London Hydro

Exhibit 3 Interrogatories

Response to Interrogatories

EB-2016-0091

Rates Effective: May 1, 2017

Date Filed: January 17, 2017

London Hydro
111 Horton Street
P.O. Box 2700
London, ON
N6A 4H6

London Hydro

File Number: EB-2016-0091

Date Filed: January 17, 2017

Tab 1 of 5

Exh 3 Board Staff Interrogatories

3-Staff-41

Load Forecast
Ref: E3/1/2, p. 1

London Hydro indicates that it has updated its analysis for actual power consumed by each customer class up to December 2015.

Please update the load forecast to include the most recent data (to October 2016) and indicate how the load and customer forecast for 2016 and 2017 may be affected.

LH Response:

London Hydro's original application projected total kWh purchases of 3,215 GWh's.

TABLE 3.1.2.1: London Hydro FORECAST VS. ACTUAL PURCHASES

Annual Actual vs. Normalized WSkWh

	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,657,286	
2007	3,457,316,677	1.7%	3,439,522,287	0.8%
2008	3,390,352,069	-1.9%	3,374,339,384	-1.9%
2009	3,265,909,314	-3.7%	3,277,065,679	-2.9%
2010	3,374,790,334	3.3%	3,386,793,783	3.3%
2011	3,358,540,971	-0.5%	3,343,370,724	-1.3%
2012	3,307,326,673	-1.5%	3,340,872,292	-0.1%
2013	3,305,662,923	-0.1%	3,296,317,361	-1.3%
2014	3,248,077,232	-1.7%	3,244,458,120	-1.6%
2015	3,247,096,763	0.0%	3,240,128,565	-0.1%
2016			3,237,280,481	-0.1%
2017			3,215,000,040	-0.7%

London Hydro has updated our purchase forecast model to reflect consumption to November 2016 and used December 2015 values for estimating total 2016 purchase values, and then projected values to obtain an updated forecast of 3,226 GWh as shown below. Please reference following attachment for further details.

Annual Actual vs. Predicted WSkWh				
	WSkWh	% Change	Predicted Value	% Change
2006	3,381,396,099		3,391,887,821	
2007	3,437,253,458	1.7%	3,420,290,349	0.8%
2008	3,370,084,710	-2.0%	3,355,008,827	-1.9%
2009	3,245,166,643	-3.7%	3,257,754,032	-2.9%
2010	3,353,468,835	3.3%	3,370,122,661	3.4%
2011	3,337,714,644	-0.5%	3,328,632,116	-1.2%
2012	3,302,327,427	-1.1%	3,329,610,055	0.0%
2013	3,306,067,868	0.1%	3,288,078,432	-1.2%
2014	3,248,466,267	-1.7%	3,238,572,906	-1.5%
2015	3,247,167,562	0.0%	3,237,527,854	0.0%
2016	3,279,837,651	1.0%	3,291,466,109	1.7%
2017			3,226,441,830	-2.0%

London Hydro's original application forecasted 3,118 GWh of billing load as shown below.

TABLE 3.1.2.3: AVERAGE LOSS FACTOR

Determination of Loss Factor				
Year	Actual Purchases	Total Billed	Losses	Loss Factor
2006	3,400,452,526	3,294,584,959	105,867,566	1.0311
2007	3,457,316,677	3,332,168,321	125,148,355	1.0362
2008	3,390,352,069	3,282,363,050	107,989,019	1.0319
2009	3,265,909,314	3,101,551,043	164,358,271	1.0503
2010	3,374,790,334	3,324,090,310	50,700,024	1.0150
2011	3,358,540,971	3,267,608,348	90,932,623	1.0271
2012	3,307,326,673	3,208,421,243	98,905,430	1.0299
2013	3,305,662,923	3,172,182,384	133,480,539	1.0404
2014	3,248,077,232	3,185,717,215	62,360,016	1.0192
2015	3,247,096,763	3,149,997,453	97,099,310	1.0312
2016		3,139,197,449		1.0312
2017	-	3,117,592,061		1.0312

Using the updated purchase load value London Hydro estimates an updated billing load of 3,128 GWh's.

Determination of Loss Factor				
Year	Actual Purchases	Total Billed	Losses	Loss Factor
2006	3,381,396,099	3,275,701,579	105,694,520	1.0313
2007	3,437,253,458	3,312,382,012	124,871,446	1.0363
2008	3,370,084,710	3,262,420,182	107,664,528	1.0319
2009	3,245,166,643	3,081,157,255	164,009,387	1.0505
2010	3,353,468,835	3,303,100,984	50,367,851	1.0150
2011	3,337,714,644	3,247,125,848	90,588,797	1.0271
2012	3,302,327,427	3,203,200,497	99,126,930	1.0300
2013	3,306,067,868	3,172,182,384	133,885,484	1.0405
2014	3,248,466,267	3,185,717,215	62,749,052	1.0193
2015	3,247,167,562	3,149,997,453	97,170,109	1.0314
2016		3,191,412,589		1.0314
2017	-	3,128,364,908		1.0314

Hence both the purchase and billing load forecast will be increased by about 11 GWh (0.35%).

London Hydro's original application forecasted the following for customer counts.

Forecasted Customers/Connections									
2016	141,179	12,623	1,566	4	1	35,570	617	1,534	193,094
2017	142,509	12,743	1,557	4	1	35,912	599	1,537	194,862
Add: WMP									
2016	-	-	4	-	-	-	-	-	4
2017	-	-	4	-	-	-	-	-	4
Total Forecasted Customers/Connections									
2016	141,179	12,623	1,570	4	1	35,570	617	1,534	193,098
2017	142,509	12,749	1,561	4	1	35,912	599	1,537	194,872

Change Customers/Connections									
2016	1,318	119	(9)	-	-	339	(19)	3	1,751
2017	1,330	120	(9)	-	-	342	(18)	3	1,768

Based on updated customer counts to December 2016 and changed its average customer calculation methodology, London Hydro has changed its forecast as follows.

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Forecasted Customers/Connections									
2016	140,655	12,563	1,562	4	1	35,712	623	1,521	192,641
2017	141,991	12,697	1,552	4	1	36,048	606	1,526	194,425
Add: WMP									
2016	-	-	4	-	-	-	-	-	4
2017	-	-	4	-	-	-	-	-	4
Total Forecasted Customers/Connections									
2016	140,655	12,563	1,566	4	1	35,712	623	1,521	192,645
2017	141,991	12,703	1,556	4	1	36,048	606	1,526	194,435

Change Customers/Connections									
2016	1,432	102	(16)	-	-	385	(23)	(4)	1,876
2017	1,336	134	(10)	-	-	336	(17)	5	1,784

Attachment 1 of 1

Updated Load Forecast

3-STAFF-41

London Hydro has within this document updated its load forecast as requested by Board staff to reflect the following changes:

a) Wholesale purchase quantities have been changed to reflect removal of lost large user (uplifted for losses), and the removal of 4 wholesale market participants from 2006 to transition 2012 (uplifted for losses). 3-LPMA-24, 3-LPMA-29, 3-VECC-24
b) Wholesale purchase quantities have been updated to include 2016 actual.
c) Updated customer counts to include 2016 actual. 3-LPMA-27
d) Changed average annual customer count methodology to use actual monthly averages. 3-LPMA-27
e) Updated 2015 CDM results to actual verified amounts. 3-VECC-28
f) Changed persistence allocation for 2015, 2016 and 2017 as suggested in 3-LPMA-38
g) Used 2013 to 2015 average for Co-Gen Demand kW as suggested in 3-VECC-30.

London Hydro has added comparative table and charts to show the resulting changes.

3.2.1 INTRODUCTION

The purpose of this section is to present the process used by London Hydro to develop its 2016 Bridge Year and 2017 Test Year weather-normalized load and customer/connections forecast utilized in the design of the 2017 proposed distribution rates.

London Hydro has prepared a Load Forecast Model (the "Model") consistent with its understanding of the Chapter 2 Filing Requirements for Electricity Distribution Rate Applications – 2016 Edition for 2017 Rate Applications issued on July 14, 2016.

3.2.2 PURCHASED KWH FORECAST

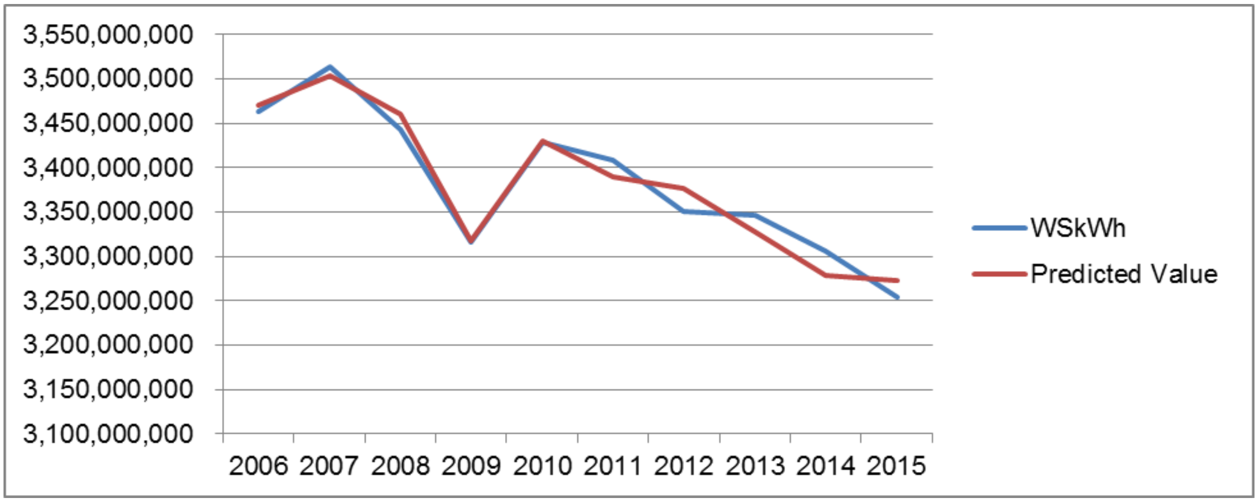
Consistent with the methodology used to prepare the approved load forecast in London Hydro's 2013 Cost of Service Application (EB-2012-0146), London Hydro utilized the multivariate linear regression analysis methodology for this Application. This methodology was chosen (i) for consistency with the London Hydro's 2013 Cost of Service Application and (ii) for its accessibility and the capability of Microsoft Excel to house the fully functional model. London Hydro believes this approach of conducting a regression analysis on historical electricity purchases and producing an equation that will predict future purchases is appropriate.

HISTORIC PURCHASES

Traditionally, kWh purchase data is accumulated by month for 10 historic years for use in the regression analysis. Sources include purchase data from the IESO, Hydro One Networks Inc. ("HONI"), as well as embedded generation data. Accordingly, London Hydro has utilized kWh purchase data, by month, for its service territory for the period of January 2006 to December 2015 as part of this regression analysis.

