillary services back into the grid, without gaming the FIT subsidies. The energy storage-related incentives of net metering can be augmented or diminished by a wide range of policy options including:

- **The price** at which the customer's self-generated energy is netted out of their energy usage from the utility grid.
- **Net injections and grid capacity:** In the absence of a feed-in tariff, net injections from an energy storage device back into the power grid do not present the same kind of gaming opportunity as is the case under Feed-in-Tariffs. However, there are still practical limits as to how much capacity the utility grid is able to accommodate, and in some U.S. states such limits have become the topic of intense debate.
- **Distribution rate structures and revenue decoupling:** The Ontario Energy Board's April 2, 2015 announcement regarding Ontario's move towards revenue decoupling will eventually insulate the Ontario's LDCs from the financial impacts of net metering policies. However, the size of fixed distribution rates could be a factor in determining when Ontario might eventually reach the grid parity point for solutions involving distributed generation and storage.
- **Grid exit and standby fees:** In some jurisdictions where the threat of customer or load defection from the grid exists, consideration has been given to such measures to recover the costs of the distribution sector attributable the building of infrastructure to support the customer site and any charges for capacity procured on the customer's behalf.
- **Tax policies and Renewable Portfolio incentives.**

Variations on the above features are the subject of debate and scrutiny in some jurisdictions as they can drastically change the level of incentives that net metering provides to the customer.

[37] Ontario Regulation 541/05 October, 24, 2005

GLOBAL PERSPECTIVES ON ENERGY CONSERVATION

VARIOUS, PROMINENT ENERGY EFFICIENCY TARGETS AND SCENARIOS….

Ontario's *Long-Term Energy Plan* calls for 30 TWh of energy savings by the year 2032.[38] This would account for approximately 21% of the province's 2014 energy usage – or 2,193 kWh per person per year based on the province's current population figures. But where do the resulting energy use growth targets stand in regards to other jurisdictions? As one will note in the table below, Ontario's conservation targets result in a planned energy use growth rate that sits somewhere in between those of the European Union and the United States.

	Scenario	Target Year	Target Energy Use Growth Rate
Ontario	*Ontario Long-Term Energy Plan*	2020 2032	0 % 12.6%[39]
International Energy Agency – Global Targets	'2DS' or '450' scenario[40]	2050	OECD countries: 16% Non-OECD countries: 145%[41]
U.S. Energy Information Administration – U.S. Scenarios	Reference Case Scenario from 2014 *Annual Energy Outlook* Low Electricity Demand scenario from 2014 *Annual Energy Outlook*	2040 2040	29% 7%
European Union	20-20-20 Scenario	2020	20% reduction in electricity use

The extent to which Ontario's conservation align with what would be required under the International Energy Agency's '2DS' or '450' scenario may depend on recent policy developments which are discussed in the next section (see also, '*Recent Developments with respect to Greenhouse Gas Policy*'). The 2DS' or '450' scenario sets out the IEA's requirements for what it determines to be necessary in order to hold the global temperature rise to 2 degrees Celsius by holding greenhouse gas emissions to 450 parts per million of CO_2. This is an

[38] Ontario Ministry of Energy, "*Achieving Balance: Ontario's Long-Term Energy Plan*", pg. 21 The LTEP assumes that this would account for 16% of the energy consumption that would have otherwise occurred in the year 2032.
[39] Inferred from Ministry target of 30 TWh of electrical energy use conserved constituting at 16% reduction in energy use attributable to conservation measures
[40] A scenario in which there is a realistic chance of holding the global temperature rise to 2 degrees Celsius which is believed to equate to holding greenhouse gas emissions to 450 parts per million of CO_2
[41] IEA, "*Energy Technology Perspectives – Executive Summary*" 2014, pg. 4

important consideration as Ontario embarks in a new stage of greenhouse gas policy with the pending introduction of a "cap and trade" emissions reduction policy[42] (see also, "Recent developments with respect to greenhouse gas policy" further on in this section).

In this section we will examine the perspectives of various jurisdictions and organizations around the world regarding the prospects for realizing energy efficiency gains. As of the date of this report, the IESO was in the midst of conducting an "*Achievable Potential Study*" assisted by an LDC Working Group.[43] The purpose of this section is not to presuppose the results of that study, but rather to understand how other jurisdictions regard the possibilities of energy conservation in generation, and electrical energy conservation in particular.

HOW MUCH INVESTMENT IS REQUIRED?

When examining the goals and scenarios of various different organizations, it is important to bear in mind the context. Energy efficiency targets can be predicated on a number of different things. For example, the International Energy Agency directly links energy efficiency to reduction of greenhouse gas emissions in various scenarios. The IEA expects electricity to take on a greater share of the world's energy burden, but electrical use to become more efficient during the planning horizon. In other words, not everything in the IEA's plans to reduce GHG emissions by greater use of electrification seek to relentlessly drive down electricity use in the same way that Ontario's Conservation First Framework envisions. Again however, the recent announcement in Ontario with respect to a cap and trade policy may further change Ontario's conservation context in the months and years to come.

The OPA previously determined that the province was able to yield some 8.6 TWh in energy savings from its various conservation programs.[44] Now, the provincial government has tasked the IESO with administering a $2.4 billion conservation funding allocation out to the year 2020. How does this measure up to other estimates of conservation investment around the world? Over the past several years the overall estimates of global energy efficiency investment have varied widely. A range of such estimates presented in a recent International Energy Agency (IEA) report spanned the most recent estimate of $130 billion globally, to $365 billion – depending on the types of capital expenditures being counted.[45] The IEA projects that over $8

[42] Ontario Ministry of the Environment and Climate Change, news release, "*Cap and Trade System to Limit Greenhouse Gas Pollution in Ontario*" April 13, 2015

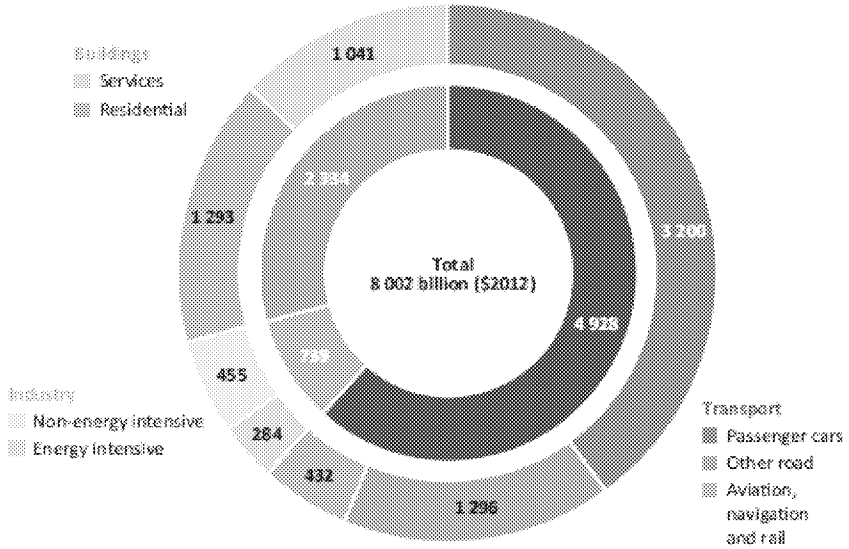
[43] AS noted on the IESO website "The Achievable Potential Study LDC Working Group has been established to seek input from representatives of Ontario's local distribution sector on the IESO's development of an updated Achievable Potential forecast for conservation in Ontario. The Study will be used to inform: the 2015-2020 Conservation First Framework mid-term review, including the aggregate and LDC-specific achievable potential by 2020; the short-term and long-term planning and program design and as an input into the 2016 Long Term Energy Plan (LTEP). A Study will be conducted every three years with the next Study completed by June 1, 2016."

[44] Ontario Power Authority "*Conservation Targets and How They Reduce the Demand Forecast - 2013 LTEP: Module 2*" January 2014

[45] International Energy Agency "*World Energy Investment Outlook*" pg. 138

trillion in cumulative energy efficiency spending will need to take place out to the year 2035 just to meet the various expectations and announced policies already made by various governments around the world.[46] To reach this goal, the current investment rate will need to more than quadruple. Some of the highlights of the IEA's projections are illustrated in the chart that follows:

Figure - IEA projections for necessary energy efficiency investment worldwide to the year 2035, needed to meet current policy announcements.



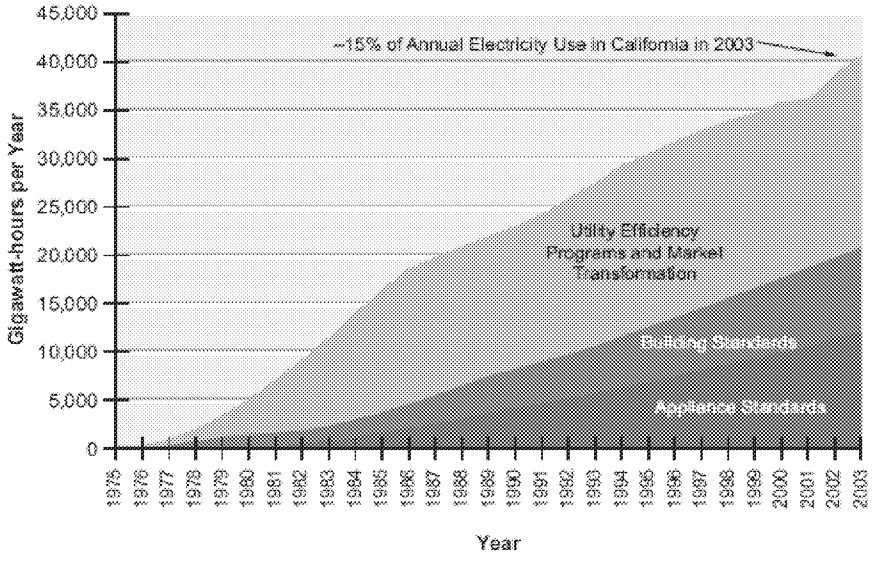
Approximately $ 1.6 trillion of that investment will need to take place in the OECD Americas region.[47] In other words, at a global level, energy efficiency investment is already falling far short of what is needed just to meet current policy goals and expectations. And to go one step further in order to meet the needs of a policy scenario that actually has a reasonable chance of holding global warming to 2 degrees Celsius, that global investment figure will have to reach over $13 trillion on cumulative investment by 2035. [48]

[46] International Energy Agency "*World Energy Investment Outlook*" pg. 135
[47] Ibid. pg. 164
[48] Ibid. Pg. 157

WHERE ARE THE GAINS EXPECTED?

As noted earlier, Ontario is in the midst of developing specific plans to meet its 30 TWh conservation target by the year 2032. When one examines the preparatory work done by the Ontario Power Authority in order to prepare this target for the 2013 *Ontario Long-Term Energy Plan*, it estimated that codes and standards will play a prominent role in delivering at least 10.2 TWh of those energy savings.[49] In Ontario, between 2006 and 2012 the OPA estimated that Codes and Standards contributed over 20% of the conservation savings achieved. 10.2 TWh represents about 34% of the provinces 2032 target of 30 TWh in savings – implying that codes and standards will have an even larger role to play going forward.

The California Experience –energy savings 1975 – 2003

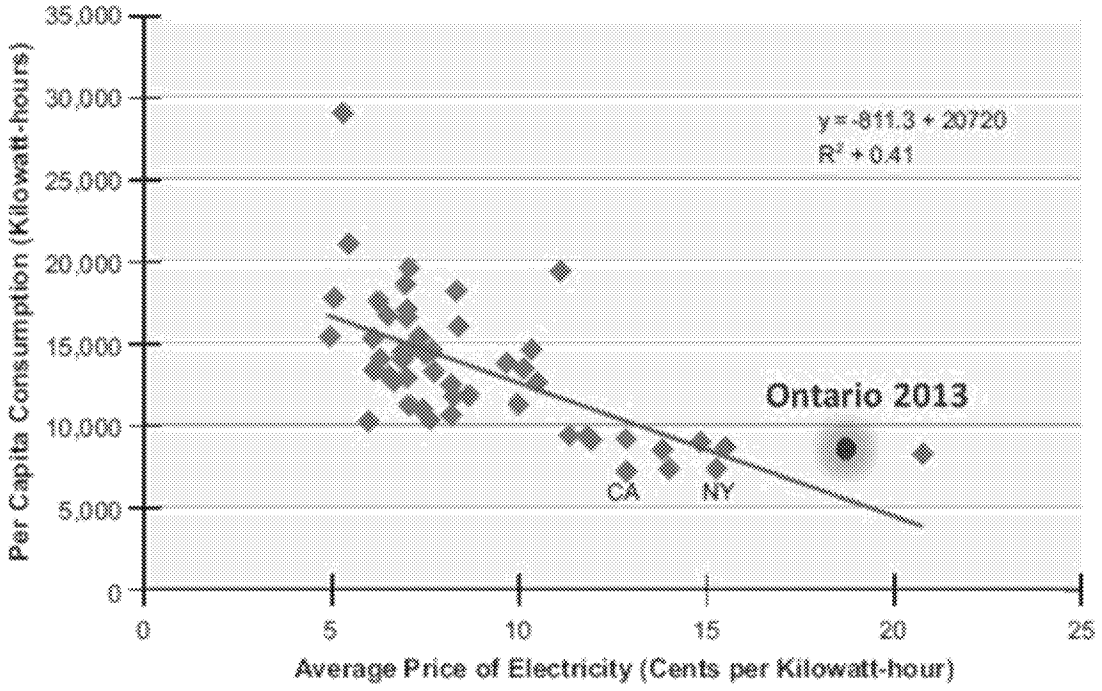


Certainly evidence shows that codes and standards can have a big impact. When one considers the above illustration of the results of various California energy efficiency programs from 1975 to 2003[50], reliance on one third of savings from codes and standards certainly seems like a reasonable prospect. However, codes and standards can sometimes have a delayed effect before their true impact is felt. While Ontario's projection may be well-grounded in previous evidence the timing of the development, implementation and monitoring of those codes and standards will therefore be crucial in the coming years.

Then of course there is the conservation impact of prices themselves. Again, Ontario's experience is not altogether different from its U.S. counterparts. Higher retail prices, not surprisingly, reduce per capita consumption, and as noted earlier, Ontario is already at the upper end of the North American range.

[49] Ontario Power Authority "*Conservation Targets and How They Reduce the Demand Forecast 2013 LTEP: Module 2*" January, 2014 slide 10
[50] National Academies Press, "*Real Prospects for Energy Efficiency in the United States*", 2010 pg. 285

Figure - A survey of U.S. energy consumption rates in various states vs. price (2006) compared with the most recent (2013) per capita data from Ontario[51]



As noted in the 2006 U.S. National Academies of Sciences study, there is certainly a relationship (illustrated above) between price and per capita electricity consumption. In Ontario, per capita residential consumption dropped about 8% between 2007 and 2013 while the compound annual growth rate for electricity prices during this period was well above 3.5%. In other words, Ontario already appears to be realizing some degree of conservation effects from a fast-rising consumer price. Furthermore, Ontario's *Long-Term Energy Plan* anticipated that Ontario electricity prices would rise by 42% during the first five years of the planning timeframe.[52] As noted earlier in this section, Ontario's all-in electricity costs for consumers continue to be put under the microscope in 2015, and the interrelationship with the province's conservation aspirations remains an important one.