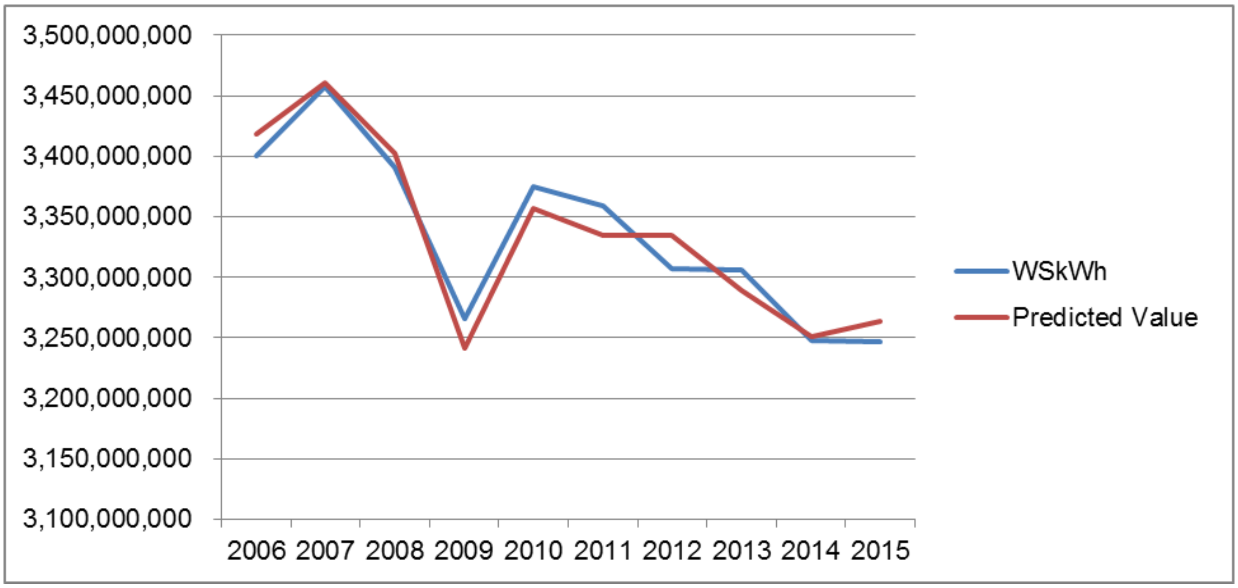
As shown in Chart 3-1 below, London Hydro experienced significant load loss between 2008 and 2010 as a result of the global recession, and any recovery post-recession has been steadily eroded to below recession levels. The blue line in Chart 3-1 illustrates that since London Hydro's recovery from the recession, the load leveled off and London Hydro is now experiencing a new profile at lower-than-historic levels. Load loss was experienced in London as businesses closed or curtailed production. In 2015, London Hydro further experienced the significant loss of two (2) Large Use customers. One large user has completely closed operations. The other load decline has resulted in it being transferred to the GS>50 kW class.

CHART 3-1: London Hydro Historical and Predicted Purchases

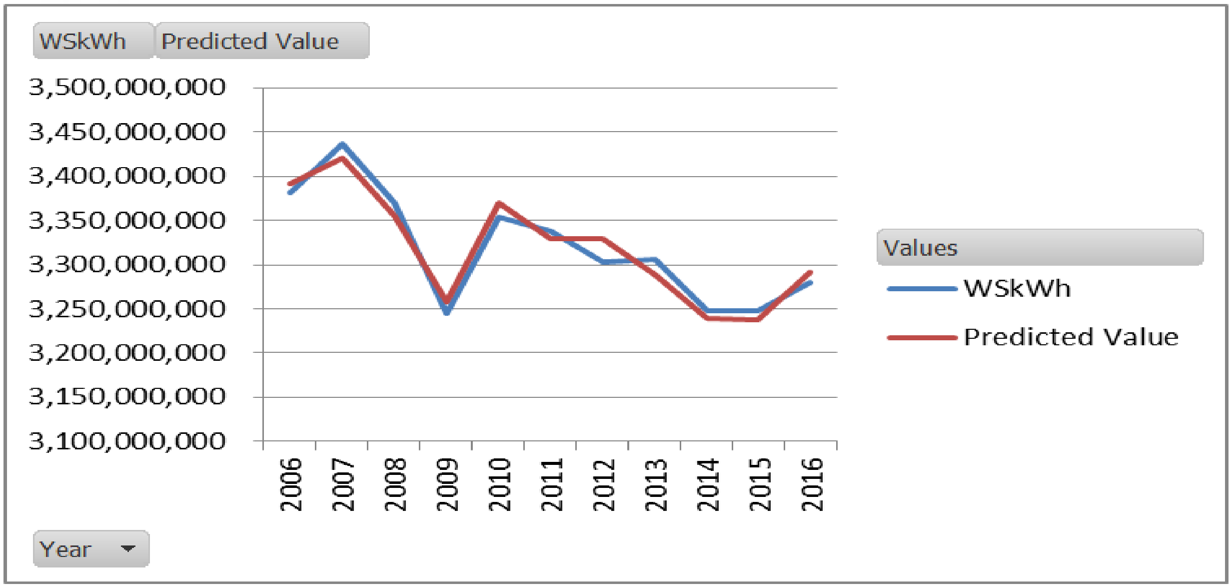


Prior to any modeling, London Hydro included an adjustment to the current profile to recognize that the one large use load no longer exists. Specifically, the adjustment pushes the historic purchased kWh downward, so the forecast model more accurately reflects customer consumption post global recession. The adjusted historical purchases are reflected in the blue line in Chart 3-2 below.

CHART 3-2: London Hydro Adjusted Historical and Predicted Purchases



The following chart reflects the update to the load forecast which has effectively removed the WMP customers, adjusted amounts for line losses and included updated values to December 2016.



MODELLED VARIABLES

Variables included in the model are designed to provide a broad coverage of the drivers of electricity use by our customers. London Hydro utilized the following variables:

- Weather Conditions
- Days in the Month
- Peak Days
- Time in Years and
- London Region Population

Weather Conditions

Weather impacts on load are apparent in both the winter heating season and in the summer cooling season. For that reason, London Hydro has included both Heating Degree Days (i.e., a measure of coldness in the winter) and Cooling Degree Days (i.e., a measure of summer heat) as variables in the regression analysis.

Weather data is measured in degrees Celsius by the London CS weather station as operated by Environment Canada. The 10 year average monthly values were used in generating forecast values.

London Region Population

Statistics Canada routinely collects historical population data for the London area, CANSIM Table 051-0059. The "2016 Ontario Economic Update: London Economic Region" by the Credit Unions of Ontario and the Ontario Chamber of Commerce suggest the labour force growth will be aided by a rising participation rate and is forecasted at 0.7 percent in 2016 and 0.8 percent in 2017.

REJECTED VARIABLES

London Hydro considered the following variables and rejected them in favour of the above, which are closer to the centroid of the service territory.

CDM Activity 2006 to 2014

This variable was rejected as London Hydro believes that the programs including persistence affecting 2006 to 2014 periods are reasonably represented in the wholesale consumption trends.

Labour Force Survey – Employment & Full Time Equivalent

These were rejected as London Hydro distribution revenue is predominantly residential in nature and hence the forecast is better supported by the population variable.

Ontario Real GDP

This variable was used in our 2013 Load Forecast, however when used in our current forecast this variable created a significant negative coefficient. London Hydro determined that this variable was too generic to the province as a whole and not fully representative of the city of London.

RESULTS

The following formula outlines the model used by London Hydro to predict normal weather purchases for 2016 and 2017 Monthly Predicted kWh Purchases.

	Coefficients
WSkWh	6,733,221,371
LonHDD	68,115
LonCDD	727,412
MonthDays	4,684,015
PeakDays	2,081,359
Year	- 3,460,144
Population	426

The following table shows the updated coefficients resulting from the adjustments to the wholesale market purchases.

	Coefficients
WSkWh	7,080,628,228
LonHDD	68,110
LonCDD	734,695
MonthDays	4,521,880
PeakDays	2,012,683
Year	- 3,660,127
Population	518

The monthly data used in the regression model and the resulting monthly prediction for the actual and forecasted years are provided in the Load Forecast Model filed in Live Excel format.

Based on the monthly corrected purchases and the above described variables used in the regression model, London Hydro expects 2016 purchases of 3,237,280,481 kWh and 2017 purchases of 3,215,000,040 kWh.

The table below shows the modeled purchases generated by the regression model for 2016 and 2017 are very close to the recent historical year purchases.

TABLE 3.1.2.1: London Hydro FORECAST VS. ACTUAL PURCHASES

Annual Actual vs. Normalized WSkWh

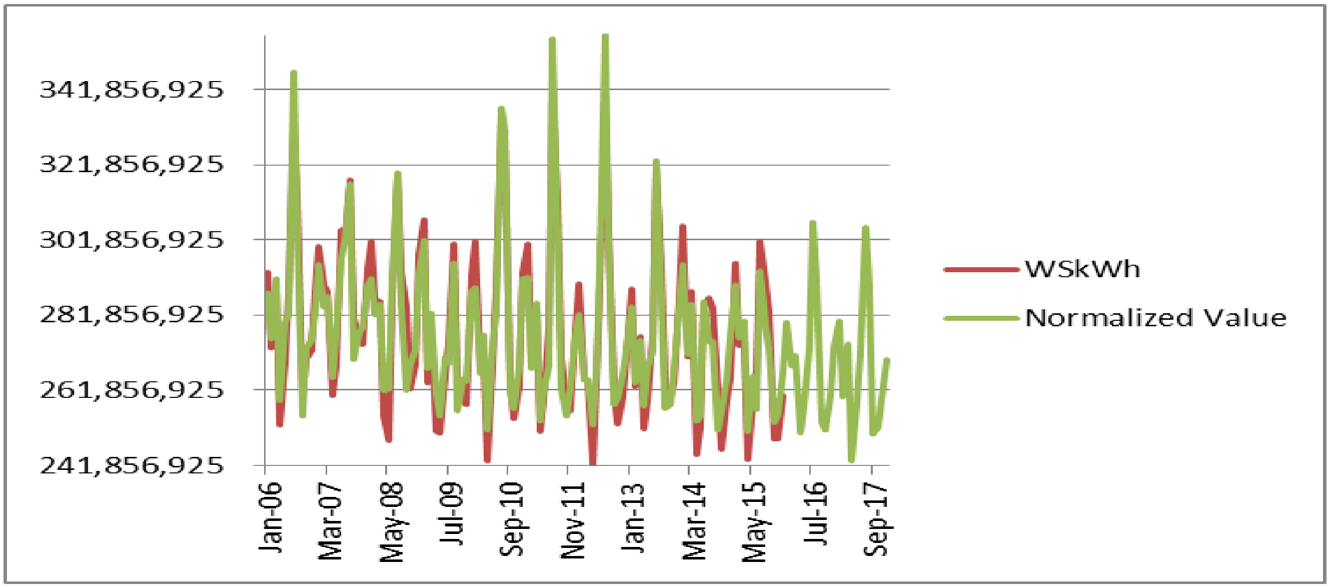
	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,657,286	
2007	3,457,316,677	1.7%	3,439,522,287	0.8%
2008	3,390,352,069	-1.9%	3,374,339,384	-1.9%
2009	3,265,909,314	-3.7%	3,277,065,679	-2.9%
2010	3,374,790,334	3.3%	3,386,793,783	3.3%
2011	3,358,540,971	-0.5%	3,343,370,724	-1.3%
2012	3,307,326,673	-1.5%	3,340,872,292	-0.1%
2013	3,305,662,923	-0.1%	3,296,317,361	-1.3%
2014	3,248,077,232	-1.7%	3,244,458,120	-1.6%
2015	3,247,096,763	0.0%	3,240,128,565	-0.1%
2016			3,237,280,481	-0.1%
2017			3,215,000,040	-0.7%

The following chart is the updated forecast for predicted 2017 wholesale purchases.

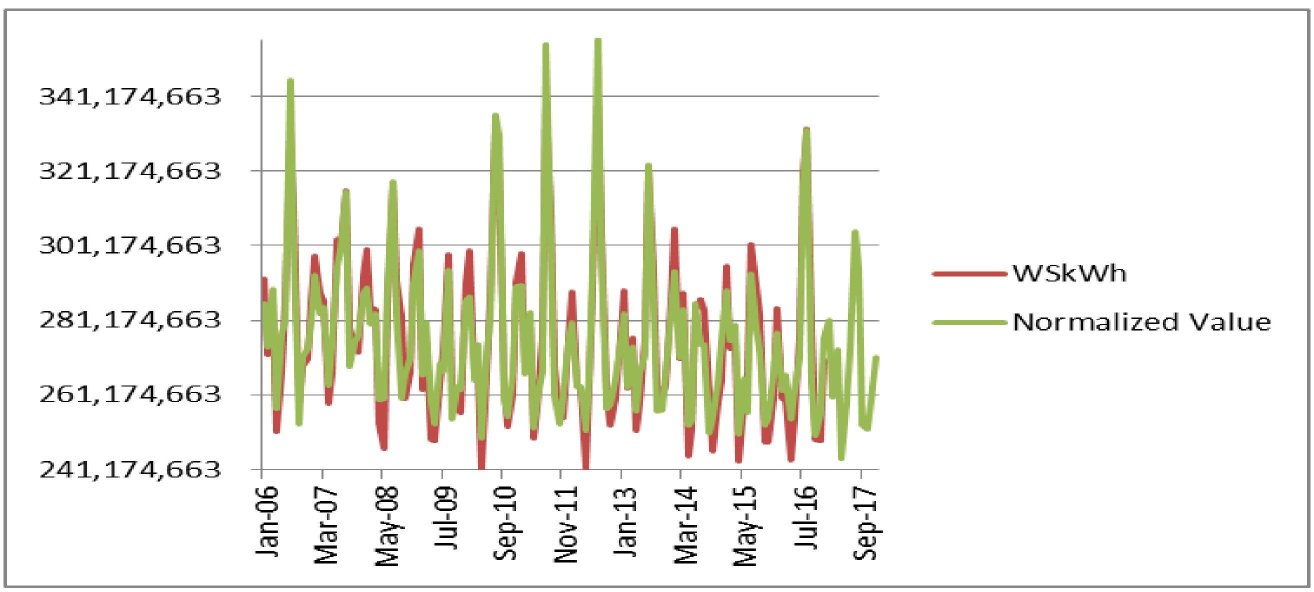
Annual Actual vs. Predicted WSkWh				
	WSkWh	% Change	Predicted Value	% Change
2006	3,381,396,099		3,391,887,821	
2007	3,437,253,458	1.7%	3,420,290,349	0.8%
2008	3,370,084,710	-2.0%	3,355,008,827	-1.9%
2009	3,245,166,643	-3.7%	3,257,754,032	-2.9%
2010	3,353,468,835	3.3%	3,370,122,661	3.4%
2011	3,337,714,644	-0.5%	3,328,632,116	-1.2%
2012	3,302,327,427	-1.1%	3,329,610,055	0.0%
2013	3,306,067,868	0.1%	3,288,078,432	-1.2%
2014	3,248,466,267	-1.7%	3,238,572,906	-1.5%
2015	3,247,167,562	0.0%	3,237,527,854	0.0%
2016	3,279,837,651	1.0%	3,291,466,109	1.7%
2017			3,226,441,830	-2.0%

Chart 3-3 below shows the variance between the modeled purchased and the historic purchases. As shown, the pattern in the forecast years shows a very similar and expected pattern.

CHART 3-3: FORECASTED PURCHASES



The following is the updated version of this chart.



The prediction formula has the following statistical results, which generally indicate the formula has a very good fit to the actual data set.

TABLE 31.2.2: T-STATISTICS FOR ACCEPTED VARIABLES

Statistic	***Value***
R Square	90.1%
Adjusted R Square	89.6%
F Test	172.14
Mean Absolute Percentage Error (Annual)	0.4%
Mean Absolute Percentage Error (Monthly)	2.1%
Variable	***t Stat***
WSkWh	2.63
LonHDD	19.51
LonCDD	29.53
MonthDays	5.25
PeakDays	3.14
Year	- 2.51
Population	1.27

The following is the updated version of this table.

Statistic	***Value***
R Square	90.4%
Adjusted R Square	90.0%
F Test	197.10
Mean Absolute Percentage Error (Annual)	0.4%
Mean Absolute Percentage Error (Monthly)	2.1%
Variable	***t Stat***
WSkWh	2.91
LonHDD	20.27
LonCDD	31.94
MonthDays	5.31
PeakDays	3.18
Year	- 2.80
Population	1.66

3.2.3 BILLED KWH LOAD FORECAST

To determine the weather normalized billed kWh forecast, the total weather normalized forecast purchased kWh (as discussed above) is adjusted for line losses. At this stage of the analysis, adjustments for CDM and wholesale market participants are not yet incorporated.

London Hydro has utilized the average loss factor from 2007 to 2015. The average loss factor during this time was 1.0312 or 3.12%; the calculation is shown in Table 3.1.2.3.

TABLE 3.1.2.3: AVERAGE LOSS FACTOR

Determination of Loss Factor				
Year	**Actual Purchases**	**Total Billed**	**Losses**	**Loss Factor**
2006	3,400,452,526	3,294,584,959	105,867,566	1.0311
2007	3,457,316,677	3,332,168,321	125,148,355	1.0362
2008	3,390,352,069	3,282,363,050	107,989,019	1.0319
2009	3,265,909,314	3,101,551,043	164,358,271	1.0503
2010	3,374,790,334	3,324,090,310	50,700,024	1.0150
2011	3,358,540,971	3,267,608,348	90,932,623	1.0271
2012	3,307,326,673	3,208,421,243	98,905,430	1.0299
2013	3,305,662,923	3,172,182,384	133,480,539	1.0404
2014	3,248,077,232	3,185,717,215	62,360,016	1.0192
2015	3,247,096,763	3,149,997,453	97,099,310	1.0312
2016		3,139,197,449		1.0312
2017	-	3,117,592,061		1.0312

The following is the updated version of this table.

Determination of Loss Factor				
Year	**Actual Purchases**	**Total Billed**	**Losses**	**Loss Factor**
2006	3,381,396,099	3,275,701,579	105,694,520	1.0313
2007	3,437,253,458	3,312,382,012	124,871,446	1.0363
2008	3,370,084,710	3,262,420,182	107,664,528	1.0319
2009	3,245,166,643	3,081,157,255	164,009,387	1.0505
2010	3,353,468,835	3,303,100,984	50,367,851	1.0150
2011	3,337,714,644	3,247,125,848	90,588,797	1.0271
2012	3,302,327,427	3,203,200,497	99,126,930	1.0300
2013	3,306,067,868	3,172,182,384	133,885,484	1.0405
2014	3,248,466,267	3,185,717,215	62,749,052	1.0193
2015	3,247,167,562	3,149,997,453	97,170,109	1.0314
2016		3,191,412,589		1.0314
2017	-	3,128,364,908		1.0314

Prior to CDM adjustments, the calculated weather normalized billed kWh for the 2016 Bridge Year and 2017 Test Year are 3,139,197,449 kWh and 3,117,592,061 kWh respectively.

3.2.4 HISTORICAL CUSTOMER DATA

As noted above, this load forecast was prepared for the London Hydro service territory in its entirety. London Hydro relied on historical rate class statistics as reported in the annual RRR 2.1.5 submissions to the Board.

In order to properly prepare the following forecasts by rate class, London Hydro restated the following billing determinants to align with the anticipated migration of specific customers amongst rate classes. These migration adjustments to the originally filed RRR data were necessary to predict accurately the specific rate class billing determinants and are described as follows:

- As part of this Application, London Hydro has proposed the removal of the one significant Large User whose lost load has been removed from the purchased wholesale kWh, as explained above. As such, the data reported in the annual RRR filings for this rate class from 2006 until December 31, 2015 has been adjusted to account for this Large User being taken out of the Large User rate class.
- London Hydro is also proposing the transfer of the other Large User customer who has been transferred into the General Service > 50 kW class. As such, the data reported in the annual RRR filings for this rate class from 2006 until December 31, 2015 has been adjusted to account for this Large User being taken out of the Large User rate class.
- London Hydro currently has four Wholesale Market Participants ("WMP"), all of whom have opted into the program in mid-2012.To properly allocate the billed kWh calculated above (which is driven by purchases where the four WMP are inherently excluded) and project customer numbers, these four General Service > 50 kW customers were removed from the historical data since becoming WMPs in 2012. These customers are forecasted separately on the "WMP" tab of the load forecast model and added back to the load forecast totals for rate design purposes.

After the above-noted reclassifications, all historic data appears in the rate class in which the associated customers are anticipated to be billed upon the completion of this Application.

3.2.5 CUSTOMER/CONNECTION FORECAST BY RATE CLASS

The forecasted number of customer/connections is based on a review of London Hydro's average annual historical customer/connection data.

As required in the DSC, London Hydro performs an annual review of customers to determine if the customers are in the correct rate class. After executive review and approval, affected customers are subjected to rate re-classification. This activity is summarized in Table 3.1.2.4 below.

TABLE 3-4: SUMMARY OF ANNUAL RATE CLASS RE-CLASSIFICATION BY YEAR

Rate Class	GS<50	GS>50	CoGen	LU	Total
2011 From	-13	-35			-48
2011 To	35	13			48
Net 2011	22	-22	0	0	0
2012 From	-12	-38			-50
2012 To	38	12			50
Net 2012	26	-26	0	0	0
2013 From		-44			-44
2013 To	44				44
Net 2013	44	-44	0	0	0
2014 From	-9	-53			-62
2014 To	52	9	1		62
Net 2014	43	-44	1	0	0
2015 From	-8	-40			-48
2015 To	40	8			48
Net 2015	32	-32	0	0	0
2016 From	-38	-57		-2	-97
2016 To	57	40			97
Net 2016	19	-17	0	-2	0
Net 2011 to 2016	186	-185	1	-2	0

The following is the updated version of the above table.

Annual Transfer Between Classes

Rate Class	GS<50	GS>50	CoGen	LU	Total
2011 From	-13	-35			-48
2011 To	35	13			48
Net 2011	22	-22	0	0	0
2012 From	-12	-38			-50
2012 To	38	12			50
Net 2012	26	-26	0	0	0
2013 From		-44			-44
2013 To	44				44
Net 2013	44	-44	0	0	0
2014 From	-9	-53			-62
2014 To	52	9	1		62
Net 2014	43	-44	1	0	0
2015 From	-8	-40			-48
2015 To	40	8			48
Net 2015	32	-32	0	0	0
2016 From	-38	-57		-2	-97
2016 To	57	40			97
Net 2016	19	-17	0	-2	0
Net 2011 to 2016	186	-185	1	-2	0
2017 From	-13	-37			-50
2017 To	37	13			50
Net 2017	24	-24	0	0	0
Net 2011 to 2017	210	-209	1	-2	0

London Hydro utilizes the customer/connection data reported in the applicable RRR submissions annually, adjusting for the Rate Class re-classifications, noted above, adjusting the closing prior amounts and then averaging the opening and closing balances annually. The results are presented in Table 3.1.2.5 below. All rate classes are based on the number of customers, except for the Unmetered Scattered Load, Sentinel Lighting and Street Lighting rate classes, which are based on number of connections.