[51] Data Sources: i. National Academies of Sciences Press, "*Real Prospects for Energy Efficiency in the United States*", 2010 pg. 281 ii. OEB yearbook of distributors, 2013 iii. Bank of Canada, average Canada/U.S. exchange rate for 2013. NOTE: U.S. prices depicted on this graph will differ from those illustrated on page 11 of the Crosscutting Issues section due to the difference in timeframe, and the above graph depicts an average over several years, while the page 11 graph is a spot point measurement from 2014.

[52] Ontario Ministry of Energy, "*Ontario Long-Term Energy Plan*", pg. 18

RECENT DEVELOPMENTS WITH RESPECT TO GREENHOUSE GAS POLICY

ONTARIO DEVELOPMENTS

On April 13, 2015 the Ontario Government announced that Ontario will soon be adopting a form of "cap and trade" greenhouse gas emission trading scheme.[53] There are many variations of cap and trade policies but, as the name would imply, there are two essential components: i, a specified cap (or series of caps specific to various economic sectors) on greenhouse gas emission credits which reduce over time; and, ii. the ability for individual entities to trade emission credits which, in aggregate, add up to the overall cap. This latter component creates an incentive for companies and organizations to reduce their greenhouse gas emissions if they can do so economically, or purchase allowances from those that are able to reduce their emissions more economically.

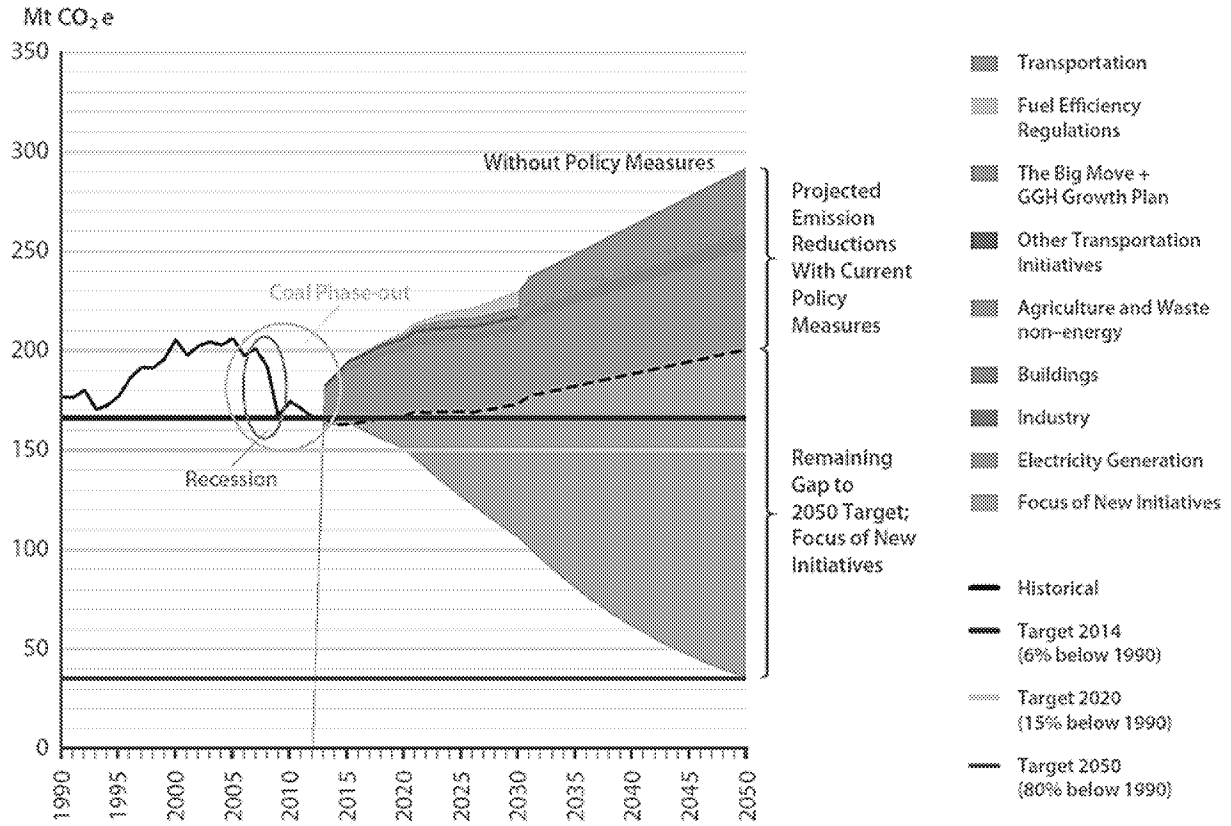
As of the date of this paper, the Ontario government has released few details regarding the pending cap and trade policy. However, in an earlier discussion paper released by the Ontario Ministry of the Environment and Climate change some important clues were offered. In February of 2015, the **Ontario Ministry of Environment and Climate Change** issued a discussion paper on a wide range of policy options including various forms of carbon pricing and taxation. More recently, the Ministry appointed a "*Special Advisor for Climate Change*" and created an attendant "*Climate Action Group*".[54] While the February, 2015 paper explored a wide range of options prior to the Ministry's April, 2015 announcement, it did set out some overarching goals for the program, as illustrated in the chart on the next page. Specifically, the paper is calling for Ontario to reduce emission levels by 15% relative to 1990 levels by 2020, and 80% relative to 1990 levels by 2050 (it should also be noted that In December of 2014, Ontario endorsed a joint statement with Quebec, California and British Columbia, reiterating their GHG reduction goals for 2020 and 2050).[55] As one will see in the chart that follows, a significant amount of those emission reductions have been, and will continue to be, realized from Ontario's electricity sector.

[53] Ontario Ministry of the Environment and Climate Change, news release, "*Cap and Trade System to Limit Greenhouse Gas Pollution in Ontario*" April 13, 2015

[54] Ontario Ministry of the Environment and Climate Change press release, "Ontario Appoints Special Advisor for Climate Change, Creates Climate Action Group" March, 9, 2015

[55] Province of Ontario, State of California, Province of Quebec and Province British Columbia, Joint statement on Climate Change, December 2014 available on the website of the Ontario Ministry of the Environment and Climate Change, accessed on March 16, 2015

Figure - Current and future policy measures – the problem space mapped out by the Ontario Ministry of the Environment and Climate Change[56]:



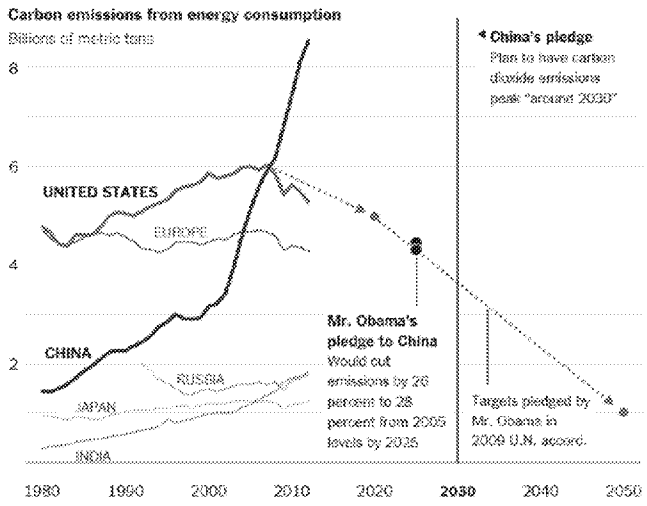
[56] Diagram source: Ontario Ministry of the Environment and Climate Change *"Ontario's Climate Change Discussion Paper, 2015"* pg. 24

WORLDWIDE DEVELOPMENTS

In the lead-up to Ontario's April, 2015 announcement regarding cap and trade emission policies, 2014 has been eventful year with respect to greenhouse gas polices. On November 11, 2014 the U.S. and China reached an accord on Greenhouse Gas emissions. The accord is notable for both its scope and scale, as illustrated in the chart below.

November 11, 2014 - U.S./China Climate Change agreement[57]:

China's Commitment	U.S.A.'s Commitment
GHG emissions to peak by no later than 2030	Reduce GHG emissions 26-28% below 2005 levels by 2025
Deploy 800 – 1000 GW of nuclear, wind, solar and zero-GHG generating capacity by 2030	Accelerated GHG reduction from 1.2% per year to 2.3-2.8% per year
20% of energy from non-fossil sources	



This U.S./China accord is also one of several developments over the course of 2014 that have collectively fuelled a renewed strategic imperative in the realm of Greenhouse Gas emissions policy as the world heads towards the the 21st Session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCC) taking place in November, 2015. Other notable events over the past year have included:

The **U.S. National Oceanographic and Atmospheric Administration (NOAA**) noted that globally, 2014 was the warmest year on record going back to since its records commenced 1880.[58] NOAA also noted that 2014 also marks, "*…the 38th consecutive year (since 1977) that the yearly global temperature was above average.*"[59]

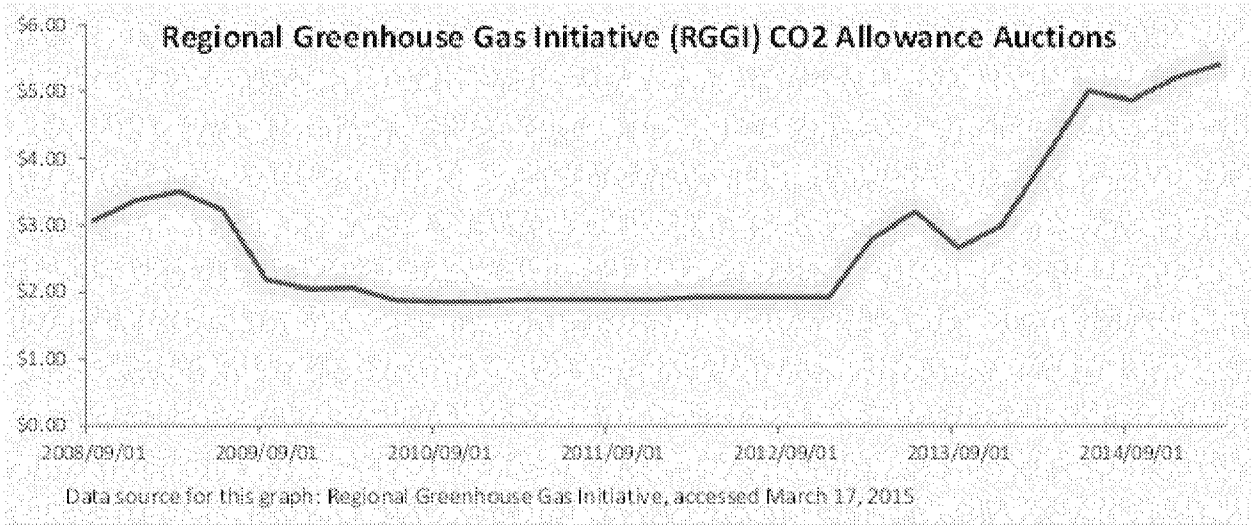
[57] Graph source: New York Times, "Deal on Carbon Emissions by Obama and Xi Jinping Raises Hopes for Upcoming Paris Climate Talks" November 12, 2014

[58] U.S. National Oceanographic and Atmospheric Administration (NOAA) 2014 State of the Climate, *Global Analysis - Annual 2014* – accessed on March 16, 2015.

[59] Ibid.

U.S. Environmental Protection Agency (EPA) Clean Power Plan: In June 2014, portions of the EPA Clean Power Plan came into force. Stemming from the Clean Energy Act passed in 2013, the Clean Power Plan seeks to reduce GHG emissions from the U.S. power sector to 30% of 2005 levels by the year 2030. As will be noted in the **Markets Section** of this report – new EPA regulations for coal fired power plants are already having a dramatic impact on near-term projections for both new generating capacity and unit retirements.

Regional Greenhouse Gas Initiative: The RGGI, one of two active auction-based carbon pricing regimes on the North American continent has now completed 27 auctions for CO2 emission allowances, and its most recent one yielded its highest price ever at $5.41/ton. As of 2015, the RGGI includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

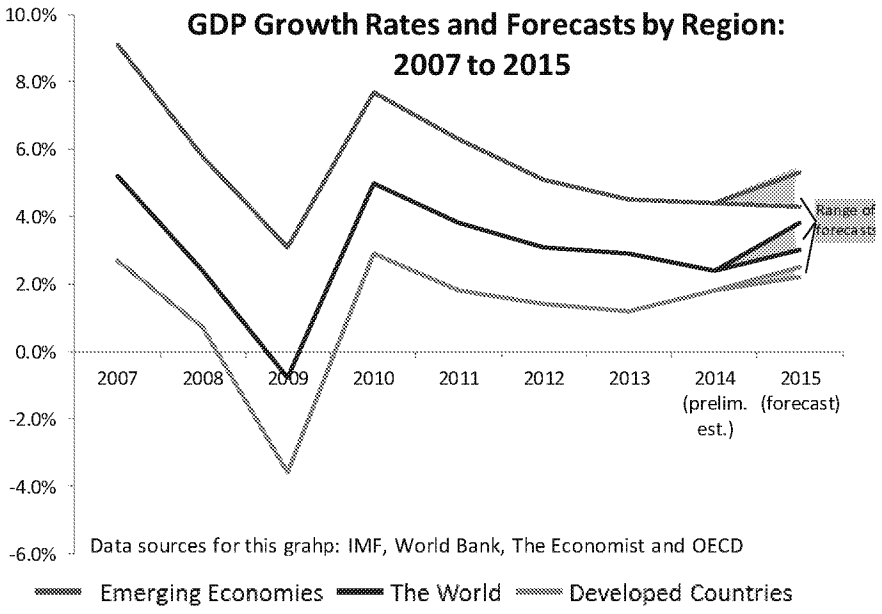


In light of the Ontario government's recent commitment to move towards a cap and trade regime, new, more rigorous greenhouse gas policies are now poised to have an impact on the energy sector. The size and scope of that impact hangs on many of the details of this new policy that have yet to be announced. They have a direct, causal relationship with several of the other topics explored in this paper including conservation, demand growth, supply mix and the bottom line costs ultimate seen by consumers and the utility companies that serve them.

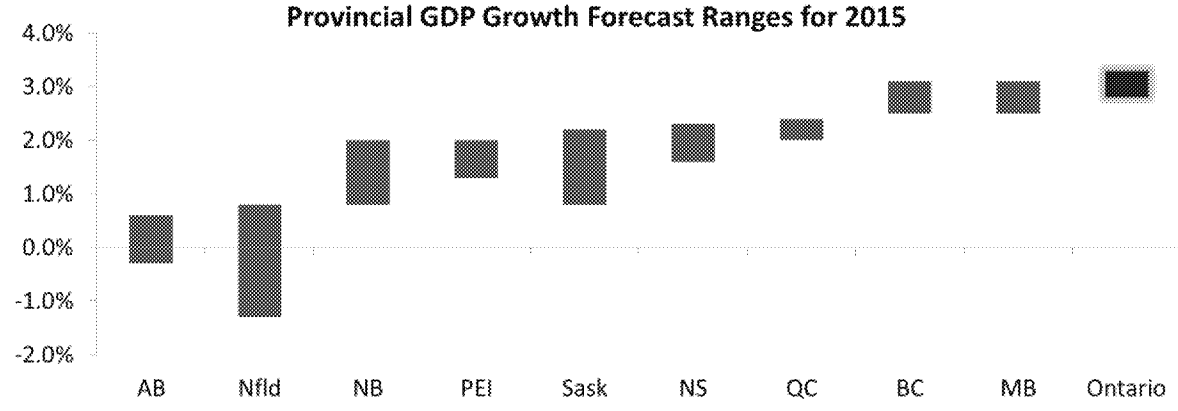
SECTION 3: MACROECONOMIC AND MARKET FUNDAMENTALS

"The global economy is still struggling to gain momentum as many high-income countries continue to grapple with the legacies of the global financial crisis and emerging economies are less dynamic than in the past."