TABLE 3.1.2.5: HISTORIC ANNUAL AVERAGE CUSTOMER/CONNECTIONS BY YEAR

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Average Annual Customers/Connections									
2006	124,978	11,846	1,566	3	1	31,926	777	1,594	172,690
2007	127,035	11,878	1,586	3	1	32,610	762	1,605	175,479
2008	129,174	11,976	1,593	3	1	33,072	752	1,471	178,042
2009	129,621	11,898	1,596	3	1	33,337	738	1,517	178,710
2010	132,014	11,939	1,623	3	1	33,625	728	1,502	181,436
2011	134,718	12,039	1,621	3	1	33,906	717	1,520	184,526
2012	135,373	12,031	1,617	3	1	34,214	697	1,542	185,478
2013	136,671	12,141	1,608	3	1	34,612	681	1,528	187,243
2014	138,010	12,268	1,590	4	1	34,980	660	1,534	189,046
2015	139,861	12,504	1,575	4	1	35,231	636	1,531	191,343

The following is the updated table from above which includes customer counts to Dec 31, 2016 and change in determination of the average annual customer.

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Average Annual Customers/Connections									
2006	124,978	11,846	1,562	3	1	31,926	777	1,594	172,686
2007	127,035	11,878	1,582	3	1	32,610	762	1,605	175,475
2008	129,174	11,976	1,589	3	1	33,072	752	1,471	178,038
2009	129,621	11,898	1,592	3	1	33,337	738	1,517	178,706
2010	132,014	11,939	1,619	3	1	33,625	728	1,502	181,432
2011	134,171	11,915	1,615	3	1	34,083	717	1,496	184,001
2012	135,321	12,011	1,627	3	1	34,410	697	1,503	185,573
2013	136,540	12,098	1,615	3	1	34,882	681	1,508	187,328
2014	137,835	12,243	1,600	4	1	35,118	666	1,520	188,986
2015	139,223	12,461	1,578	4	1	35,327	646	1,525	190,765
2016	140,655	12,563	1,562	4	1	35,712	623	1,521	192,641

From the historic data, London Hydro calculates the growth rate for each rate class. London Hydro utilizes the annual growth from the past four years (2012 to 2015) to calculate the geometric growth rate for all rate classes. London Hydro believes these four years best represent the current economic situation of its service territory and takes into consideration the stabilization after the global recession. The results are presented below in Table 3.1.2.6.

TABLE 3.1.2.6: HISTORICAL CUSTOMER/CONNECTION GROWTH RATES BY YEAR

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Customer Growth Rate								
2007	1.0165	1.0027	1.0128	0.9730	1.0000	1.0214	0.9800	1.0066
2008	1.0168	1.0082	1.0045	1.0000	1.0000	1.0142	0.9878	0.9169
2009	1.0035	0.9935	1.0018	1.0000	1.0000	1.0080	0.9808	1.0310
2010	1.0185	1.0035	1.0169	1.0000	1.0000	1.0087	0.9871	0.9905
2011	1.0205	1.0084	0.9992	1.0000	1.0000	1.0083	0.9843	1.0120
2012	1.0049	0.9993	0.9975	1.0000	1.0000	1.0091	0.9721	1.0142
2013	1.0096	1.0091	0.9943	1.0000	1.0000	1.0116	0.9766	0.9908
2014	1.0098	1.0105	0.9885	1.1667	1.0000	1.0106	0.9701	1.0042
2015	1.0134	1.0193	0.9909	1.1429	1.0000	1.0072	0.9627	0.9979
Geomean (2012 to 2015)	**1.0094**	**1.0095**	**0.9928**	**1.0746**	**1.0000**	**1.0096**	**0.9704**	**1.0017**

The following is the updated table from above which includes customer counts to Dec 31, 2016.

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Customer Growth Rate									
2006	-	-	-	-	-	-	-	-	
2007	1.0165	1.0027	1.0129	0.9730	1.0000	1.0214	0.9800	1.0066	
2008	1.0168	1.0082	1.0045	1.0000	1.0000	1.0142	0.9878	0.9169	
2009	1.0035	0.9935	1.0018	1.0000	1.0000	1.0080	0.9808	1.0310	
2010	1.0185	1.0035	1.0170	1.0000	1.0000	1.0087	0.9871	0.9905	
2011	1.0163	0.9980	0.9978	1.0000	1.0000	1.0136	0.9843	0.9957	
2012	1.0086	1.0081	1.0074	1.0000	1.0000	1.0096	0.9721	1.0047	
2013	1.0090	1.0072	0.9926	1.0000	1.0000	1.0137	0.9766	1.0033	
2014	1.0095	1.0120	0.9904	1.1667	1.0000	1.0068	0.9785	1.0080	
2015	1.0101	1.0178	0.9866	1.1429	1.0000	1.0060	0.9700	1.0033	
2016	1.0103	1.0082	0.9899	1.0000	1.0000	1.0109	0.9644	0.9974	
Geomean (2012 to 2016)	**1.0095**	**1.0107**	**0.9934**	**1.0592**	**1.0000**	**1.0094**	**0.9723**	**1.0033**	

For the 2016 Bridge Year customer/connections forecast, London Hydro applied the resulting rate class specific geometric mean to the total year end 2015 customer/connections. Similarly, London Hydro applied the resulting rate class specific geometric mean to the 2016 Bridge Year results to calculate the 2017 Test Year results.

London Hydro would note that the Residential and General Service Less than 50 kW geometric mean growth of .94% is reasonably consistent with the “2016 Ontario Economic Update: London Economic Region” by the Credit Unions of Ontario and the Ontario Chamber of Commerce suggest the labour force growth will be aided by a rising participation rate and is forecasted at 0.7 percent in 2016 and 0.8 percent in 2017.

London Hydro then adjusts for the four Wholesale Market Participant customers to provide for the total forecasted number of customers and connections for the 2016 Bridge Year and the 2017 Test year. The results are presented in Table 3.1.2.7 below.

TABLE 3.1.2.7: FORECASTED NUMBER OF CUSTOMERS/CONNECTION BY YEAR

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Forecasted Customers/Connections									
2016	141,179	12,623	1,566	4	1	35,570	617	1,534	193,094
2017	142,509	12,743	1,557	4	1	35,912	599	1,537	194,862
Add: WMP									
2016	-	-	4	-	-	-	-	-	4
2017	-	-	4	-	-	-	-	-	4
Total Forecasted Customers/Connections									
2016	141,179	12,623	1,570	4	1	35,570	617	1,534	193,098
2017	142,509	12,749	1,561	4	1	35,912	599	1,537	194,872

Change Customers/Connections									
2016	1,318	119	(9)	-	-	339	(19)	3	1,751
2017	1,330	120	(9)	-	-	342	(18)	3	1,768

The following is the updated table from above which includes customer counts to Dec 31, 2016.

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Forecasted Customers/Connections									
2016	140,655	12,563	1,562	4	1	35,712	623	1,521	192,641
2017	141,991	12,697	1,552	4	1	36,048	606	1,526	194,425
Add: WMP									
2016	-	-	4	-	-	-	-	-	4
2017	-	-	4	-	-	-	-	-	4
Total Forecasted Customers/Connections									
2016	140,655	12,563	1,566	4	1	35,712	623	1,521	192,645
2017	141,991	12,703	1,556	4	1	36,048	606	1,526	194,435

Change Customers/Connections									
2016	1,432	102	(16)	-	-	385	(23)	(4)	1,876
2017	1,336	134	(10)	-	-	336	(17)	5	1,784

The 2017 Test Year results are discussed below:

- Residential – The London Hydro service territory has been challenged to reach pre-recession numbers. London Hydro continues to see increases in the Residential rate class due to small subdivision growth. At this time, London Hydro is unaware of any future major residential development plans.
- General Service – Recent economic data seems to indicate a slow gradual and subtle growth uptake. Economic trends in London Hydro's service territory compare favourably

with overall provincial economic trends. While London does show modest growth in this sector, it is mostly to be found in small services. Conservation initiatives continue to erode kW demand with more customers moving to the lower rate class. London Hydro is not aware of any significant future development plans. Accordingly, London Hydro expects to witness a continuation of the modest incline in the General Service rate classes, consistent with historic data trends.

- Large Use – Similar to the General Service rate classes, the Large Use rate class is not expected to see any growth and is projected to remain relatively flat. A large Combined Heat and Power (CHP) conservation initiative is forecasted to influence this class significantly. London Hydro is not aware of any significant future developments.
- Unmetered Scattered Load and Street Lighting connections are projected to show modest increases in line with the residential and general service rate classes. Sentinel Lighting in London Hydro's service territory is projected to continue the slow phasing out of the class.

3.2.6 CDM ADJUSTMENTS

London Hydro's 2015 to 2020 CDM plan articulation EM-14-03 was submitted in April 2015. Table 3.1.2.8 below outlines the plan. The plan for municipal roadway lighting is currently under development. Notably, the plan also includes three large scale embedded load displacement generation projects. The timing on these projects is currently unknown so have been placed on a straight line basis, as have all the other Save-On-Energy programs.

TABLE 3.1.2.8: LONDON HYDRO CDM PLAN BY YEAR

Rate Class	Program	Total kWh	2015	2016	2017	2018	2019	2020
RES	saveONenergy HEATING & COOLING INCENTIVE Program	6,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
RES	saveONenergy COUPON EVENT Program	4,200,000	700,000	700,000	700,000	700,000	700,000	700,000
RES	saveONenergy NEW HOME CONSTRUCTION Program	1,200,000	200,000	200,000	200,000	200,000	200,000	200,000
RES	saveONenergy HOME ASSISTANCE Program	2,700,000	450,000	450,000	450,000	450,000	450,000	450,000
GS<50	saveONenergy RETROFIT PROGRAM	62,300,000	10,383,333	10,383,333	10,383,333	10,383,333	10,383,333	10,383,333
GS<50	saveONenergy AUDIT FUNDING	1,200,000	200,000	200,000	200,000	200,000	200,000	200,000
GS<50	saveONenergy PROCESS & SYSTEMS Program	12,800,000	2,133,333	2,133,333	2,133,333	2,133,333	2,133,333	2,133,333
GS<50	Embedded Energy Manager subprogram	6,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
GS>50	Embedded Load-Displacement Generation Projects Industrial Customer #1	11,853,000	1,975,500	1,975,500	1,975,500	1,975,500	1,975,500	1,975,500
Large User	Embedded Load-Displacement Generation Projects Industrial Customer #2	70,000,000	11,666,667	11,666,667	11,666,667	11,666,667	11,666,667	11,666,667
GS>50	Embedded Load-Displacement Generation Projects Municipal Customer #3	465,000	77,500	77,500	77,500	77,500	77,500	77,500
GS>50	Embedded Load-Displacement Generation Projects Municipal Customer #4	-	-					
STRL	Municipal Roadway Lighting	5,600,000	5,600,000					
		184,318,000	35,386,333	29,786,333	29,786,333	29,786,333	29,786,333	29,786,333

Based on the Conservation First Framework, issued by the Board on September 19, 2014, London Hydro has been tasked with achieving CDM savings of 196.66 GWh for the period of 2015 to 2020. London Hydro submitted an overall plan to the IESO in April 2015 detailing the timing of these expected savings. Table 3.1.2.9 below shows the planned savings by year in order for London Hydro to achieve its target (as outlined in the CDM plan in Table 3.1.2.8 above).