IMF Global Economic Prospects, Jan. 2015

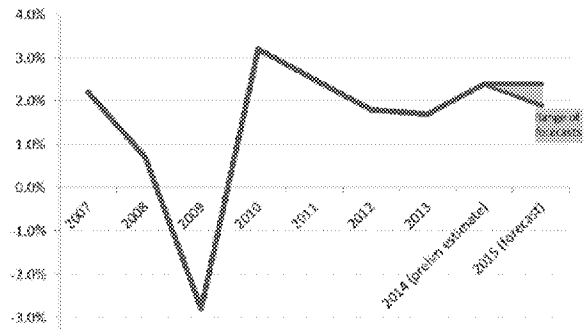


The decline in oil prices in the latter portion of 2014 has sent a ripple through the usual cycle of economic forecasts and projections for 2015. Since the beginning of 2015 many institutions have had to rethink economic prospects at both a global and a local level. For example, between October, 2014 and January 2015 the International Monetary Fund downgraded its projections for worldwide Gross Domestic Product (GDP) growth rates by 0.3% to 3.5%. The sudden imbalance in near-term oil markets was a significant contributing factor – being interpreted as both an opportunity for growth in some sectors, and also as a sign of a faltering economic recovery. And indeed this global trend also applies itself to the fortunes of individual Canadian provinces in proportion to their economic dependency on various facets of the oil industry. Suddenly, the diversified Ontario economy leads the provincial projections for 2015:

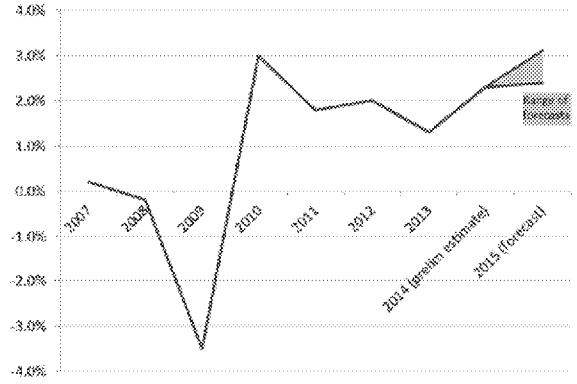


Canada and Ontario synopsis

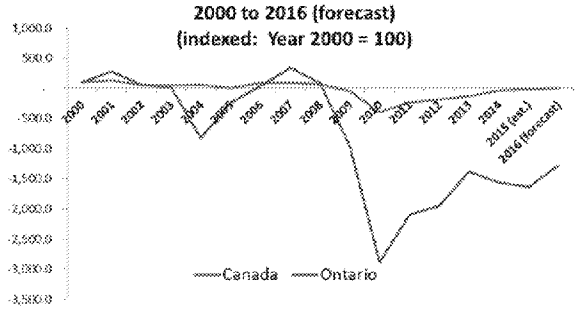
Canada GDP Growth Rates



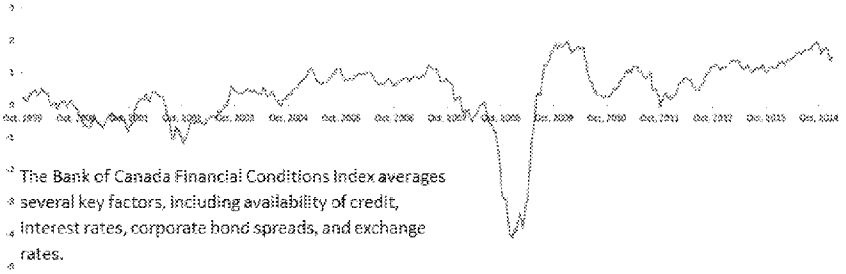
Ontario GDP Growth Rates



Canadian and Ontario Government Fiscal Balances 2000 to 2016 (forecast) (indexed: Year 2000 = 100)



Bank of Canada Financial Conditions Index - 1999 to end of 2014



The Bank of Canada Financial Conditions Index averages several key factors, including availability of credit, interest rates, corporate bond spreads, and exchange rates.

> ***"Canada is particularly vulnerable to the slide in crude oil prices. The EIU (Economist Intelligence Unit) has reduced the 2015 real GDP growth forecast to 2% and we expect the Bank of Canada to cut its key policy rate by another 25 basis points in March or April. The impact of the oil price slump will be offset slightly by the weakness of the loonie."***
>
> ***The Economist*, Canada synopsis**
> **February, 2015**

	Canada	Ontario
Population growth 2014 (est.)	1.1%	1.0%
GDP growth for 2014 (preliminary estimates)	2.4%	2.3%
GDP growth for 2015 (range of forecasts)	1.9% to 2.4%	2.8% to 3.3%
Consumer prices (Dec. 2013 to Dec. 2014)	1.5%	1.9%
Unemployment rate (December, 2014)	6.7%	7.0%
Industrial capacity utilization rates (Q3, 2014)	83.4%	Not measured
12-month change in Housing Starts (2014)	0.75%	-3.19%
Housing Price changes (Jan. 2014 to Jan. 2015)	3.1%	3.7%

Canada to U.S. Exchange Rates Jan. 1, 2014 to Dec. 31, 2014

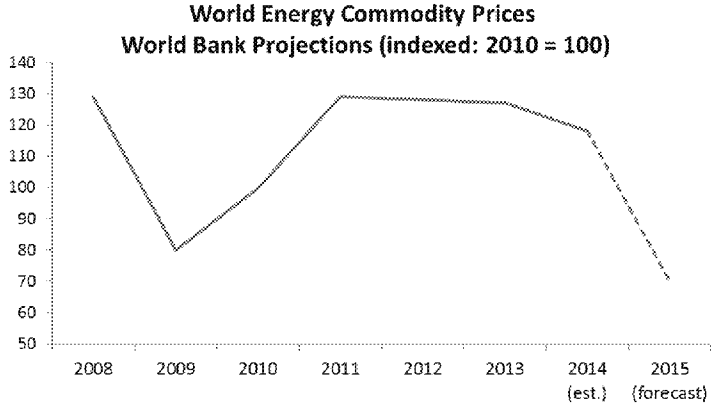
HIGHEST (Dec. 15, 2014)	1.1656
LOWEST (Jan. 3, 2014)	1.0639
AVERAGE (2014)	1.10483917

Data Sources: Statistics Canada, Ontario Ministry of Finance, Canadian Department of Finance, Canadian Real Estate Association, and the Bank of Canada

UPSTREAM INPUTS TO THE ELECTRICITY SECTOR:

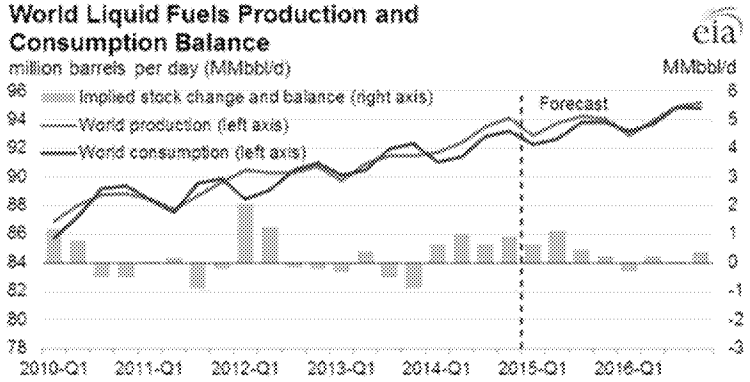
ENERGY COMMODITIES GENERALLY:

On a global scale, three years of relative price stability in global energy commodities have come to an abrupt end. In general, 2014 has been a lacklustre year for global commodity indexes, with declines in energy (down 40.5%), agriculture (down 4.8%) and metals (-6.6%).[60] Among these three, energy of course stands out with the largest decline. And within the energy index, **oil** stands out as the most significant cause…



OIL:

The World Bank, the U.S. Energy Information Administration and a host of other institutions, have highlighted that current downward trends in world oil markets have been several years in the making. The result is a near-term imbalance of excess supply and stagnating demand. In North America, the expansion of non-conventional oil supplies has continued to make its mark. Since 1990 Canada's oil supply has risen from approximately 2 million barrels/day to almost 4 million barrels/day in 2014.[61] In the United States, the growth of shale oil production helped boost U.S. production to just short of its highest levels since 1970.[62] Compounding the effects of increased supply on world oil markets, is stagnant demand which grew at only 0.6 million barrels per day in 2014.[63]



Source: Short-Term Energy Outlook, February 2015.

[60] World Bank, "*Commodity Markets Outlook*", January, 2015 pg. 2
[61] World Bank, "*Commodity Markets Outlook*", January, 2015 pg. 9
[62] U.S. Energy Information Administration, "*Short-Term Energy Outlook*" February 2015 pg. 1
[63] International Energy Agency, "*Oil Market Report*", February 2015.

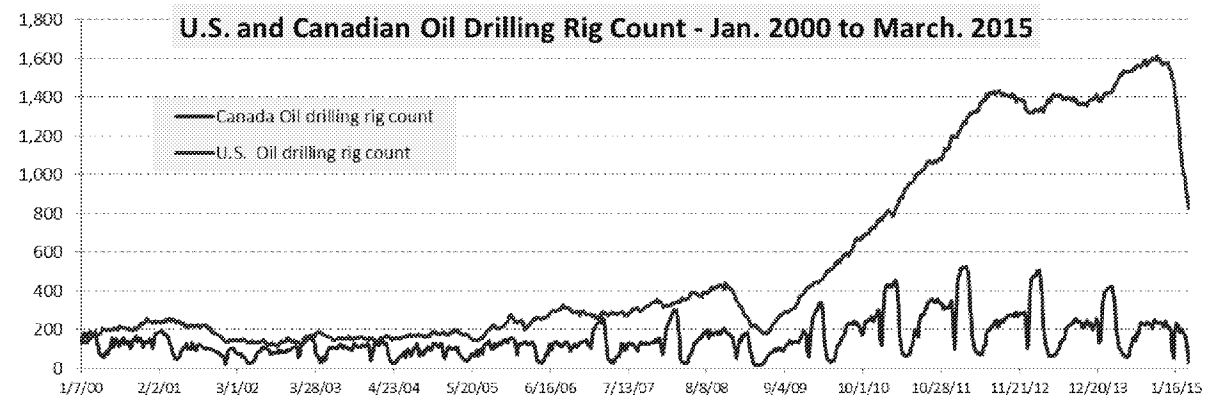
"The most straightforward piece of reform, pretty much everywhere, is simply to remove all the subsidies for producing or consuming fossil fuels. Last year governments around the world threw $550 billion down that rathole—on everything from holding down the price of petrol in poor countries to encouraging companies to search for oil. By one count, such handouts led to extra consumption that was responsible for 36% of global carbon emissions in 1980-2010."

The Economist,
Editorial, January 15, 2015

"Over the past seven-plus months, the price of a barrel of oil dropped from $107 to less than $50. This took prices to 2009 levels and surprised just about everyone. Stock markets do not like surprises, and many global indexes have dropped, adding another wrinkle of worry to an already wobbly global economic recovery."

***McKinsey Quarterly*, Commentary,**
February, 2015[64]

The beginning of an industry response has begun to take hold however. As noted in the graph below, the North American oil industry as already exhibited a significant amount of responsiveness in reducing the number operational, exploratory drilling rigs. The degree of responsiveness of the North American oil industry is particularly important in a year where OPEC has refused to alter their production levels from their 2011 target of 30 million barrels/day.[65] In addition, the International Energy Agency is projecting a 0.9 million barrels/day increase in world oil demand.[66] Together, these may have an impact on tightening inventories and prices over the coming year. However as of March 2015, neither the futures markets nor the U.S. Energy Information Administration is expecting prices to bounce back to pre-2014 levels before the end of 2015.[67]

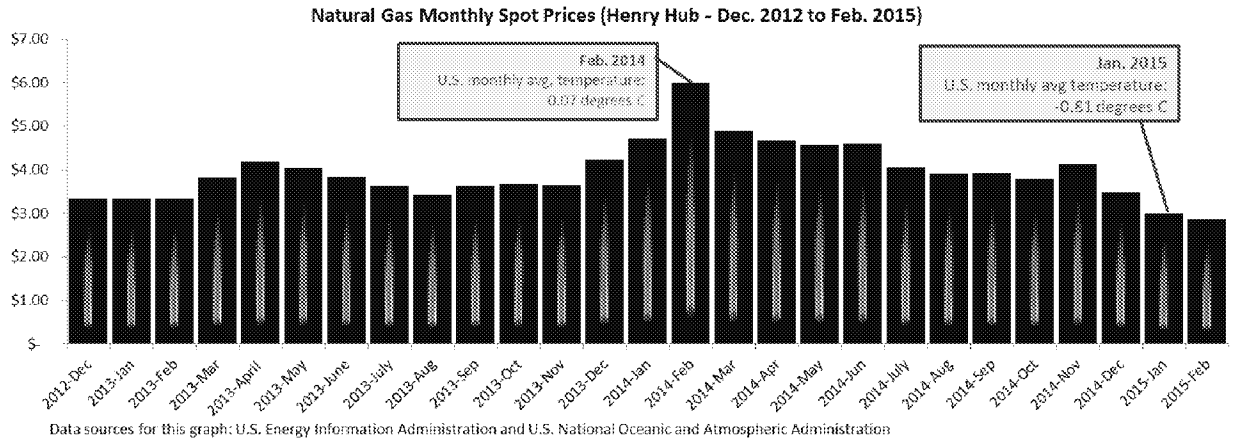


Data Source: Baker Hughes

[64] McKinsey Quarterly, Scott Nyquist, "*A cheat sheet on lower oil prices*", February, 2015
[65] Organization of the Petroleum Exporting Countries (OPEC) news release, "*OPEC 166th Meeting concludes*" November 27, 2014
[66] International Energy Agency, "*Oil Market Report*", February 2015.
[67] Data sources: CME Group Crude Oil futures price curve as of February 27, 2015 and U.S. Energy Information Administration, Short-term Energy Outlook, February 27, 2015

NATURAL GAS:

As noted in last year's *Reading of the World,* the year 2014 began with a cold snap in the month of February which caused natural gas spot market prices to brief spike above $6/MMBtu. Compare this with an even colder January, 2015 (see graph below) with its relatively calm price response and one can see the impact of North America's ever-growing natural gas supply. Over the course of 2014, The U.S. was able to replenish its depleted natural gas inventories from the harsh winter of 2013/14 and meet a steadily rising demand.[68]



Natural gas storage levels were certainly taxed across the North American continent during the February, 2014 price spike, (see also, diagram on next page). However, more recent data from the U.S. Energy Information Administration has shown that this dip in supplies was not nearly as pronounced during the winter of 2014/2015.