TABLE 3-9: LONDON HYDRO PROGRAM SAVINGS BY YEAR

Description	2015	2016	2017	2018	2019	2020	TOTAL
Planned Program Savings by Year							
2015 Programs	35,386,333	35,386,333	35,386,333	35,386,333	35,386,333	35,386,333	
2016 Programs		29,786,333	29,786,333	29,786,333	29,786,333	29,786,333	
2017 Programs		-	29,786,333	29,786,333	29,786,333	29,786,333	
2018 Programs		-	-	29,786,333	29,786,333	29,786,333	
2019 Programs		-	-	-	29,786,333	29,786,333	
2020 Programs		-	-	-	-	29,786,333	
Total Planned Programs	**35,386,333**	**65,172,667**	**94,959,000**	**124,745,333**	**154,531,667**	**184,318,000**	
Annual % of Planned	**19.20%**	**16.16%**	**16.16%**	**16.16%**	**16.16%**	**16.16%**	100.00%
Allocated Tasked Savings	**37,755,815**	**31,780,837**	**31,780,837**	**31,780,837**	**31,780,837**	**31,780,838**	**196,660,000**

The following is the updated table from above which includes actual verified amounts to Dec 31, 2015.

Allocation of Tasked Savings by Year							
Description	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**TOTAL**
Planned Program Savings by Year							
2015 Programs	31,995,332	31,995,332	31,995,332	31,995,332	31,995,332	31,995,332	
2016 Programs		37,443,333	37,443,333	37,443,333	37,443,333	37,443,333	
2017 Programs		-	31,843,333	31,843,333	31,843,333	31,843,333	
2018 Programs		-	-	31,843,333	31,843,333	31,843,333	
2019 Programs		-	-	-	31,843,333	31,843,333	
2020 Programs		-	-	-	-	31,691,335	
Total Planned Programs	**31,995,332**	**69,438,665**	**101,281,999**	**133,125,332**	**164,968,665**	**196,660,000**	
Annual % of Planned	**16.27%**	**19.04%**	**16.19%**	**16.19%**	**16.19%**	**16.11%**	100.00%
Allocated Tasked Savings	**31,995,332**	**37,443,333**	**31,843,333**	**31,843,333**	**31,843,333**	**31,691,336**	**196,660,000**

Note that the CDM Planned Savings submitted by London Hydro, summarized above, do not exceed the savings for which London Hydro was tasked under the Conservation First Framework. London Hydro recognizes that it will be measured by the latter savings.

Consistent with the Board's Guidelines for Electricity Distributor Conservation and Demand Management (EB-2012-0003), dated April 26, 2012, London Hydro has integrated a manual adjustment into its 2016 Bridge Year and 2017 Test Year load forecast for anticipated CDM results.

London Hydro's load forecast draws on the regression analysis of historical actual usage including most of the CDM efforts to the conclusion of the 2014 programs. London Hydro has taken the following approach, consistent with Board methodology, to developing a CDM adjustment for the 2016 Bridge Year and 2017 Test Year load forecasts.

Table 3.1.2.10 below outlines the program and persistence savings by year to be used in adjusting the individual rate classes.

TABLE 3.1.2.10: LONDON HYDRO PROGRAM AND PERSISTENCE SAVINGS BY YEAR

Sum of Amount	2015	2015 Total	2016		2016 Total	2017		2017 Total
	Program		Program	Persistence		Program	Persistence	
RES								
2015	2,350,000	2,350,000		2,350,000	2,350,000		2,350,000	2,350,000
2016			2,350,000		2,350,000		2,350,000	2,350,000
2017						2,350,000		2,350,000
RES Total	**2,350,000**	**2,350,000**	**2,350,000**	**2,350,000**	**4,700,000**	**2,350,000**	**4,700,000**	**7,050,000**
GS<50								
2015	13,716,667	13,716,667		13,716,667	13,716,667		13,716,667	13,716,667
2016			13,716,667		13,716,667		13,716,667	13,716,667
2017						13,716,667		13,716,667
GS<50 Total	**13,716,667**	**13,716,667**	**13,716,667**	**13,716,667**	**27,433,333**	**13,716,667**	**27,433,333**	**41,150,000**
GS>50								
2015	2,053,000	2,053,000		2,053,000	2,053,000		2,053,000	2,053,000
2016			2,053,000		2,053,000		2,053,000	2,053,000
2017						2,053,000		2,053,000
GS>50 Total	**2,053,000**	**2,053,000**	**2,053,000**	**2,053,000**	**4,106,000**	**2,053,000**	**4,106,000**	**6,159,000**
Large User								
2015	11,666,667	11,666,667		11,666,667	11,666,667		11,666,667	11,666,667
2016			11,666,667		11,666,667		11,666,667	11,666,667
2017						11,666,667		11,666,667
Large User Total	**11,666,667**	**11,666,667**	**11,666,667**	**11,666,667**	**23,333,333**	**11,666,667**	**23,333,333**	**35,000,000**
STRL								
2015	5,600,000	5,600,000		5,600,000	5,600,000		5,600,000	5,600,000
STRL Total	**5,600,000**	**5,600,000**		**5,600,000**	**5,600,000**		**5,600,000**	**5,600,000**
Grand Total	**35,386,333**	**35,386,333**	**29,786,333**	**35,386,333**	**65,172,667**	**29,786,333**	**65,172,667**	**94,959,000**

Table 3.1.2.11 below segregates the planned savings as submitted by London Hydro, which are expected to yield 184.3 GWh on a net basis, from the tasked savings directed by government which are to achieve 199.66 GWh. The planned savings will be used to reduce the individual rate classes for the load forecast while the tasked saving will be used for the LRAMVA.

TABLE 3.1.2.11: Allocation of 2016 & 2017 Tasked Savings by Rate Class

Allocation of 2016 & 2017 Tasked Savings by Rate Class									
Description	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Allocation of 2016 Tasked Savings									
2015 Persistence	2,350,000	13,716,667	2,053,000		11,666,667	5,600,000			35,386,333
2016 Programs	2,350,000	13,716,667	2,053,000		11,666,667				29,786,333
2016 Planned Savings	**4,700,000**	**27,433,333**	**4,106,000**	**-**	**23,333,333**	**5,600,000**	**-**	**-**	**65,172,667**
% Allocator	7.2%	42.1%	6.3%	0.0%	35.8%	8.6%	0.0%	0.0%	100.0%
2016 Tasked Savings	**5,014,714**	**29,270,279**	**4,380,939**	**-**	**24,895,742**	**5,974,978**	**-**	**-**	**69,536,652**
Allocation of 2017 Tasked Savings									
2015 Persistence	2,350,000	13,716,667	2,053,000		11,666,667	5,600,000			35,386,333
2016 Persistence	2,350,000	13,716,667	2,053,000		11,666,667				29,786,333
2017 Programs	2,350,000	13,716,667	2,053,000		11,666,667				29,786,333
2017 Planned Savings	**7,050,000**	**41,150,000**	**6,159,000**	**-**	**35,000,000**	**5,600,000**	**-**	**-**	**94,959,000**
% Allocator	7.42%	43.33%	6.49%	0.00%	36.86%	5.90%	0.00%	0.00%	
2017 Tasked Savings	**7,522,071**	**43,905,419**	**6,571,409**	**-**	**37,343,613**	**5,974,978**	**-**	**-**	**101,317,489**

The following is the updated table from above which includes actual verified amounts to Dec 31, 2015.

Allocation of 2016 & 2017 Tasked Savings by Rate Class									
Description	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Allocation of 2016 Tasked Savings									
2015 Persistence	7,550,482	19,392,356	5,052,494		0	0			31,995,332
2016 Programs	4,407,000	13,716,667	2,053,000		11,666,667	5,600,000			37,443,333
2016 Planned Savings	**11,957,482**	**33,109,023**	**7,105,494**	**-**	**11,666,667**	**5,600,000**	**-**	**-**	**69,438,665**
% Allocator	17.2%	47.7%	10.2%	0.0%	16.8%	8.1%	0.0%	0.0%	100.0%
2016 Tasked Savings	**11,957,482**	**33,109,023**	**7,105,494**	**-**	**11,666,667**	**5,600,000**	**-**	**-**	**69,438,665**
Allocation of 2017 Tasked Savings									
2015 Persistence	7,550,482	19,392,356	5,052,494		0	0			31,995,332
2016 Persistence	4,407,000	13,716,667	2,053,000		11,666,667	5,600,000			37,443,333
2017 Programs	4,407,000	13,716,667	2,053,000		11,666,667				31,843,333
2017 Planned Savings	**16,364,482**	**46,825,689**	**9,158,494**	**-**	**23,333,333**	**5,600,000**	**-**	**-**	**101,281,999**
% Allocator	16.16%	46.23%	9.04%	0.00%	23.04%	5.53%	0.00%	0.00%	
2017 Tasked Savings	**16,364,482**	**46,825,689**	**9,158,494**	**-**	**23,333,333**	**5,600,000**	**-**	**-**	**101,281,998**

London Hydro has calculated the estimated persistence of 2015 Program savings into the 2016 Bridge Year and 2017 Test Year by rate class. Due to the timing of implementation of these programs, some, but not all, of the 2015 Program amounts would have been captured in the 2015 actual results used in the load forecast regression analysis.

Using the half year rule, London Hydro used the above planned savings to calculate the 2016 Bridge Year and 2017 Test Year load forecast adjustments. The results are presented in Table 3.1.2.12 below. For the 2016 Bridge Year adjustment, London Hydro used 50% of the 2015 Program Savings and 50% of the 2016 Tasked Savings. For the 2017 Test Year adjustment, London Hydro continued to use 100% of the 2015 Program savings, 50% of the 2016 Tasked Savings and 50% of the 2017 Tasked Savings.

TABLE 3.1.2.12: Calculation of CDM Load Forecast Adjustment by Rate Class

Calculation of Load Forecast Adjustment by Rate Class									
Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
2016 Load Forecast Adjustment									
2015 Persistence (50%)	1,175,000	6,858,333	1,026,500	-	5,833,333	2,800,000	-	-	17,693,167
2016 Programs (50%)	1,175,000	6,858,333	1,026,500	-	5,833,333	-	-	-	14,893,167
Total	**2,350,000**	**13,716,667**	**2,053,000**	**-**	**11,666,667**	**2,800,000**	**-**	**-**	**32,586,333**
2017 Load Forecast Adjustment									
2015 Persistence (100%)	2,350,000	13,716,667	2,053,000	-	11,666,667	5,600,000	-	-	35,386,333
2016 Persistence (50%)	1,175,000	6,858,333	1,026,500	-	5,833,333	-	-	-	14,893,167
2017 Programs (50%)	1,175,000	6,858,333	1,026,500	-	5,833,333	-	-	-	14,893,167
Total	**4,700,000**	**27,433,333**	**4,106,000**	**-**	**23,333,333**	**5,600,000**	**-**	**-**	**65,172,667**

The following is the updated table from above which includes actual verified amounts to Dec 31, 2015.

Calculation of Load Forecast Adjustment by Rate Class									
Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
2016 Load Forecast Adjustment									
2015 Persistence (50%)	3,775,241	9,696,178	2,526,247	-	-	-	-	-	15,997,666
2016 Programs (50%)	2,203,500	6,858,333	1,026,500	-	5,833,333	2,800,000	-	-	18,721,667
Total	**5,978,741**	**16,554,511**	**3,552,747**	**-**	**5,833,333**	**2,800,000**	**-**	**-**	**34,719,333**
2017 Load Forecast Adjustment									
2015 Persistence (50%)	3,775,241	9,696,178	2,526,247	-	-	-	-	-	15,997,666
2016 Persistence (100%)	4,407,000	13,716,667	2,053,000	-	11,666,667	5,600,000	-	-	37,443,333
2017 Programs (50%)	2,203,500	6,858,333	1,026,500	-	5,833,333	-	-	-	15,921,667
Total	**10,385,741**	**30,271,178**	**5,605,747**	**-**	**17,500,000**	**5,600,000**	**-**	**-**	**69,362,666**

3.2.7 LRAMVA BASELINE CALCULATION

Consistent with Board Appendix 2-I, London Hydro has calculated the LRAMVA baseline.

London Hydro has prepared an adjusted baseline calculation and included the results in Table 3.1.2.13 below.

TABLE 3.1.2.13: ADJUSTED LRAMVA BASELINE

ADJUSTED LRAMVA BASELINE	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
2016 Tasked Savings	5,014,714	29,270,279	4,380,939	-	24,895,742	5,974,978	-	-	69,536,652
2017 Tasked Savings	7,522,071	43,905,419	6,571,409	-	37,343,613	5,974,978	-	-	101,317,489
Total	**12,536,784**	**73,175,698**	**10,952,348**	**-**	**62,239,354**	**11,949,956**	**-**	**-**	**170,854,141**

The following is the updated table from above which includes actual verified amounts to Dec 31, 2015.

ADJUSTED LRAMVA BASELINE	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
2016 Tasked Savings	11,957,482	33,109,023	7,105,494	-	11,666,667	5,600,000	-	-	69,438,665
2017 Tasked Savings	16,364,482	46,825,689	9,158,494	-	23,333,333	5,600,000	-	-	101,281,998
Total	**28,321,964**	**79,934,712**	**16,263,988**	**-**	**35,000,000**	**11,200,000**	**-**	**-**	**170,720,663**

3.2.8 WHOLESALE MARKET PARTICIPANTS

London Hydro currently has four Wholesale Market Participants ("WMPs") operating within its service territory. These customers buy power directly from the IESO but use the London Hydro distribution system to deliver the power to their business locations. They are billed distribution and transmission charges by London Hydro for use of its facilities in delivering power to their service addresses within London. Other charges such as commodity, Global Adjustment and wholesale market service are billed directly to the WMPs by the IESO.

The regression analysis to derive the forecasted purchased kWh inherently excludes the kWh related to the WMPs. For this reason London Hydro has excluded their historical billed kWh data from the rate class energy kWh and demand kW allocation calculations. London Hydro has forecasted the kWh consumption for these customers based on their historical usage. The four WMP opted into the program in mid-2012 and are General Service > 50 kW customers.

To forecast the consumption of these customers, London Hydro utilized the 2012 to 2015 actual results as applied to the previously calculated geometric mean for the applicable rate class. The results are shown in Table 3.1.2.14 below.

TABLE 3.1.2.14: WMP FORECASTED KWH

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Historical kWh									
2011			-						-
2012			12,651,732						12,651,732
2013			17,002,607						17,002,607
2014			16,769,932						16,769,932
2015			17,665,651						17,665,651
Geometric Mean (2012 to 2015)			99.82%						
Forecasted kWh									
2016			17,633,855						17,633,855
2017			17,602,117						17,602,117

The following is the updated table from above. The Geometric mean used in this calculation is the value used for the entire GS>50 kW class shown below.

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Historical kWh									
2011			-						-
2012			12,561,209						12,561,209
2013			17,002,607						17,002,607
2014			16,769,932						16,769,932
2015			17,665,651						17,665,651
Geometric Mean (2012 to 2015) GS>50 Class			100.01%						
Forecasted kWh									
2016			17,666,883						17,666,883
2017			17,668,115						17,668,115

Similar to the demand calculations following, London Hydro calculated the WMPs demand by comparing the actual kW demand to the actual kWh consumption and using the average applied to the above forecasted kWh amounts to derive the forecasted bill kW. The results are presented in Table 3.1.2.15 below.

TABLE 3.1.2.15: WMP FORECASTED KW

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Historical kW									
2011			-						-
2012			25,109						25,109
2013			31,196						31,196
2014			30,245						30,245
2015			31,912						31,912
Percentage kW/kWh									
2011									
2012			0.20%						
2013			0.18%						
2014			0.18%						
2015			0.18%						
Average (2012 to 2015)			0.18%						
Total kW Forecast									
2016			32,004						32,004
2017			31,946						31,946

The following is the updated table from above.

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Historical kW									
2011			-						-
2012			24,440						24,440
2013			31,196						31,196
2014			30,245						30,245
2015			31,912						31,912
Percentage kW/kWh									
2011									
2012			0.19%						
2013			0.18%						
2014			0.18%						
2015			0.18%						
Average (2012 to 2015)			0.18%						
Total kW Forecast									
2016			32,064						32,064
2017			32,066						32,066

3.2.9 BILLED KWH LOAD FORECAST BY RATE CLASS

This section reviews the methodology utilized by London Hydro to calculate the forecasted load by rate class.

London Hydro begins with the annual historic billed kWh as reported in the applicable annual RRR submissions and adjusts the data for the reclassifications noted above in Section 3.2.4. The results are presented in Table 3.1.2.16 below.

TABLE 3.1.2.16: HISTORICAL KWH USAGE BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Consumption (kWh)									
2006	1,088,755,114	410,108,836	1,627,356,865	30,875,410	108,044,054	22,245,536	870,735	6,328,409	3,294,584,959
2007	1,117,283,048	417,026,808	1,615,211,987	37,213,732	115,273,670	23,071,309	872,679	6,215,088	3,332,168,321
2008	1,119,770,671	418,620,282	1,561,039,026	39,755,988	113,396,330	23,270,767	862,739	5,647,248	3,282,363,050
2009	1,067,984,894	392,901,741	1,446,931,261	42,590,885	121,341,105	23,394,430	836,233	5,570,493	3,101,551,043
2010	1,146,514,255	407,620,994	1,571,501,087	45,965,216	122,601,392	23,532,529	831,089	5,523,748	3,324,090,310
2011	1,128,889,459	407,986,442	1,539,418,651	37,918,668	123,286,320	23,650,724	812,670	5,645,414	3,267,608,348
2012	1,103,889,962	400,003,533	1,513,436,751	39,375,740	121,512,036	23,812,743	790,064	5,600,414	3,208,421,243
2013	1,091,107,757	400,291,647	1,485,615,093	43,072,446	121,362,031	24,330,710	772,541	5,630,160	3,172,182,384
2014	1,096,195,854	405,335,151	1,499,515,193	36,488,426	117,379,515	24,496,241	738,785	5,568,049	3,185,717,215
2015	1,084,665,542	399,647,918	1,484,614,973	38,831,481	111,335,382	24,640,359	738,971	5,522,828	3,149,997,453

The table from above has not changed from previously reported.

London Hydro then takes the annual results from Table 3.1.2.16 above and divides the annual rate class total by the respective annual customer/connection data shown in Table 3.1.2.5. The results are presented in Table 3.1.2.17 below.

TABLE 3.1.2.17: AVERAGE ANNUAL CONSUMPTION PER CUSTOMER/CONNECTION

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Average Consumption per Customer (kWh)								
2006	8,712	34,620	1,039,500	10,013,751	108,044,054	697	1,120	3,970
2007	8,795	35,108	1,018,667	12,404,636	115,273,670	707	1,146	3,873
2008	8,669	34,956	980,109	13,252,068	113,396,330	704	1,147	3,839
2009	8,239	33,023	906,858	14,196,962	121,341,105	702	1,133	3,673
2010	8,685	34,142	968,531	15,321,739	122,601,392	700	1,141	3,677
2011	8,380	33,888	949,479	12,639,556	123,286,320	698	1,133	3,713
2012	8,154	33,247	935,810	13,125,247	121,512,036	696	1,134	3,632
2013	7,983	32,972	923,890	14,357,482	121,362,031	703	1,135	3,685
2014	7,943	33,041	943,388	10,425,265	117,379,515	700	1,119	3,629
2015	7,755	31,962	942,613	9,707,870	111,335,382	699	1,163	3,607

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Average Consumption per Customer (kWh)								
2006	8,712	34,620	1,030,070	10,013,751	108,044,054	697	1,120	3,970
2007	8,795	35,108	1,008,733	12,404,636	115,273,670	707	1,146	3,873
2008	8,669	34,956	970,024	13,252,068	113,396,330	704	1,147	3,839
2009	8,239	33,023	896,324	14,196,962	121,341,105	702	1,133	3,673
2010	8,685	34,142	957,957	15,321,739	122,601,392	700	1,141	3,677
2011	8,414	34,241	940,518	12,639,556	123,286,320	694	1,133	3,774
2012	8,158	33,303	926,992	13,125,247	121,512,036	692	1,134	3,726
2013	7,991	33,087	919,886	14,357,482	121,362,031	698	1,135	3,734
2014	7,953	33,108	937,490	10,425,265	117,379,515	698	1,109	3,663
2015	7,791	32,072	940,821	9,707,870	111,335,382	697	1,144	3,622

From the historical usage per customer/connection data, London Hydro calculates the annual growth rate per customer/connection per year. For all rate classes, London Hydro utilizes the annual growth rate from the past four years (2012 to 2015) to calculate the geometric growth rate. London Hydro believes four years best represents the current economic situation of its service territory and takes into consideration the stabilization after the global recession. The results are presented in Table 3.1.2.18 below.

TABLE 3.1.2.18: HISTORICAL KWH USAGE GROWTH RATES BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Average Growth per Customer								
2007	100.95%	101.41%	98.00%	123.88%	106.69%	101.43%	102.32%	97.56%
2008	98.57%	99.57%	96.21%	106.83%	98.37%	99.58%	100.09%	99.12%
2009	95.04%	94.47%	92.53%	107.13%	107.01%	99.72%	98.78%	95.68%
2010	105.41%	103.39%	106.80%	107.92%	101.04%	99.72%	100.71%	100.11%
2011	96.49%	99.26%	98.03%	82.49%	100.56%	99.71%	99.30%	100.98%
2012	97.30%	98.11%	98.56%	103.84%	98.56%	99.71%	100.09%	97.82%
2013	97.90%	99.17%	98.73%	109.39%	99.88%	101.01%	100.09%	101.46%
2014	99.50%	100.21%	102.11%	72.61%	96.72%	99.57%	98.59%	98.48%
2015	97.63%	96.73%	99.92%	93.12%	94.85%	99.86%	103.93%	99.39%
Geomean (2012 to 2015)	**98.08%**	**98.55%**	**99.82%**	**93.61%**	**97.48%**	**100.04%**	**100.66%**	**99.28%**

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Average Growth per Customer								
2006	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2007	100.95%	101.41%	97.93%	123.88%	106.69%	101.43%	102.32%	97.56%
2008	98.57%	99.57%	96.16%	106.83%	98.37%	99.58%	100.09%	99.12%
2009	95.04%	94.47%	92.40%	107.13%	107.01%	99.72%	98.78%	95.68%
2010	105.41%	103.39%	106.88%	107.92%	101.04%	99.72%	100.71%	100.11%
2011	96.88%	100.29%	98.18%	82.49%	100.56%	99.14%	99.30%	102.64%
2012	96.96%	97.26%	98.56%	103.84%	98.56%	99.71%	100.09%	98.73%
2013	97.95%	99.35%	99.23%	109.39%	99.88%	100.87%	100.09%	100.21%
2014	99.52%	100.06%	101.91%	72.61%	96.72%	100.00%	97.71%	98.10%
2015	97.96%	96.87%	100.36%	93.12%	94.85%	99.86%	103.16%	98.88%
Geomean (2012 to 2015)	**98.09%**	**98.38%**	**100.01%**	**93.61%**	**97.48%**	**100.11%**	**100.24%**	**98.98%**

To derive the 2016 Bridge Year forecast, London Hydro applied the geometric mean growth rate by class to the 2015 average consumption per customer/connections to derive the forecasted average annual kWh consumption. To determine the 2017 Test Year forecast, London Hydro applied the same geometric growth rate by class to the calculated 2016 Bridge Year forecasted average annual kWh usage. The results are presented in Table 3-19 below.