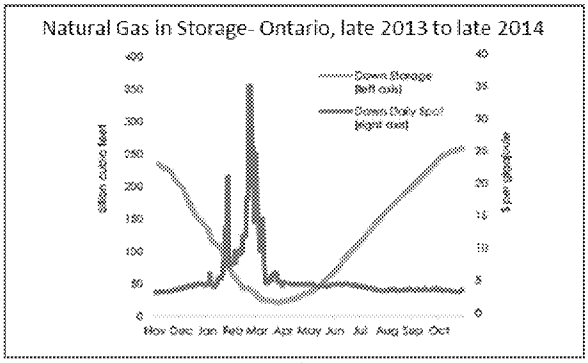
In addition to weather, often pipeline capacity has been cited as a reason for gas congestion pricing dynamics in the U.S. northeast over the past several years. As noted on the next page however, this may begin to change with over 27,000 million cubic feet per day in pipeline capacity additions being added to the region over the next 6 years.[69]

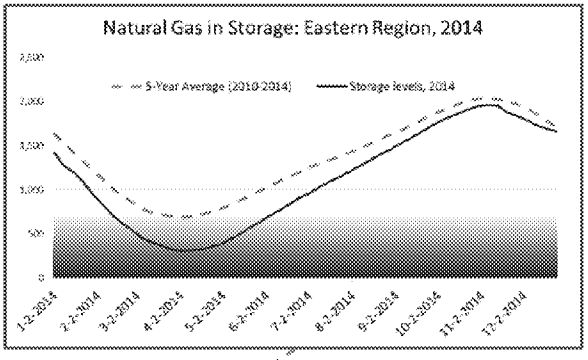
Since the U.S. Energy Information Administration first began tracking natural gas deliveries to electric power consumers, the electric power industry's consumption of natural gas has risen from 12% in 1997 to 30% in 2014. In Ontario, the natural gas generation fleet's share of installed capacity has risen from 12% in 2002 to approximately 29% of total installed capacity in the province as of the end of 2014.

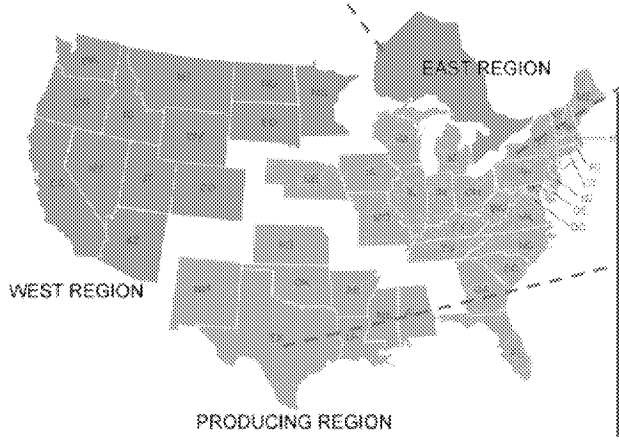
[68] U.S. Energy Information Administration, "*Weekly Natural Gas Storage Report*" for the week ending March 6, 2015.
[69] U.S. Energy Information Administration, "U.S. natural gas pipeline projects", April 1, 2015

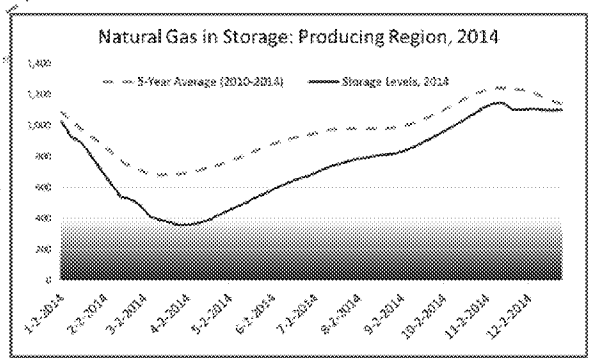
Natural Gas in North America, 2014

Storage Levels, 2014

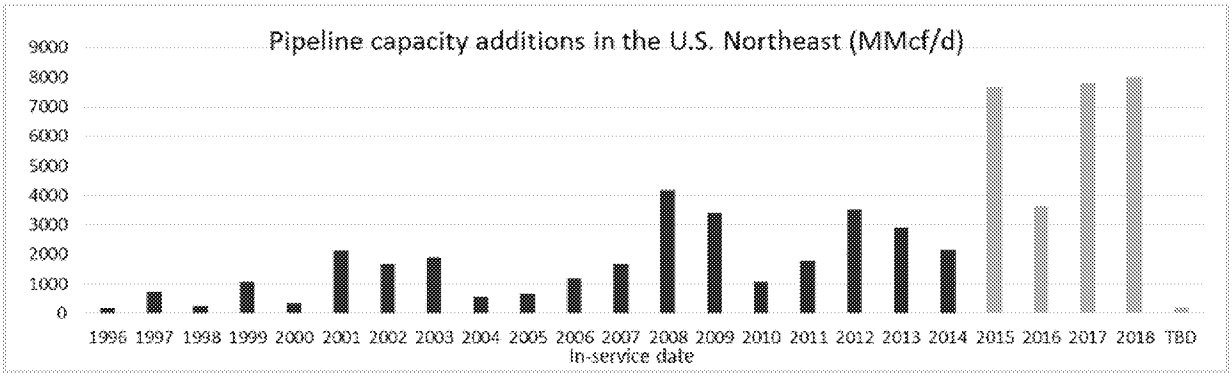








U.S. Northeast pipeline capacity additions (million cubic feet/day)



Data Sources:
National Energy Board, "Canadian Energy Dynamics: Review of 2014 - Energy Market Assessment", February 2015
U.S. Energy Information Administration, "Weekly Natural Gas Storage Report" April 17, 2015
U.S. Energy Information Administration, "U.S. natural gas pipeline projects", April 1, 2015

SECTION 4: RELIABILITY-RELATED DEVELOPMENTS

"In your country, how would you assess the reliability of the electricity supply (lack of interruptions and lack of voltage fluctuations)? [1 = not reliable at all; 7 = extremely reliable]"

RANK	COUNTRY/ECONOMY	VALUE
1	Switzerland	6.8
2	Hong Kong	6.8
3	Finland	6.8
4	Norway	6.7
5	Denmark	6.7
6	Singapore	6.7
7	Austria	6.6
8	Iceland	6.6
9	Netherlands	6.6
10	Luxembourg	6.6
11	United Arab Emirates	6.6
12	United Kingdom	6.6
13	**Canada**	6.5
14	France	6.5
15	Qatar	6.5
16	Belgium	6.4
17	Ireland	6.4
18	Portugal	6.4
19	Czech Rep.	6.4
20	Oman	6.3
21	Spain	6.3
22	Sweden	6.3
23	Barbados	6.3
24	**United States**	6.3
25	Japan	6.3
26	Saudi Arabia	6.2
27	Australia	6.2
28	Taiwan and China	6.2
29	New Zealand	6.2
30	Slovenia	6.2
31	Bahrain	6.2
32	Slovak Rep	6.2
33	Germany	6.1
34	Israel	5.9
35	Italy	5.9
36	Hungary	5.9
37	Bhutan	5.9
38	Uruguay	5.7
39	Malaysia	5.7
40	Croatia	5.7
41	Lithuania	5.6
42	Costa Rica	5.6
43	Cyprus	5.5
44	Korea, Rep. of	5.5
45	Mauritius	5.5
46	Poland	5.5
47	Latvia	5.5
48	Morocco	5.4
49	Jordan	5.4
50	Guatemala	5.4
51	Trinidad and Tobago	5.4
52	Namibia	5.4
53	Estonia	5.4
54	Chile	5.4
55	Greece	5.3
56	China	5.2
57	Georgia	5.2
58	Thailand	5.1
59	Puerto Rico	5.1
60	Colombia	5.1
61	Iran, Islamic Rep.	5.1
62	Armenia	5.1
63	Kuwait	5
64	Lao	5
65	Tunisia	5
66	Macedonia,	4.9
67	El Salvador	4.9
68	Panama	4.9
69	Ukraine	4.9
70	Azerbaijan	4.9
71	Peru	4.9
72	Turkey	4.8
73	Russian Federation	4.8
74	Sri Lanka	4.8
75	Seychelles	4.8
76	Serbia	4.7
77	Malta	4.7
78	Kazakhstan	4.7
79	Albania	4.7
80	Mexico	4.6
81	Romania	4.6
82	Moldova	4.4
83	Jamaica	4.4
84	Indonesia	4.3
85	Montenegro	4.3
86	Bulgaria	4.2
87	Philippines	4.2
88	Vietnam	4.2
89	Brazil	4.1
90	Swaziland	4.1
91	Algeria	4
92	Rwanda	4
93	Nicaragua	3.9
94	Bolivia	3.9
95	Kenya	3.9
96	Côte d'Ivoire	3.9
97	Lesotho	3.7
98	Honduras	3.6
99	South Africa	3.6
100	Mongolia	3.6
101	Mali	3.5
102	Suriname	3.4
103	India	3.4
104	Zambia	3.3
105	Mauritania	3.3
106	Gambia,	3.3
107	Paraguay	3.2
108	Mozambique	3.1
109	Timor-Leste	3
110	Cambodia	3
111	Senegal	3
112	Ghana	3
113	Malawi	2.9
114	Uganda	2.9
115	Kyrgyz Rep.	2.9
116	Libya	2.8
117	Myanmar	2.8
118	Ethiopia	2.8
119	Guyana	2.7
120	Cape Verde	2.7
121	Egypt	2.7
122	Tajikistan	2.6
123	Argentina	2.6
124	Bangladesh	2.5
125	Tanzania	2.5
126	Cameroon	2.4
127	Botswana	2.4
128	Dominican Rep.	2.4
129	Gabon	2.3
130	Madagascar	2.3
131	Zimbabwe	2.1
132	Burundi	2.1
133	Pakistan	2.1
134	Sierra Leone	2
135	Haiti	1.9
136	Nepal	1.8
137	Venezuela	1.7
138	Angola	1.7
139	Burkina Faso	1.7
140	Chad	1.7
141	Nigeria	1.6
142	Yemen	1.5
143	Lebanon	1.4
144	Guinea	1.3

Data source: World Economic Forum, "*The Global Competitiveness Report 2014–2015*"
Table 2.07 "*Quality of electricity supply*" Sample size: 13,264 based on surveys across 144 nations[70]

[70] World Economic Forum, "*The Global Competitiveness Report 2014–2015*" pgs. 86 and 434

RELIABILTY AND RESOURCE ADEQUACY:

How will Ontario fare through the upcoming nuclear refurbishment schedules for Bruce, and Darlington nuclear generating stations? The latest NERC *Long-Term Reliability Assessment* shows several important trends, both for Ontario and the broader Eastern Interconnection. Reserve Margins are a crucial summation of each region's stated generation development plans relative to their anticipated demand growth to determine if there will be overall resource adequacy over the coming decade. In general NERC has noted that overall reserve margins[71] across the Eastern Interconnection have been in a bit of a slump over the past several years – a trend reported in previous versions of *Reading of the World*. Over the longer-term however, NERC projects a major change in fortunes between the various control areas when it comes to overall adequacy margins – a trend one can spot in just a casual glance at the table below. There is a lot of background noise during this timeframe, not the least of which is a steady stream of fossil-fuel and nuclear generation retirements over the coming decade.

NERC's assessment of anticipated reserve margins across the Eastern Interconnection: Summer 2015 vs. Summer 2024[72]

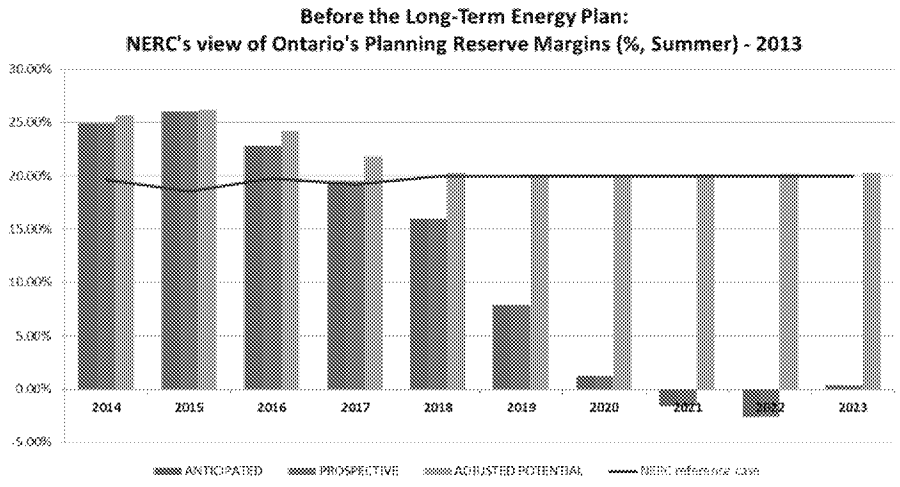
2015			2024		
Rank	NERC Region	Anticipated Margin	Rank	NERC Region	Anticipated Margin
1	NPCC-Maritimes	88.17%	1	NPCC-Maritimes	83.75%
2	WECC-RMRG	61.70%	2	NPCC-Québec	49.71%
3	NPCC-Québec	47.03%	3	MRO-Manitoba Hydro	49.38%
4	MRO-Manitoba Hydro	42.57%	4	NPCC-Ontario	29.39%
5	SPP	36.17%	5	FRCC	22.92%
6	SERC-SE	33.56%	6	SERC-SE	22.24%
7	WECC-SWSG	31.83%	7	MRO-SaskPower	19.21%
8	MRO-MAPP	29.35%	8	PJM	16.22%
9	FRCC	27.40%	9	NPCC-New England	14.92%
10	SERC-N	26.52%	10	SPP	14.32%
11	PJM	25.93%	n/a	Eastern Interconnection	14.27%
n/a	Eastern Interconnection Average	24.80%	11	SERC-N	13.71%
12	NPCC-New England	23.75%	12	WECC-CAMX	13.38%
13	NPCC-Ontario	22.36%	13	WECC-RMRG	13.30%
14	WECC-NWPP	21.78%	14	WECC-NWPP	13.18%
15	MRO-SaskPower	20.12%	15	WECC-SWSG	12.19%
16	SERC-E	19.24%	16	SERC-E	9.94%
17	MISO	17.01%	17	NPCC-New York	7.33%
18	NPCC-New York	16.53%	18	MRO-MAPP	5.41%
19	WECC-CAMX	15.27%	19	TRE-ERCOT	4.64%
20	TRE-ERCOT	14.31%	20	MISO	4.45%

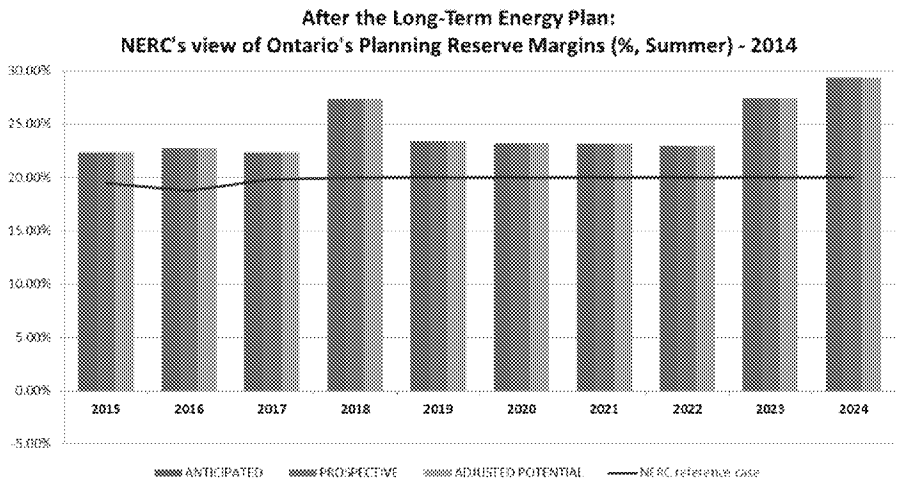
[71] Anticipated, prospective, and prospective adjusted reserve margins are calculated as a ratio between anticipated resource capacity and anticipated demand. In general "anticipated" levels are considered the more conservative of the three estimates as they rely on concrete plans announced in the public domain.

[72] Data Source: North American Electric Reliability Corporation (NERC), "*2014 Long-Term Reliability Assessment*", Appendix I

As illustrated below the change in Ontario's reserve margin outlook between last year and this year is also striking. This is largely due to Ontario's self-assessment of the impact of the province's *Long-Term Energy Plan* which was published at the end of 2013.

The impacts of the Ontario Long-Term Energy Plan of Ontario's overall adequacy: 2013 vs. 2014





With the publication of NERC's annual *Long-Term Reliability Assessment* in the fall of 2014, the impact of Ontario's *Long-Term Energy Plan* (LTEP) can be seen relative to the year before (see above). For the past two years, *Reading of the World* has highlighted the potential challenges of Ontario's looming nuclear refurbishment schedule. Factoring in the LTEP's plans as reasonably certain changes this outlook relative to the previous year. In the near-term, this is evidenced by the latest (March, 2015) edition of the *IESO 18-Month Outlook*, which projects 2,290 MW of planned resource additions over the span of that report's 18-month planning timeframe.

RENEWABLE SUPPLY IMPACTS ON RELIABILITY

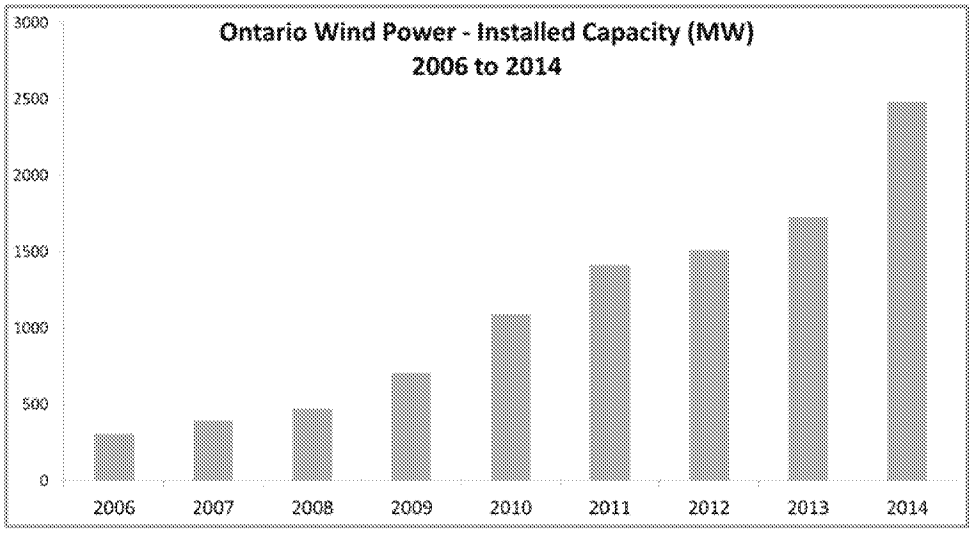
Since operations began in March, 2006 Ontario's wind fleet has steadily gown each year to an installed capacity of 2,543 MW has of the March 2015. When one examines the second of the three graphs on the next page, it is not difficult to discern a seasonal pattern to Ontario's wind power production over the past nine years (particularly if you let your eyes go out of focus a bit).

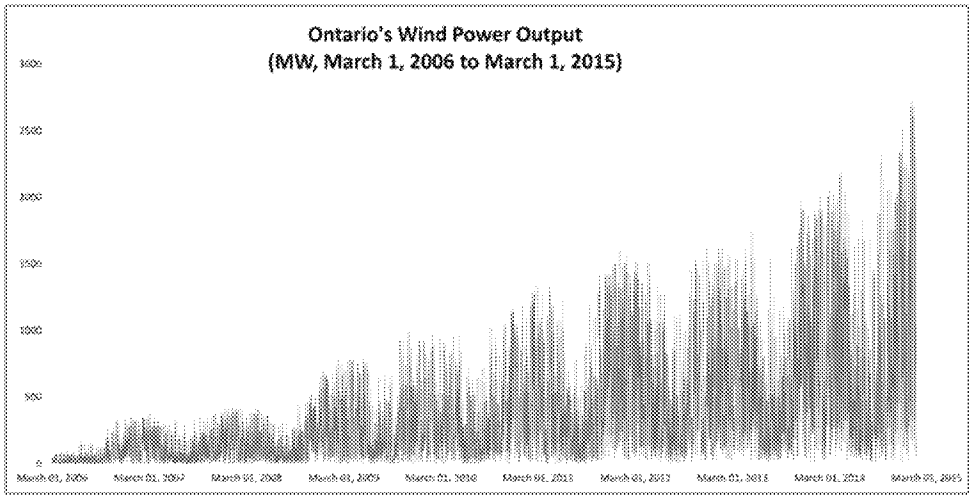
Wind patterns display a high degree of randomness on a day to day basis, and hence the importance of the IESO's recent Renewable Integration Initiative, instituting better forecasting, telemetry requirements and dispatchability for Ontario's wind feet. On a seasonal basis however, heightened variability can certainly be anticipated (see also, the third graph on the next page). Here, there are a multitude of competing and emerging options to manage such events. In the near term, these include adding more dispatchability to the baseload portion of the generation fleet, intertie trading, and demand response capacity. Over the longer-term are the potential prospects of energy storage and microgrids to offer value-added services to help manage high volatility periods.

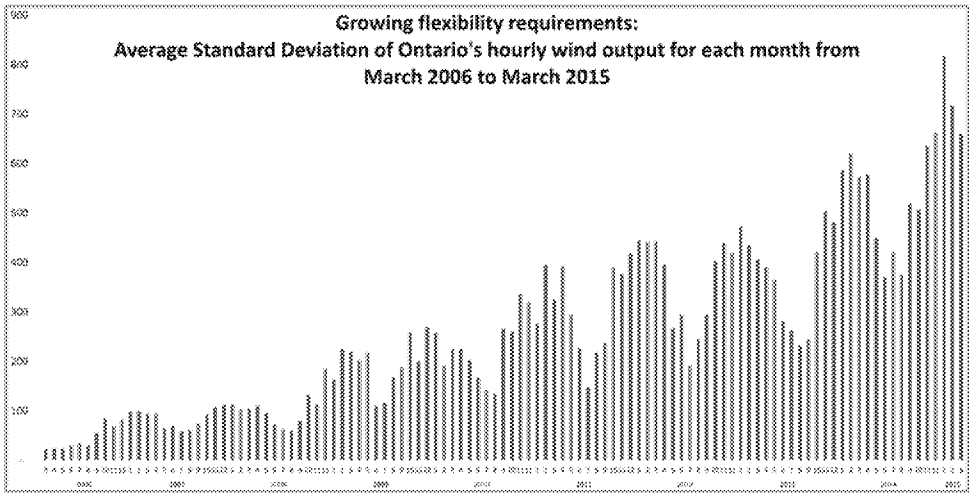
Notwithstanding the current challenge of renewables and the need for system flexibility that Ontario is facing, there is little public evidence to suggest that renewables have posed a significant threat to the reliability of the bulk electricity system in North America thus far. However, many issues loom large as renewables continue to proliferate. The North American Electric Reliability Corporation (NERC) annual report, "*State of Reliability, 2014*" reiterated its previous position, that higher renewable penetration levels will require, *"…new tools and practices, including potential enhancements to NERC Reliability Standards or guidelines.".*[73] As of the end of 2014, 3,211 MW of non-hydro renewables were contracted to be added to the Ontario fleet (see also, Markets section).

[73] NERC, "*State of Reliability, 2014*" pg. 21

Figure - Ontario's wind output: capacity, short-term randomness, long-term patterns and growing hourly variability.

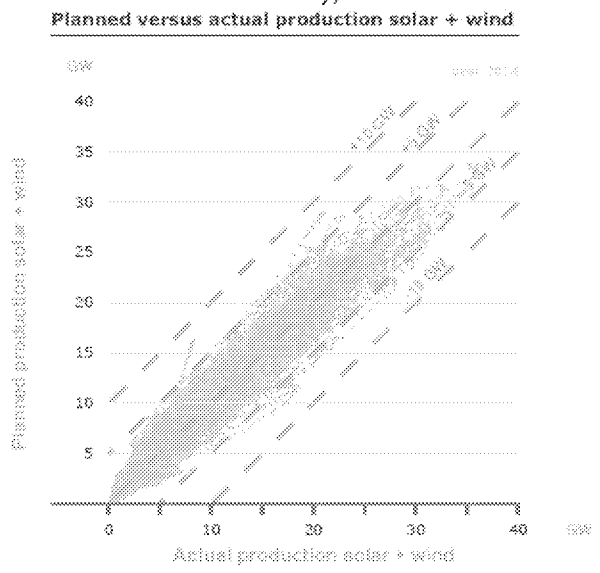






GERMAN EXPERIENCE WITH LARGE SCALE WIND AND SOLAR OPERATIONS

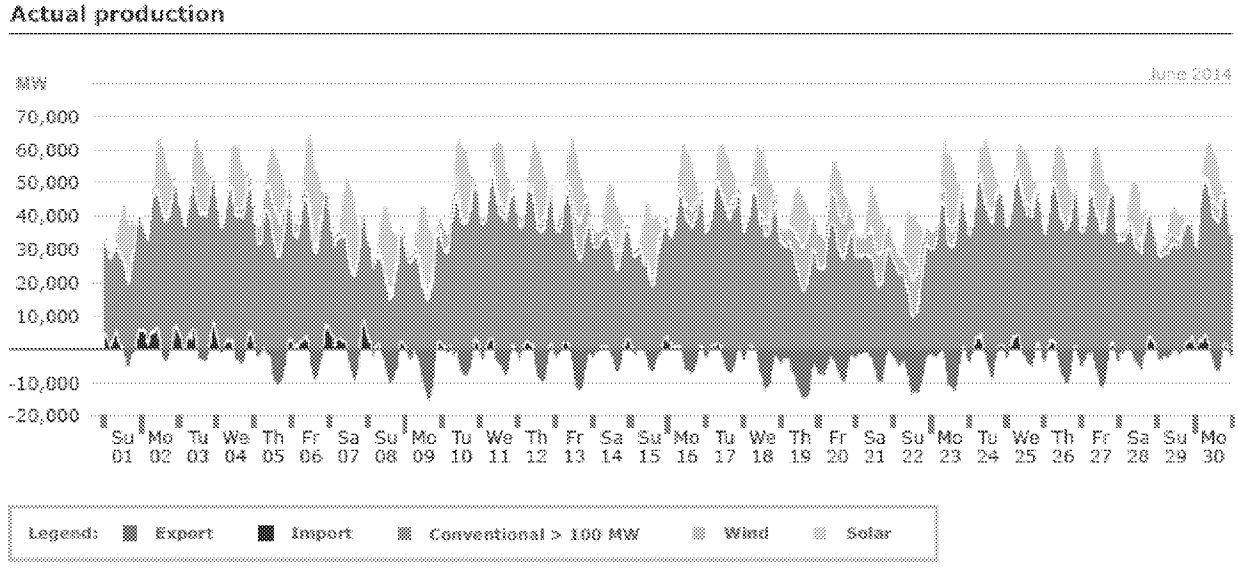
Planned vs. actual solar and wind production in Germany, 2014



Once again in 2014 Germany has provided some interesting data regarding renewable energy production. Germany ended 2014 with 35.67 GW of installed wind capacity and 38.1 GW of installed solar capacity.[74] As one can see in the graph at left, the bulk of deviations from planned production schedules fell well within ± 5 GW, or 6.8% of installed capacity values. Another finding of the Fraunhofter Institute is the complementarity of wind and solar, with the two forms of production offsetting each other both on a daily and seasonal basis.

A quick inspection of the graph below also shows the important relationship between the country's installed base of 38.1 GW of solar power and its export trade with neighbouring jurisdictions.

June 2014: energy production and exports in Germany[75]



[74] Fraunhofer Institute, "*Electricity Production from Wind and Solar in Germany, 2014*" slide 5
[75] Source: Fraunhofer slide 79

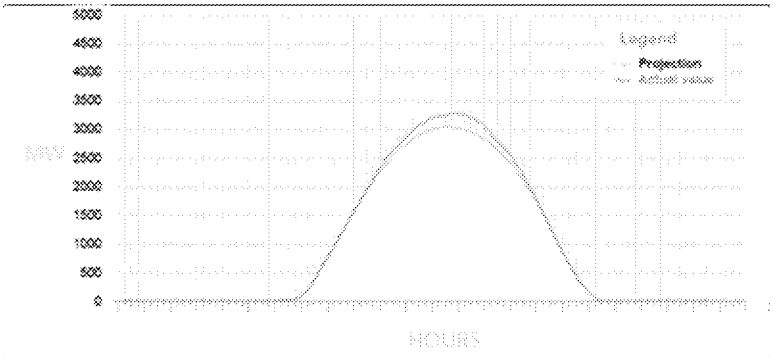
Mid-day solar peaks in Germany now directly affect daily the import/export trade balance for the nation, especially during the summer months. In France in August, 2014 a combination of solar, baseload nuclear and reduced demand all contributed to negative wholesale electricity prices.[76] As Ontario's renewable fleet continues to grow, so too may its connections with its intertie trade, demand response programs, conservation measures, and required levels of smart grid investment.

SOLAR POWER AND SOLAR ECLIPSES:

On Friday, March 20, 2015 a partial solar eclipse was visible over a large portion of northern Europe.[77] The two images below contrast solar production in a particular segment of the German power grid - the day before and the day of the eclipse. No significant disruptions or reliability events were reported as of date this paper was prepared.