TABLE 3.1.2.19: FORECASTED AVERAGE ANNUAL KWH USAGE PER CUSTOMER/CONNECTION BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Forecasted Average Consumption per Customer (kWh)								
2016	7,606	31,497	940,916	9,088,022	108,534,152	699	1,171	3,581
2017	7,460	31,039	939,222	8,507,751	105,803,402	699	1,179	3,555

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Forecasted Average Consumption per Customer (kWh)								
2016	7,642	31,551	940,887	9,088,022	108,534,152	698	1,147	3,585
2017	7,496	31,039	940,953	8,507,751	105,803,402	699	1,150	3,548

London Hydro used the average kWh usage from Table 3.1.2.19 and multiplied it by the forecasted customer\connections from Table 3.1.2.7 to determine the non-weather normalized total kWh by rate class. The results are presented in Table 3.1.2.20 below.

TABLE 3.1.2.20: FORECASTED BILLED KWH – WEATHER NON-NORMALIZED

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Calculated Consumption Non-Weather Adjusted (kWh)									
2016	1,073,807,474	397,586,631	1,473,474,456	36,352,088	108,534,152	24,863,430	722,507	5,493,254	3,120,833,992
2017	1,063,117,140	395,529,977	1,462,368,654	34,031,004	105,803,402	25,102,488	706,221	5,464,035	3,092,122,921

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Calculated Consumption Non-Weather Adjusted (kWh)									
2016	1,074,885,510	396,375,213	1,469,665,494	36,352,088	108,534,152	24,926,976	714,581	5,452,785	3,116,906,799
2017	1,064,364,536	394,102,183	1,460,359,056	34,031,004	105,803,402	25,197,552	696,900	5,414,248	3,089,968,881

As previously noted, the forecasted weather normalized billed kWh for the 2016 Bridge Year and the 2017 Test Year are 3,139,197,449 kWh and 3,117,592,061 kWh as shown in Table 3.1.2.3 above. These amounts represent weather normalized billed kWh but the forecasted billed kWh amounts shown in Table 3.1.2.20 above are based on actual weather conditions, which means they are weather non-normalized. In order to reconcile these numbers back to the macro forecast, the non-weather normalized kWh amounts, identified in Table 3-19, are adjusted based on weather sensitivity factors.

To determine the weather sensitivity of the various rate classes, London Hydro utilized the HONI weather sensitivity data prepared in the 2006 Load Profile Study. London Hydro then calculated the weighted average percentage of sensitive load and applied these percentages to the amounts calculated in Table 3.1.2.20 above to derive the total weather sensitive load by rate class. The results are presented in Table 3.1.2.21 below.

TABLE 3.1.2.21: WEATHER SENSITIVE LOAD

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Calculation of Weather Sensitive Load									
% of Load	100.0%	100.0%	76.5%	48.9%	44.4%				
2016	1,073,807,474	397,586,631	1,126,618,569	17,779,806	48,221,724	-	-	-	2,664,014,204
2017	1,063,117,140	395,529,977	1,118,127,073	16,644,564	47,008,452	-	-	-	2,640,427,205

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Calculation of Weather Sensitive Load									
% of Load	100.0%	100.0%	76.5%	48.9%	44.4%				
2016	1,074,885,510	396,375,213	1,123,706,237	17,779,806	48,221,724	-	-	-	2,660,968,490
2017	1,064,364,536	394,102,183	1,116,590,534	16,644,564	47,008,452	-	-	-	2,638,710,269

London Hydro then allocated the necessary weather normalization adjustment among the rate classes based on their weather sensitive load calculated in Table 3.1.2.21 above. The results are presented in Table 3.1.2.22 below.

TABLE 3.1.2.22: WEATHER NORMALIZATION ADJUSTMENT

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Allocation of Weather Adjustment									
Percent	40.3%	14.9%	42.3%	0.7%	1.8%	0.0%	0.0%	0.0%	100.0%
2016	7,401,919	2,740,625	7,765,954	122,559	332,400	-	-	-	18,363,457
Percent	40.3%	15.0%	42.3%	0.6%	1.8%	0.0%	0.0%	0.0%	100.0%
2017	10,254,658	3,815,219	10,785,275	160,551	453,436	-	-	-	25,469,140

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Allocation of Weather Adjustment									
Percent	40.4%	14.9%	42.2%	0.7%	1.8%	0.0%	0.0%	0.0%	100.0%
2016	30,096,258	11,098,308	31,463,214	497,826	1,350,184	-	-	-	74,505,790
Percent	40.3%	14.9%	42.3%	0.6%	1.8%	0.0%	0.0%	0.0%	100.0%
2017	15,487,631	5,734,604	16,247,574	242,196	684,023	-	-	-	38,396,027

To calculate the 2016 Bridge Year and 2017 Test Year weather normalized kWh forecast, London Hydro added the results of Table 3.1.2.21 and the results of Table 3.1.2.22. The resulting weather normalized billed kWh forecast is presented in Table 3.1.2.23 below. Amounts presented here exclude any adjustments for CDM and kWh related to Wholesale Market Participants.

TABLE 3.1.2.23: TOTAL WEATHER NORMALIZED KWH BY RATE CLASS

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
TOTAL NORMALIZED LOAD FORECAST									
2016	1,081,209,393	400,327,256	1,481,240,410	36,474,647	108,866,552	24,863,430	722,507	5,493,254	3,139,197,449
2017	1,073,371,798	399,345,196	1,473,153,929	34,191,555	106,256,838	25,102,488	706,221	5,464,035	3,117,592,061

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
TOTAL NORMALIZED LOAD FORECAST									
2016	1,104,981,768	407,473,521	1,501,128,708	36,849,914	109,884,336	24,926,976	714,581	5,452,785	3,191,412,589
2017	1,079,852,167	399,836,787	1,476,606,630	34,273,200	106,487,425	25,197,552	696,900	5,414,248	3,128,364,908

In order to properly forecast the 2016 Bridge Year and 2017 Test Year Load, London Hydro needs to reduce the Load Forecast for the anticipated Conservation Demand Management ("CDM") programs savings and add the forecasted kWh related to the WMP noted in Section 3.2.4 above. For more information on the CDM Adjustment and the WMP Adjustment, please see Section 3.2.4 and Section 3.2.5 respectively. The results of these adjustments are presented in Table 3.1.2.24 below.

TABLE 3.1.2.24: CDM AND WMP ADJUSTMENTS

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
CDM ADJUSTMENT									
2016	(2,350,000)	(13,716,667)	(2,053,000)	-	(11,666,667)	(2,800,000)	-	-	(32,586,333)
2017	(4,700,000)	(27,433,333)	(4,106,000)	-	(23,333,333)	(5,600,000)	-	-	(65,172,667)
WMP ADJUSTMENT									
2016			17,633,855						17,633,855
2017			17,602,117						17,602,117

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
CDM ADJUSTMENT									
2016	(5,978,741)	(16,554,511)	(3,552,747)	-	(5,833,333)	(2,800,000)	-	-	(34,719,333)
2017	(10,385,741)	(30,271,178)	(5,605,747)	-	(17,500,000)	(5,600,000)	-	-	(69,362,666)
WMP ADJUSTMENT									
2016			17,666,883						17,666,883
2017			17,668,115						17,668,115

London Hydro's total weather normalized load forecast, including CDM and WMP, is shown in Table 3.1.2.25 below.

TABLE 3.1.2.25: LONDON HYDRO'S WEATHER NORMALIZED LOAD FORECAST

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
TOTAL ADJUSTED WEATHER NORMALIZED LOAD FORECAST									
2016	1,078,859,393	386,610,590	1,496,821,265	36,474,647	97,199,885	22,063,430	722,507	5,493,254	3,124,244,971
2017	1,068,671,798	371,911,863	1,486,650,047	34,191,555	82,923,505	19,502,488	706,221	5,464,035	3,070,021,511

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
TOTAL ADJUSTED WEATHER NORMALIZED LOAD FORECAST									
2016	1,099,003,027	390,919,010	1,515,242,844	36,849,914	104,051,003	22,126,976	714,581	5,452,785	3,174,360,139
2017	1,069,466,426	369,565,609	1,488,668,998	34,273,200	88,987,425	19,597,552	696,900	5,414,248	3,076,670,357

3.2.10 BILLED KW LOAD FORECAST

The volumetric revenue components for General Service > 50 kW, Co-Generation, Large Use, Street Lighting and Sentinel Lighting are calculated based on billed kW demand. Since the load forecast is calculated based on kWh, forecasted kW for these classes must be correlated with the forecasted kWh for each class.

London Hydro began with the annual historic billed kW as reported in the applicable annual RRR submissions and adjusted the data for the reclassifications noted above in Section 3.2.4. The results are presented in Table 3.1.2.26 below.