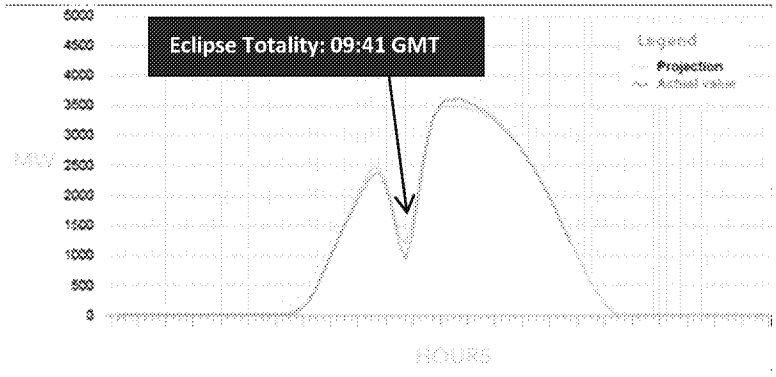
The Day before the eclipse: Solar production, in the German TransNet BW Control Area:

March 19, 2015



The Day of the eclipse: Solar production, in the German TransNet BW Control Area,

March 20, 2015



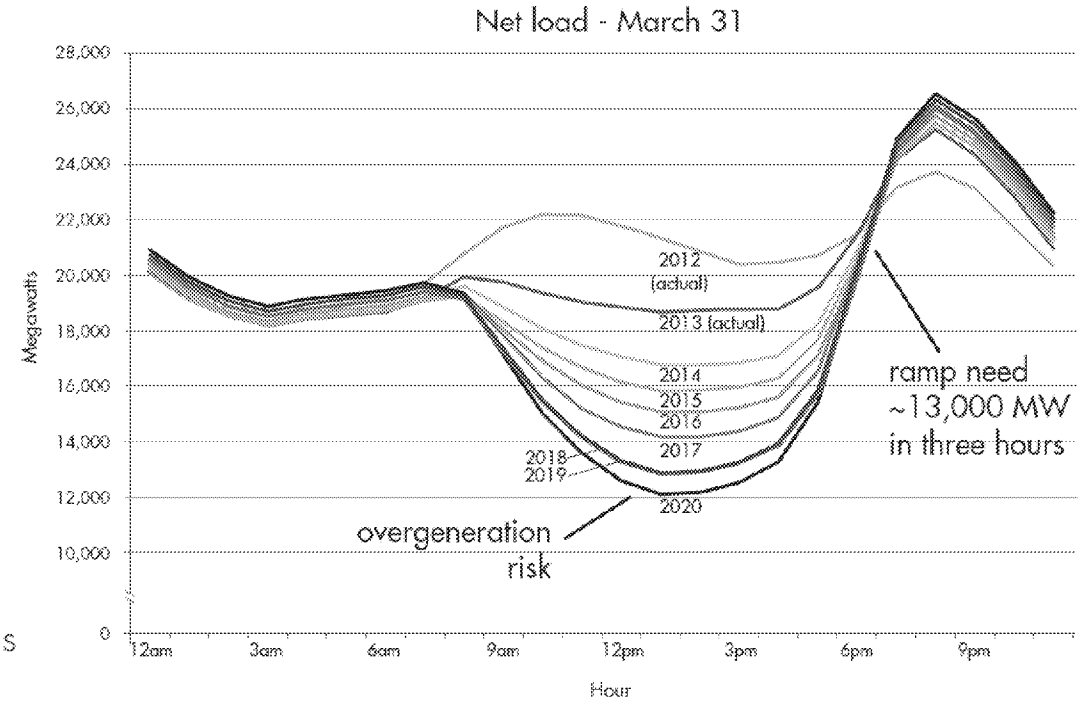
In the lead-up to this event the potential impacts of the eclipse on solar power production were anticipated and studied by Europe's community of system operators and umbrella organization, European Network of Transmission System Operators for Electricity (ENTSO-E). This preparatory work included the development of mathematical techniques to model the impact

[76] European Commission, "*Quarterly Report on European Electricity Markets*," Volume 7, 3rd quarter of 2014 pg. 3

[77] During this particular event, a total eclipse was visible around the Arctic Circle area, though in much of northern Europe a significant portion of the sun was obscured.

on solar irradiance over the course of the eclipse and allowed system operators to account for these effects in their forecasts.[78] The recent European experience with the solar eclipse underscores the growing prominence of aggregated, distributed generation as a reliability consideration. Typically the IESO has little operational relationship with individual facilities under 5 MW in size. However the sum total effects of such facilities is an important consideration for system operators around the world – and not just for unique events such as solar eclipses. In many jurisdictions solar power is eroding mid-day peak demand and actually turning it into a downturn. Consider for example, the recent projections by the *California Independent System Operator (CAISO)* regarding their own anticipated needs of up to 13,000 MW of ramping capacity by the year 2020. Their projections are illustrated on the diagram below and highlight the new types of demands being put on system operators by mass numbers of generation facilities that they have no direct relationship with. Here again the importance of, growing variability, localized control and the changing nature of the relationship between system operators and the distribution sector is coming to the fore.

Figure – the "duck curve": projections by the California Independent System Operator on the growing need for ramping capability to manage transitions to and from mid-day solar output peak.[79]



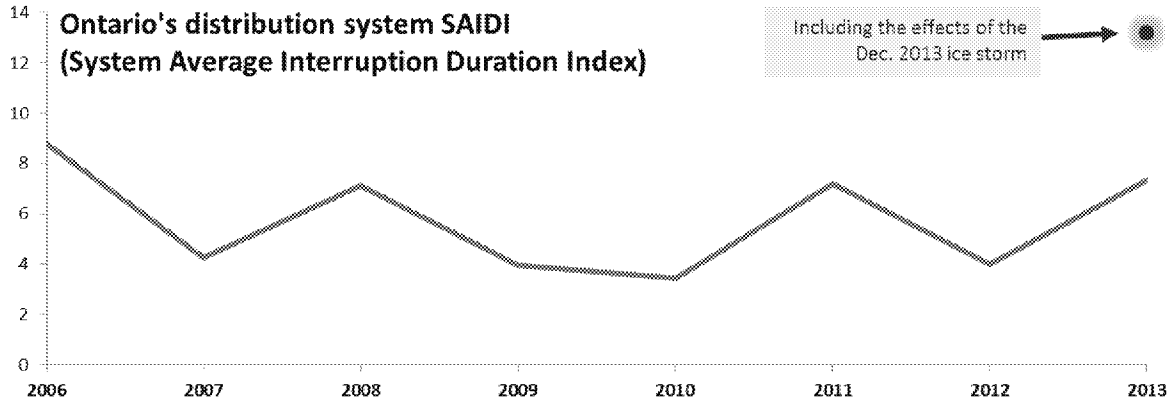
[78] With reference to, European Network of Transmission System Operators for Electricity (ENTSO-E), "*Solar Eclipse 2015 - Impact Analysis - Report prepared by Regional Group Continental Europe and Synchronous Area Great Britain*" February 19, 2015

[79] California Independent System Operator, fast facts sheet, *"What the duck curve tells us about managing a green grid"*

WEATHER IMPACTS ON RELIABLITY:

For most weather-related reliability data, there is a one-year lag in the reporting period. However, as noted, in the OEB's most recent reliability for the Ontario distribution system, 2013 ended with a stark reminder of the growing concern of weather-related reliability. As noted in last year's *Reading of the World*, the December 21-23, 2013 ice storm which left up to 830,000 retail customers without power.[80] The impact of this single event almost doubled the observed System Average Interruption Duration Index (SAIDI) for the province of Ontario distribution network in 2013.

Figure - System Average Interruption Duration Index (SAIDI) for Ontario's distribution network in 2013 – an indexed measure of the average span of time of a power outage. (2013 data shown with and without the December ice storm anomaly)



Data Source: OEB Yearbook of Electricity Distributors, 2013 published, Aug. 2014

According to the latest publicly-available data from NERC for 2013 (released May, 2014) seven of the top ten most strained days on the North American Power Grid, as measured by the NERC Severity Risk Index (SRI)[81] were all weather-related – including the top three. [82] As weather-related reliability continued to become an important issue in 2014 a connection seems to form between reliability, weather and the emergence of new, more rigourous environmental policies in Ontario.

[80] Ontario Ministry of Community Safety and Correctional Services, Office of the Fire Marshal and Emergency Management "*2013 Southern Ontario Ice Storm Ontario After Action Report*", pg. 3
[81] The Severity Risk Index (SRI) measures the overall impact of an event on the scale of 0 to 1000 on the continent-wide power grid – where a score of 1000 represents a complete loss of load for the continent. The August 2003 blackout scored at 71.28
[82] NERC, "*State of Reliability, 2014*" May, 2014, pg. 25

CYBER-SECURITY AND PHYSICAL SECURITY:

CYBER-SECURITY:

This year's NERC "*State of Reliability Report*" had very little to say specifically on cyber-security issues with respect to the Bulk Electricity System, other than citing its ongoing work in this area. However in other quarters, work has continued to progress. In February, 2014, the U.S. National Institute of Standards and Technology (NIST) published its new cyber-security framework.[83] The NIST framework was issued in response to the U.S. President's Executive Order 13636, "*Improving Critical Infrastructure Cybersecurity*," signed into force a year earlier on February 12, 2013.[84] NIST standards are particularly noteworthy as they guide the work of the Smart Grid Interoperability Panel – one of the most influential organizations developing the body of standards that govern emerging smart grid technologies. Closer to home the IESO has now completed over a full year of meetings of its cyber-security Forum with a mandate to "….improve cyber security within Ontario's electricity sector."

Karachi, Pakistan in blackout condition, January 25, 2015
Image source: New York Times

PHYSICAL SECURITY:

Despite the growing prominence of cyber-security as a potential reliability concern, there are occasionally stark reminders of the difficulty in protecting a widely-dispersed bulk electricity system from more basic, physical threats. On January 25, 2015, 80% of Pakistan was left without power due to a guerilla attack on a high-voltage transmission path. Most of the country's electrical customers were restored within 24 hours of the attack.

In North America, as reported in the 2014 NERC "*State of Reliability*", the standards body was in the process of developing a new standard for physical security which would, "*…require owners or operators of the BPS, as appropriate, to identify facilities on the BPS that are critical to the reliable operation of the BPS*".[85] Some of these attendant standards are formally under review through the Ontario Reliability Compliance Program (ORCP) as of the date of this paper.

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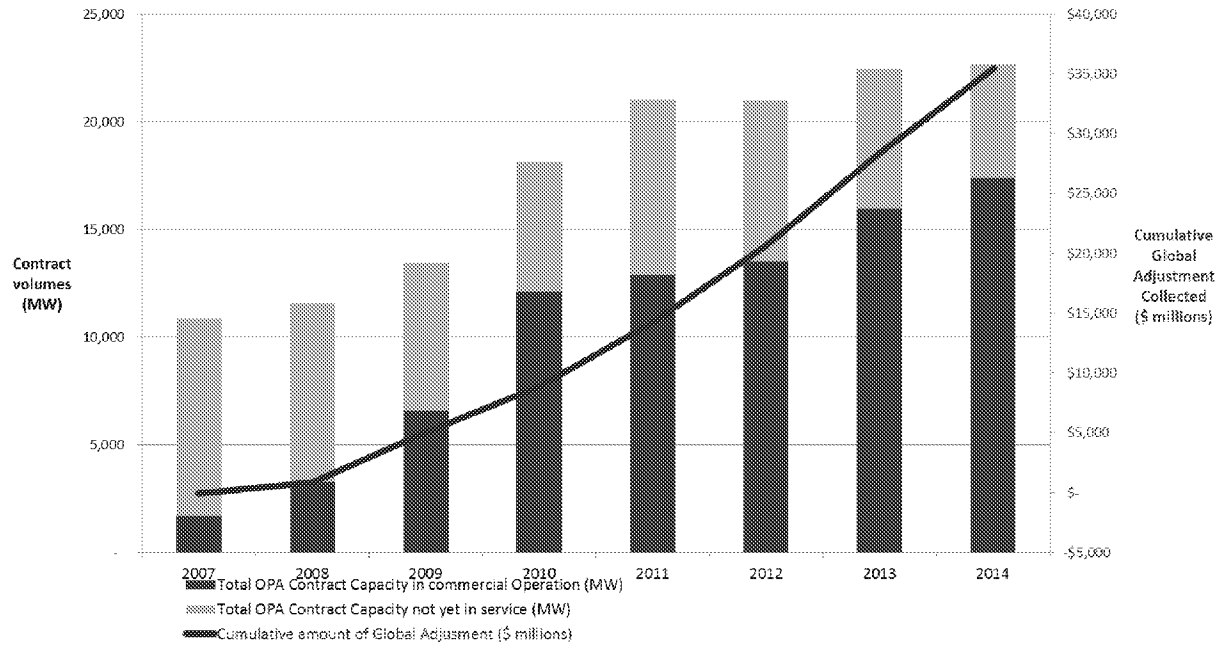
[83] National Institute of Standards and Technology, *Framework for Improving Critical Infrastructure Cybersecurity*, February, 12, 2014

[84] As reported in *Reading of the World 2013*, the presidential order was issued, partly in response to revelations that Chinese state actors had possibly been conducting coordinated espionage activities on U.S. targets. See also, Mandiant "*APT1 Exposing One of China's Cyber Espionage Units*", February 19, 2013

[85] NERC "*State of Reliability, 2014*" pg. 21

SECTION 5: MARKET-RELATED DEVELOPMENTS

Cumulative Global Adjustment and OPA Contract Volumes (MW, committed and in operation)



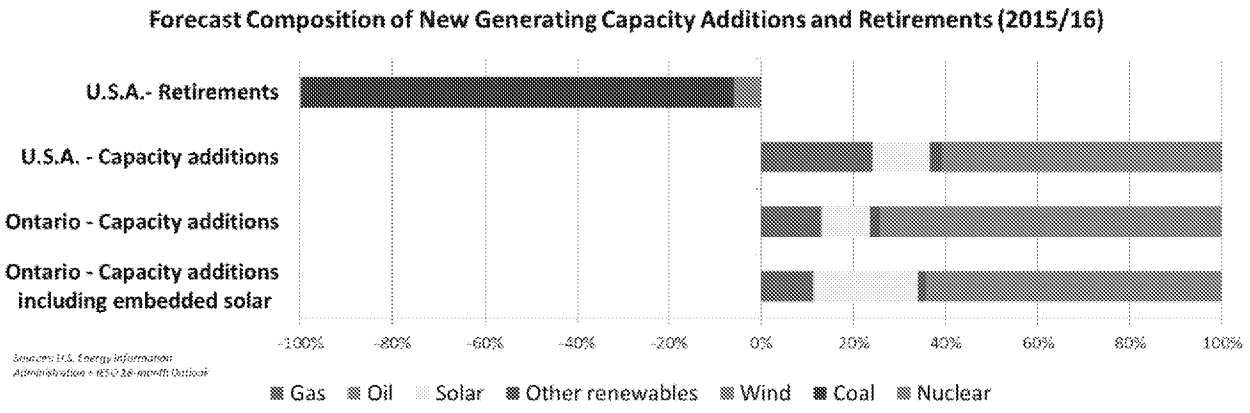
The newly-merged IESO has now administers several important mechanisms governing the growth and development of Ontario's supply mix:

- A wholesale market in the midst of discussions to add a capacity market, and auction-style procurement of demand response;
- A 22,640 MW portfolio of supply contracts (as of Q3, 2014), of which 23% is still pending for delivery; and
- A clear mandate from Ontario's *Long-Term Energy Plan* to absorb virtually all new demand growth through conservation measures.

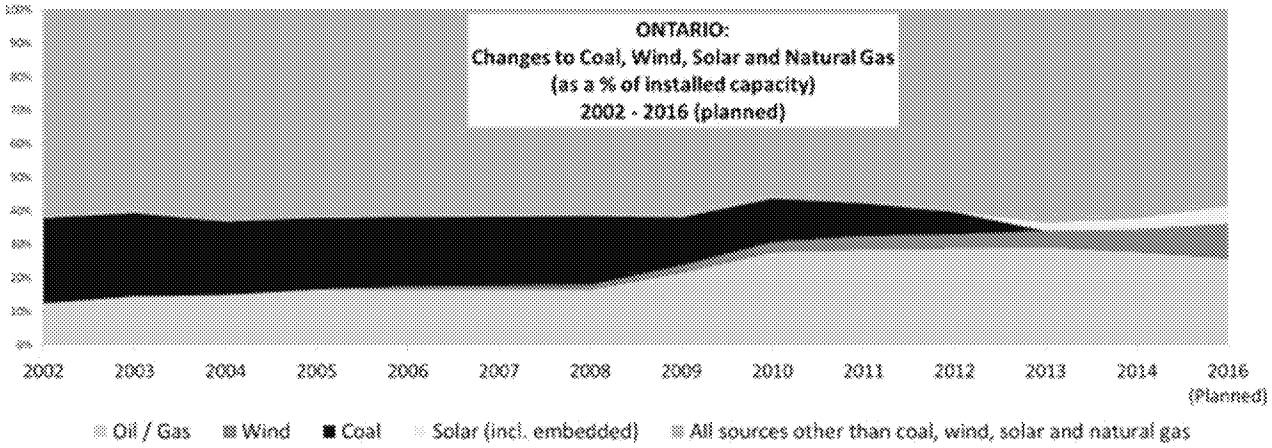
For several years of course, the Global Adjustment portfolio has been a unique feature on the Ontario landscape. Perhaps even more so now that it falls under the administrative authority of an organization that also acts as the system and market operator. This organizational feature makes the IESO unique amongst its system operator peers across North America. However, the next section will illustrate how other forces have now brought about a convergence between the kind of changes being seen in Ontario relative to other jurisdictions across the continent. Coal retirements are now common place, renewables are showing real staying power, and electricity prices are once again under pressure…

SUPPLY:

The International Energy Agency estimates that just under 52% of all worldwide generation capacity additions by 2035 will be from renewable forms of energy.[86] Like Ontario, the latest near-term projections for the United States (illustrated below), show that the vast majority of near-term capacity additions are also from renewable sources.



As recently as 2011, coal capacity in the United States was still rising.[87] Today, it represents over 90% of the planned retirements in the U.S. over the coming year. Apart from the modest amount of new nuclear being added to the U.S. system, Ontario's near-term supply mix changes suddenly look strikingly similar to the kind of changes happening south of the border. In the U.S., a combination of EPA regulations, cheap natural gas, falling prices of renewables and government policies are now making a serious mark on going forward plans.



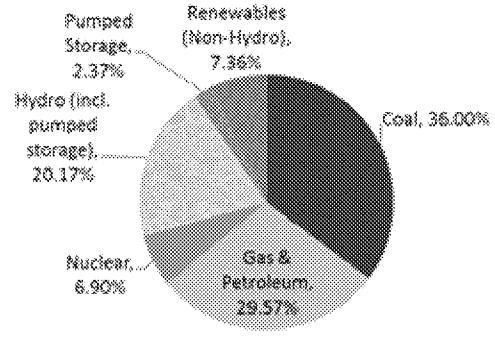
[86] International Energy Agency, "*World Energy Investment Outlook 2014*" pg. 99

[87] U.S. Energy Information Administration, "Electric Power Annual", Table 4.2.A. Existing net summer capacity by energy source and producer type

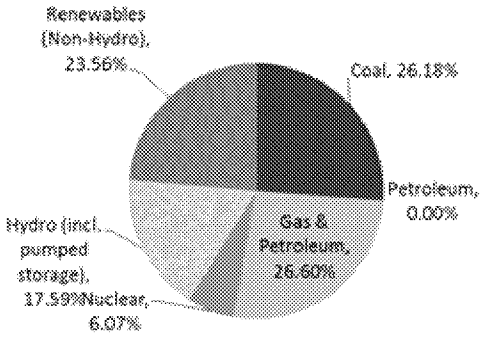
Supply (Installed Capacity)

The World

2011

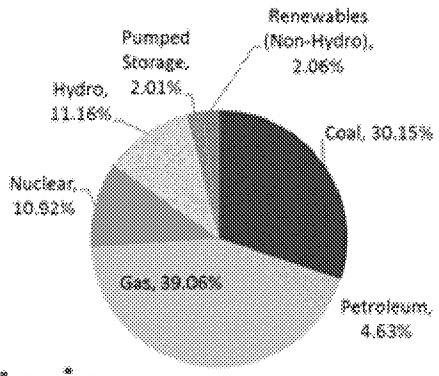


2035 - IEA projection

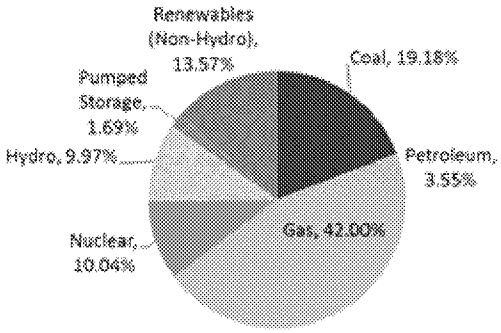


North America

2013

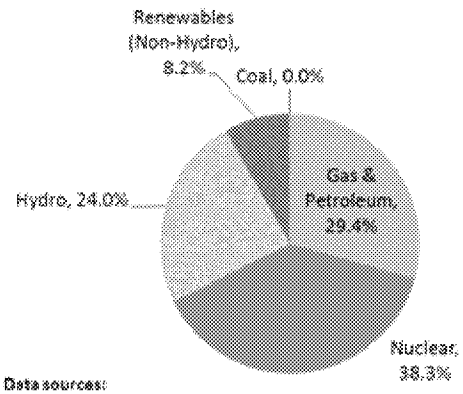


2023 (Planned and conceptual)

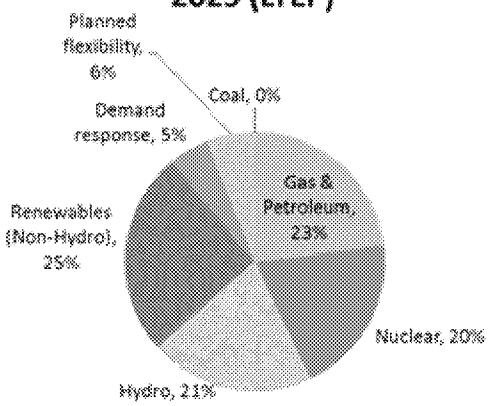


Ontario

2014



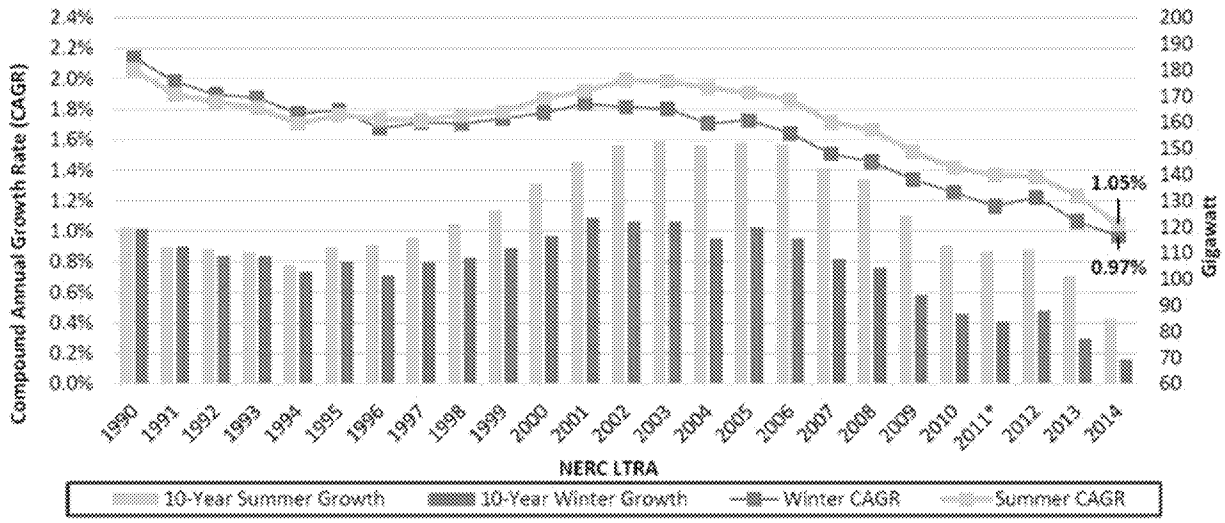
2025 (LTEP)



Data sources:
United Nations, *"2011 Energy Statistics Yearbook"*
International Energy Agency, *"World Energy Investment Outlook 2014"*
NERC *"2013 Long-Term Reliability Assessment"*, December 2013
Ontario Ministry of Energy, *"Ontario Long-Term Energy Plan"* December 2013

DEMAND:

Compound Annual Growth Rates of Demand (NERC-wide, summer and winter seasons)[88]*:*



Once again in 2014, electricity demand and energy use is stagnating at a North American level and particularly so in Ontario. As noted in the Crosscutting Issues section, Ontario's energy use is in its longest slump ever recorded.

2015 may see a slight change from this trend however. Going forward into 2015, Ontario's most recent economic projections remain relatively buoyant (see also, **Macroeconomics section**). South of the border, the U.S. Energy Information Administration anticipates industrial-based, commercial, and transportation-related electrical demand to increase over the coming year.[89] Over the longer horizon, Ontario's plans are certainly clear – absorption of demand growth through significant energy conservation programs (see also, **Crosscutting issues** section). In the U.S., the U.S. Energy Information Administration projects 0.7% growth out to the year 2040 in their reference case.[90]

[88] Graph source: NERC "2014 *Long-Term Reliability Assessment*", November, 2014 pg. 2
[89] U.S. Energy Information Administration "*Short-Term Energy Outlook*" March 10, 2015 – U.S. electricity consumption projections
[90] U.S. Energy Information Administration "*Annual Energy Outlook, 2014*" Table A2. Energy consumption by sector and source

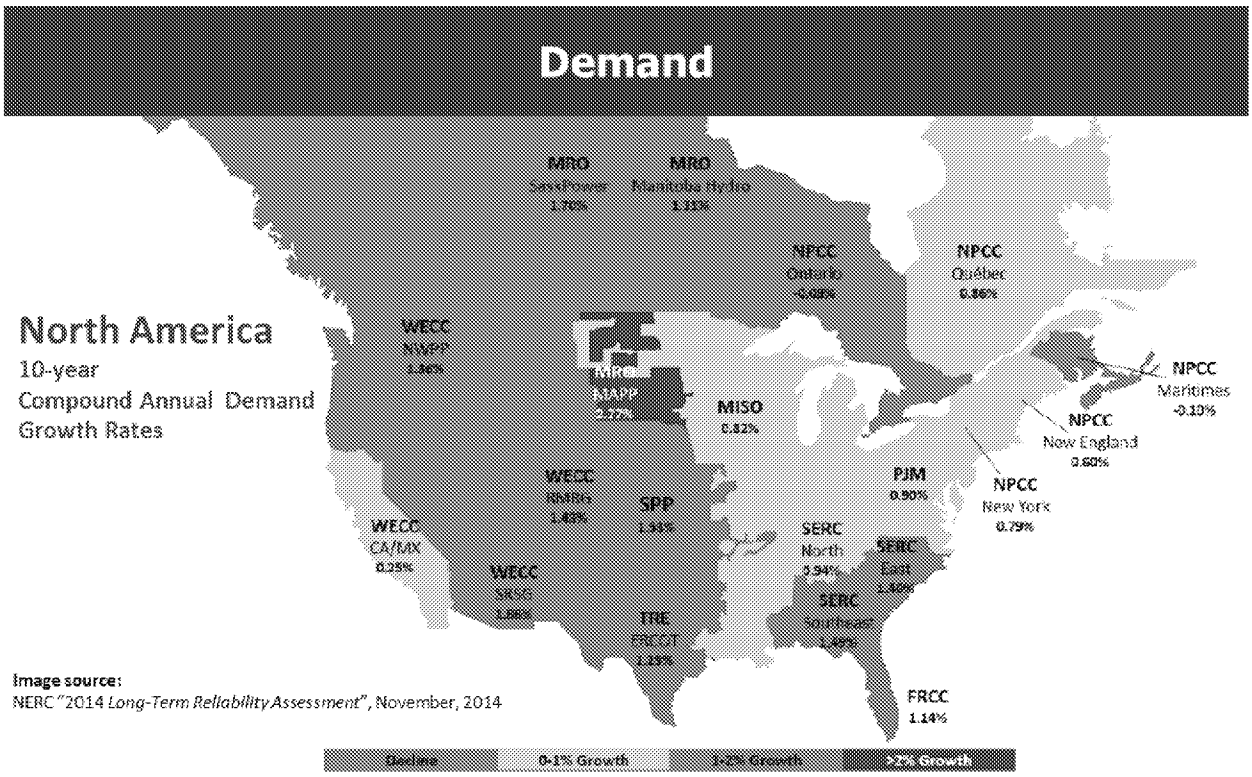
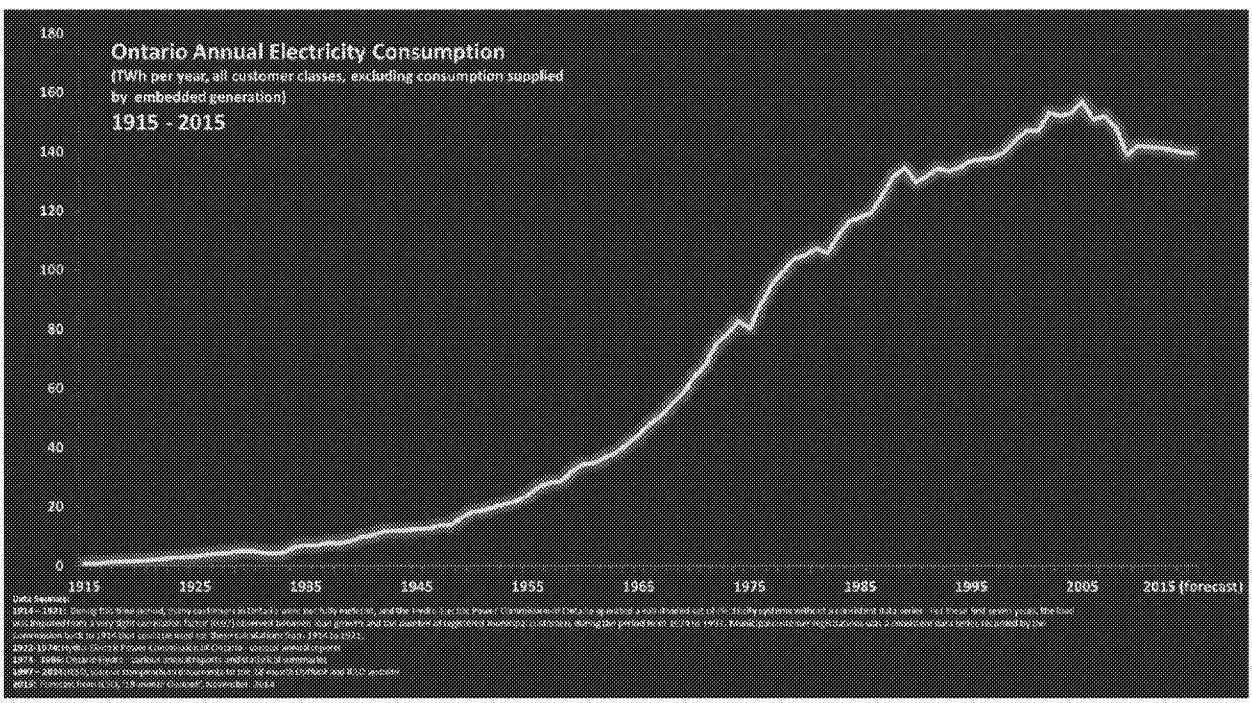


Image source:
NERC "2014 *Long-Term Reliability Assessment*", November, 2014

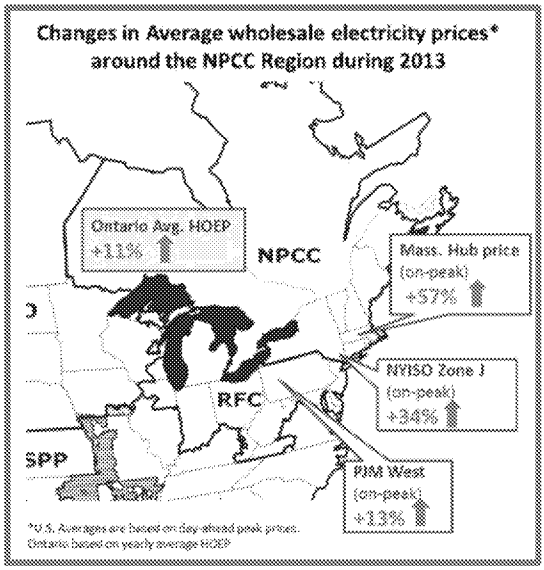
Ontario Energy Use Over the Past Century



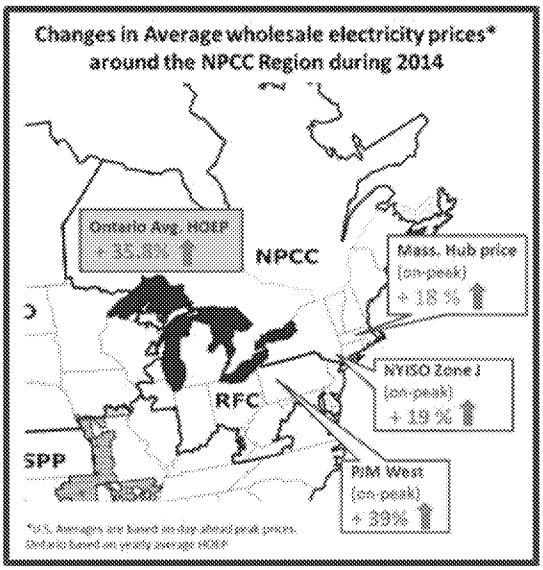
PRICES:

WHOLESALE PRICES:

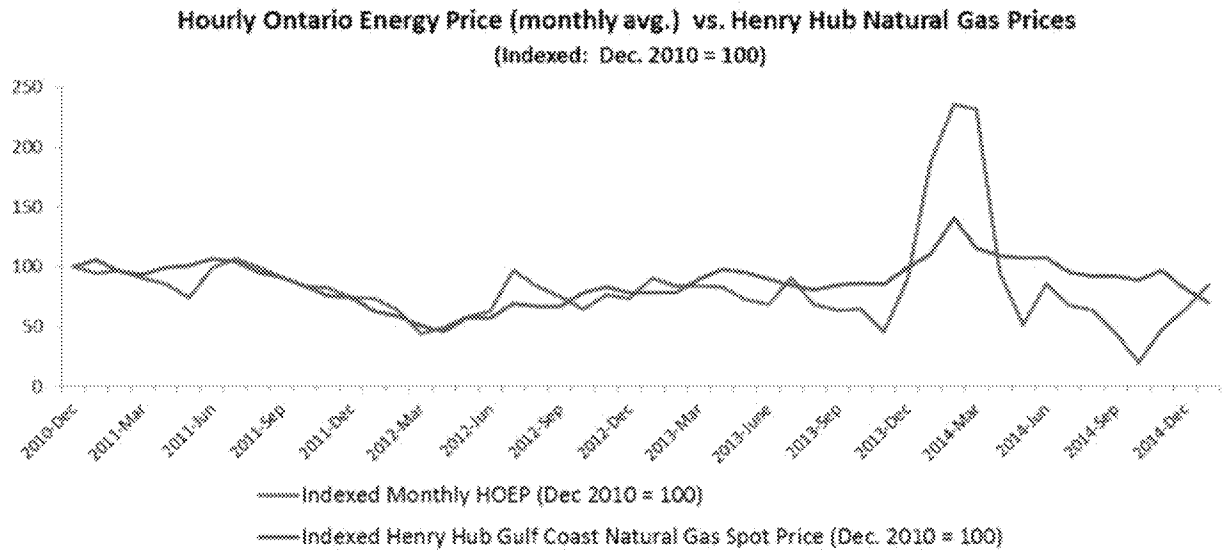
2013



2014



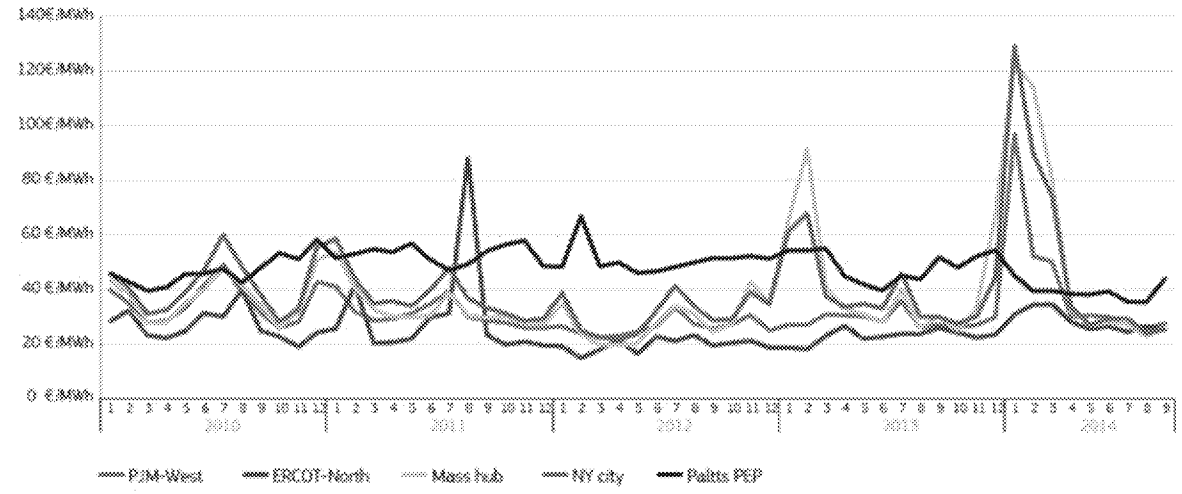
Around the NPCC region in 2014, wholesale electricity prices tightened for the second year in a row after falling dramatically in 2012. As has been noted in previous editions of *Reading of the World*, natural gas plays a prominent role in overall price trends in the northeastern region.



In 2014, a casual inspection of the indexed price of natural gas relative to the Hourly Ontario Energy Price (HOEP) in the graph on the previous page highlights the impact of the cold

weather snap at the beginning of 2014. This trend held true across much of the North American continent in 2014 and is particularly well illustrated when compared to pan-European wholesale electricity prices over the same time period:

U.S. and European (Platts PEP index) wholesale electricity prices compared, 2010 - 2014[91]

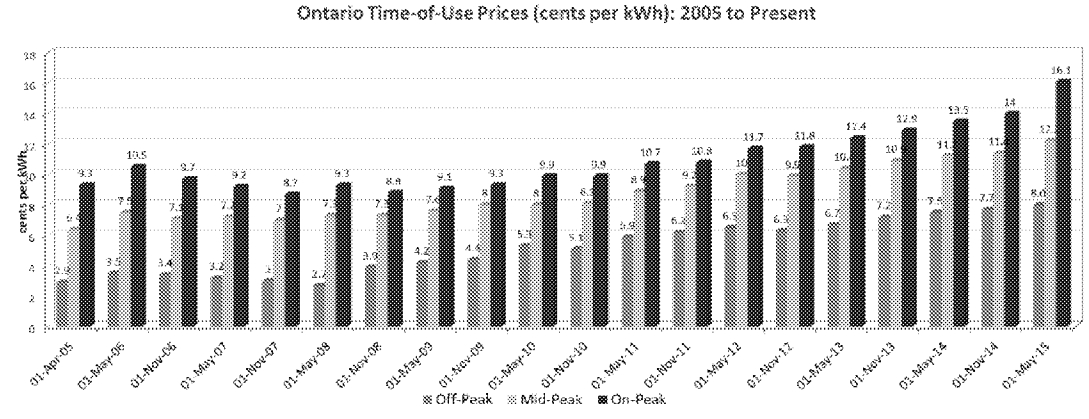


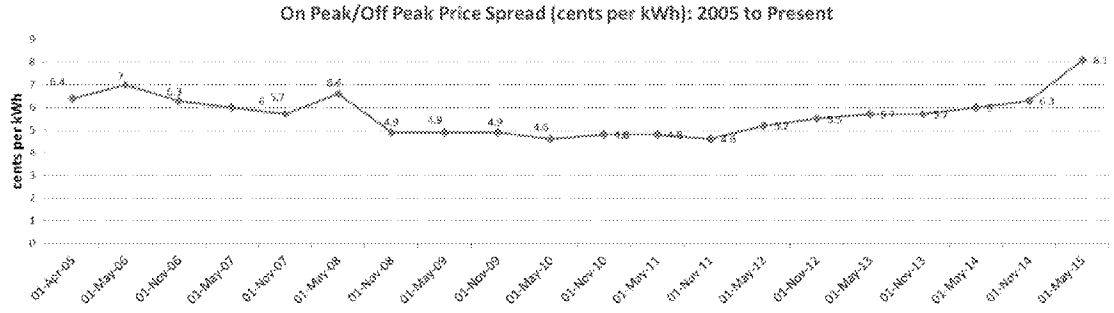
Once again, the weather impacts of cold winters in early 2013 and 2014 on northeastern markets highlights the relative dependency of North American electric markets on natural gas. This trend does seem to be changing however. As noted in the **Markets section** of this report, the natural gas/electricity price impact of the cold weather start to 2015 wasn't nearly as pronounced as it was at the beginning of 2014.

[91] Graph source: European Commission, "*Quarterly Report on European Electricity Markets*," Volume 7, 3rd quarter of 2014 pg. 23

RETAIL PRICES:

This year, retail prices were elevated to the **Crosscutting Issues section** of this report due to their close interrelationship with several pressing issues including distribution sector reform, conservation, and financial viability of the legacy electricity system. In last year's Reading *of the World*, it was noted that both the Ontario Energy Board and the Ontario Power Authority had conducted their own studies into the effectiveness of Time of Use rates in Ontario thus far[92]. The two reports had noted some degree of peak load shifting and the potential to do much more if the on-peak/off-peak price spread was further widened – a point more recently made by the Auditor General of Ontario in her own report as well.[93] As one will note in the graph below, the on-peak/off-peak price spread was widened for next TOU pricing period commencing on May 1, 2015. However, according to the recent studies conducted, the resulting ratio of 2:1 still falls short of what would be required in order to effect material results.[94] At the close of 2014, Ontario still awaits a regulatory review of Time-of-Use rates in the province by the Ontario Energy Board (a point the Auditor General pressed the OEB in her most recent annual report).





[92] Commissioned by the Ontario Energy Board: Navigant Consulting, "*Time of Use Rates in Ontario Part 1: Impact Analysis*", December 20, 2013 Commissioned by the Ontario Power Authority: Brattle Group, "*Impact Evaluation of Ontario's Time-of-Use Rates: First Year Analysis*", November 26, 2013

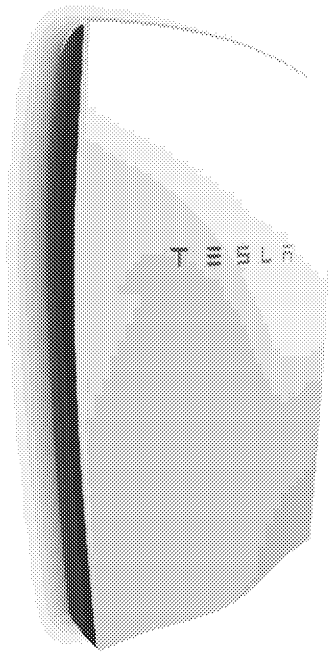
[93] Auditor General of Ontario, *2014 Annual Report*, Chapter 3.11 pgs. 385-386

[94] With reference to the findings of: Brattle Group, "*Impact Evaluation of Ontario's Time-of-Use Rates: First Year Analysis*", pg. 21

IN SUMMARY…

On the cover of this year's *Reading of the World*, is an image of the ongoing construction of the Tesla/Panasonic "Gigafactory" in the Nevada desert. The ultimate aim of this project is to achieve economies-of-scale in the production of batteries for electric vehicles and stationary battery packs for residential and commercial electricity customers, such as that pictured at right. As of March, 2015 the Tesla stationary battery pack is in trial use for selected group of Solar City customers in California and is currently advertised as a "back-up system" for people's homes.[95] On April 30th, Tesla opened a broader commercial effort to promote roll-out of the Tesla Powerwall and PowerPack battery units for residential and commercial customers respectively. By 2016, the Powerwall is expected to become widely available in Canada.[96] Such innovations could someday be of significance to Ontario's aspirations to have 10% of peak demand met by of demand response by the year 2025.[97]

Tesla's "Powerwall" (7 to 10 kWh stationary battery storage unit). An earlier prototype has been undergoing trials with select retail customers in California for the past year.
Image source: Tesla Motors



The purpose of *Reading of the World* is not to speculate on the ultimate success (or failure) of distributed energy storage – it's simply too early to discern reliable data trend at this point. Perhaps the advent of distributed energy storage may emerge to become a suitable topic of examination for *Reading of the World, 2016* or *2017*. In the meantime however, the ***possibilities*** of this new technology are perhaps an appropriate topic to end this year's edition with. Distributed energy storage adds an important technological dimension to some emerging stories that have run through this year's *Reading of the World*, including:

- The relative cost and convenience of self-generated electricity versus that of the traditional electricity system;

[95] With reference to Solar City website overview "*Home energy storage solutions*" accessed on March 18, 2015
[96] Globe and Mail, Blackwell, R. "*Tesla Powerwall in-home battery pack coming to Canada; Solar-power storage system expected to go on sale in early 2016, with former Home Depot Canada boss's firm named as distributor*" May 5, 2015
[97] Ontario Ministry of Energy, "*Ontario Long-Term Energy Plan*" December 2013, pg. 5

- The rise of new entrants into the electricity industry;
- The response from the 'traditional' electricity sector and the future role of the distribution company; and
- The growing environmental imperative of greenhouse gas reduction and the future valuation of renewable energy.

Together they underscore the changing value proposition of the traditional electricity system to the end-use consumer. The growth of distributed energy storage solutions may in fact serve as a barometer to customer value perceptions regarding the electricity sector in general. At what point will microgrids, distributed generation and storage provide more value to the consumer that the traditional grid does?

It is here where the discourse focuses on the concept of "two-way" value between the customer and the grid. Even if solar power and batteries reach the coveted 'grid parity' point, the electricity grid still affords a marketplace that the customer can participate in and extract further value from their investment. Over time this reason on its own could become the strongest argument against grid defection. Already in 2014, this document has shown an example of where New York State is looking ahead to this question through their Renewed Energy Vision (REV) regulatory process. Should distributors look a lot more like system/market operators in the future? And if so, what value do organizations such as the IESO offer to new business models such as these? Again in 2014 we have seen plenty of early evidence that this debate may soon be headed to Ontario – particularly as the Ontario government changes its future relationship with its transmission and distribution assets.

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