TABLE 3.1.2.26: HISTORICAL KW BY RATE CLASS BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen Stand-by	Co-Gen Non Stand-by	Co-Gen Total	Adjusted Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Demand (kW)											
2006	-	-	3,915,477	155,066	32,470	187,536	216,900	63,698	2,347	-	4,385,958
2007	-	-	4,060,704	154,800	38,943	193,743	225,300	64,717	2,369	-	4,546,833
2008	-	-	3,931,362	154,800	38,424	193,224	222,580	65,068	2,335	-	4,414,570
2009	-	-	3,753,529	154,800	37,861	192,661	232,523	65,643	2,278	-	4,246,633
2010	-	-	4,011,621	154,800	36,305	191,105	233,420	66,009	2,260	-	4,504,414
2011	-	-	3,888,174	154,800	48,044	202,844	239,280	66,345	2,203	-	4,398,846
2012	-	-	3,888,895	154,800	46,415	201,215	233,476	66,305	2,146	-	4,392,037
2013	-	-	3,840,563	154,800	68,938	223,738	234,157	68,984	2,099	-	4,369,541
2014	-	-	3,810,876	154,800	72,831	227,631	229,583	68,713	2,005	-	4,338,809
2015	-	-	3,784,947	154,800	75,192	229,992	212,176	69,126	2,009	-	4,298,250
Average (2012 to 2015)	**-**	**-**	**3,831,320**	**154,800**	**65,844**	**220,644**	**227,348**	**68,282**	**2,065**	**-**	**4,349,659**

The table from above has changed from previously reported to reflect the change in Co-Gen using a three year average (2013 to 2015) in response to 3-VECC-30.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen Stand-by	Co-Gen Non Stand-by	Co-Gen Total	Adjusted Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Demand (kW)											
2006	-	-	3,915,477	155,066	32,470	187,536	216,900	63,698	2,347	-	4,385,958
2007	-	-	4,060,704	154,800	38,943	193,743	225,300	64,717	2,369	-	4,546,833
2008	-	-	3,931,362	154,800	38,424	193,224	222,580	65,068	2,335	-	4,414,570
2009	-	-	3,753,529	154,800	37,861	192,661	232,523	65,643	2,278	-	4,246,633
2010	-	-	4,011,621	154,800	36,305	191,105	233,420	66,009	2,260	-	4,504,414
2011	-	-	3,888,174	154,800	48,044	202,844	239,280	66,345	2,203	-	4,398,846
2012	-	-	3,888,895	154,800	46,415	201,215	233,476	66,305	2,146	-	4,392,037
2013	-	-	3,840,563	154,800	68,938	223,738	234,157	68,984	2,099	-	4,369,541
2014	-	-	3,810,876	154,800	72,831	227,631	229,583	68,713	2,005	-	4,338,809
2015	-	-	3,784,947	154,800	75,192	229,992	212,176	69,126	2,009	-	4,298,250
Average (2012 to 2015)	**-**	**-**	**3,831,320**	**154,800**	**72,320**	**220,644**	**227,348**	**68,282**	**2,065**	**-**	**4,349,659**

London Hydro then calculated the annual historical ratios, excluding Co-Generation, between the historical kW in Table 3.1.2.26 and the historical kWh in Table 3.1.2.16. London Hydro utilized the average from the past four years (2012 to 2015) to calculate the average kW/kWh relationships. London Hydro believes these four years best represent the current economic situation of its service territory and take into consideration the stabilization after the global recession. The results are presented in Table 3.1.2.27 below.

TABLE 3.1.2.27: HISTORICAL BILLED KW/KWH RATIO BY RATE CLASS BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen Stand-by	Co-Gen Non Stand-by	Co-Gen Total	Adjusted Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Percentage of kW to kWh											
2006			0.240%				0.200%	0.290%	0.270%		
2007			0.250%				0.200%	0.280%	0.270%		
2008			0.250%				0.200%	0.280%	0.270%		
2009			0.260%				0.190%	0.280%	0.270%		
2010			0.260%				0.190%	0.280%	0.270%		
2011			0.250%				0.190%	0.280%	0.270%		
2012			0.260%				0.190%	0.280%	0.270%		
2013			0.260%				0.190%	0.280%	0.270%		
2014			0.250%				0.200%	0.280%	0.270%		
2015			0.250%				0.190%	0.280%	0.270%		
Average (2012 to 2015)			**0.255%**				**0.193%**	**0.280%**	**0.270%**		

The table from above has not changed from previously reported.

To derive the 2016 Bridge Year forecast for the demand based rate classes excluding Co-Generation, London Hydro applied the average relationship by rate class to the 2016 Bridge Year weather normalized, CDM adjusted forecast. The same approach is taken for the 2017 Test Year kW forecast. For Co-Generation, London Hydro is using the stand-by boilerplate generation plus the last four year's historical average, as shown in Table 3.1.2.26 above. Based on the calculations in Section 3.2.10, London Hydro also added an adjustment to reflect the Wholesale Market Participants. The results are presented in Table 3.1.2.28 below.

TABLE 3.1.2.28: FORECASTED BILLED KW BY RATE CLASS BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen Stand-by	Co-Gen Non Stand-by	Co-Gen Total	Adjusted Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Total Demand Forecast (kW)											
2016	-	-	3,771,928	154,800	65,844	220,644	187,110	61,778	1,951	-	4,243,411
2017	-	-	3,746,072	154,800	65,844	220,644	159,628	54,607	1,907	-	4,182,858
WMP Adjustment											
2016	-	-	32,004	-	-	-	-	-	-	-	32,004
2017	-	-	31,946	-	-	-	-	-	-	-	31,946
Total Adjusted Demand (kW)											
2016	-	-	3,803,932	154,800	65,844	220,644	187,110	61,778	1,951	-	4,275,415
2017	-	-	3,778,018	154,800	65,844	220,644	159,628	54,607	1,907	-	4,214,804

The following is the updated table from above.

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen Stand-by	Co-Gen Non Stand-by	Co-Gen Total	Adjusted Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Total Demand Forecast (kW)											
2016	-	-	3,818,819	154,800	72,320	227,120	200,298	61,956	1,929	-	4,310,122
2017	-	-	3,751,052	154,800	72,320	227,120	171,301	54,873	1,882	-	4,206,228
WMP Adjustment											
2016	-	-	32,064	-	-	-	-	-	-	-	32,064
2017	-	-	32,066	-	-	-	-	-	-	-	32,066
Total Adjusted Demand (kW)											
2016	-	-	3,850,883	154,800	72,320	227,120	200,298	61,956	1,929	-	4,342,186
2017	-	-	3,783,118	154,800	72,320	227,120	171,301	54,873	1,882	-	4,238,294

3.2.11 SUMMARY OF 2016 AND 2017 LOAD FORECAST

Table 3.1.2.29 below provides a summary of the total forecasted customer/connections, forecasted billed kWh and kW for all customer classes including CDM Adjustments but excludes WMP for the 2016 Bridge Year and the 2017 Test Year. These values are used for the calculation of energy revenue in the working capital calculation.

TABLE 3.1.2.29: WEATHER NORMALIZED LOAD FORECASTED BY RATE CLASS

Weather Normalized Load Forecast by Rate Class							
Line No.	Rate Class	2016			2017		
		Cust/Conn	kWh	kW	Cust/Conn	kWh	kW
1	Residential	141,179	1,078,859,393	-	142,509	1,068,671,798	-
2	GS < 50 kW	12,623	386,610,590	-	12,749	371,911,863	-
3	GS > 50 - 4,999 kW	1,566	1,479,187,410	3,771,928	1,557	1,469,047,929	3,746,072
4	Wholesale Market Participant						
5	Co-Generation	4	36,474,647	65,844	4	34,191,555	65,844
	Standby			154,800			154,800
6	Large Use	1	97,199,885	187,110	1	82,923,505	159,628
7	Street Lights	35,570	22,063,430	61,778	35,912	19,502,488	54,607
8	Sentinel Lights	617	722,507	1,951	599	706,221	1,907
9	Unmetered Scattered Load	1,534	5,493,254	-	1,537	5,464,035	-
10	**Total**	**193,094**	**3,106,611,116**	**4,243,411**	**194,868**	**3,052,419,394**	**4,182,858**

The following is the updated table from above.

Weather Normalized Load Forecast by Rate Class							
Line No.	Rate Class	2016			2017		
		Cust/Conn	kWh	kW	Cust/Conn	kWh	kW
1	Residential	140,655	1,099,003,027	-	141,991	1,069,466,426	-
2	GS < 50 kW	12,563	390,919,010	-	12,703	369,565,609	-
3	GS > 50 - 4,999 kW	1,562	1,497,575,961	3,818,819	1,552	1,471,000,883	3,751,052
4	Wholesale Market Participant						
5	Co-Generation	4	36,849,914	72,320	4	34,273,200	72,320
	Standby			154,800			154,800
6	Large Use	1	104,051,003	200,298	1	88,987,425	171,301
7	Street Lights	35,712	22,126,976	61,956	36,048	19,597,552	54,873
8	Sentinel Lights	623	714,581	1,929	606	696,900	1,882
9	Unmetered Scattered Load	1,521	5,452,785	-	1,526	5,414,248	-
10	**Total**	**192,641**	**3,156,693,256**	**4,310,122**	**194,431**	**3,059,002,242**	**4,206,228**

Table 3.1.2.30 below provides a summary of the total forecasted customer/connections, forecasted billed kWh and kW for all customer classes including CDM Adjustments and includes WMP for the 2016 Bridge Year and the 2017 Test Year. These values are used for the cost allocation and rate design.

TABLE 3.1.2.30: LOAD FORECAST FOR COST ALLOCATION & DISTRIBUTION RATE DESIGN

Weather Normalized Load Forecast by Rate Class - Used for Cost Allocation and Distribution Rate Design							
Line No.	Rate Class	2016			2017		
		Cust/Conn	kWh	kW	Cust/Conn	kWh	kW
1	Residential	141,179	1,078,859,393	-	142,509	1,068,671,798	-
2	GS < 50 kW	12,623	386,610,590	-	12,749	371,911,863	-
3	GS > 50 - 4,999 kW	1,566	1,479,187,410	3,771,928	1,557	1,469,047,929	3,746,072
4	Wholesale Market Participant	4	17,633,855	32,004	4	17,602,117	31,946
5	Co-Generation	4	36,474,647	65,844	4	34,191,555	65,844
	Standby			154,800			154,800
6	Large Use	1	97,199,885	187,110	1	82,923,505	159,628
7	Street Lights	35,570	22,063,430	61,778	35,912	19,502,488	54,607
8	Sentinel Lights	617	722,507	1,951	599	706,221	1,907
9	Unmetered Scattered Load	1,534	5,493,254	-	1,537	5,464,035	-
10	**Total**	**193,098**	**3,124,244,971**	**4,275,415**	**194,872**	**3,070,021,511**	**4,214,804**

The following is the updated table from above.

Weather Normalized Load Forecast by Rate Class - Used for Cost Allocation and Distribution Rate Design							
Line No.	Rate Class	2016			2017		
		Cust/Conn	kWh	kW	Cust/Conn	kWh	kW
1	Residential	140,655	1,099,003,027	-	141,991	1,069,466,426	-
2	GS < 50 kW	12,563	390,919,010	-	12,703	369,565,609	-
3	GS > 50 - 4,999 kW	1,562	1,497,575,961	3,818,819	1,552	1,471,000,883	3,751,052
4	Wholesale Market Participant	4	17,666,883	32,064	4	17,668,115	32,066
5	Co-Generation	4	11,733,849	72,320	4	10,913,365	72,320
	Standby		25,116,064	154,800		23,359,835	154,800
6	Large Use	1	104,051,003	200,298	1	88,987,425	171,301
7	Street Lights	35,712	22,126,976	61,956	36,048	19,597,552	54,873
8	Sentinel Lights	623	714,581	1,929	606	696,900	1,882
9	Unmetered Scattered Load	1,521	5,452,785	-	1,526	5,414,248	-
10	**Total**	**192,645**	**3,174,360,139**	**4,342,186**	**194,435**	**3,076,670,357**	**4,238,294**

London Hydro has completed RRWF Sheet 10 Load Forecast, which has been filed in Live Excel format with the RRWF and is included in Exhibit 3 Tab 1 Schedule 2 Attachment 1.1

3-Staff-42

Load Forecast
Ref: E3/1/2, p. 1

a) How did London Hydro determine that the 2013 model was still appropriate for use in this application?

LH Response:

London Hydro predominately believed that the multi-variate regression model used in 2013 produced reasonable results for the actual year 2013, as evidenced in discussions in our original application. Please reference Exhibit 3 Tab 2 Schedule 1 for detailed discussion on testing of the forecast results.

b) Has London Hydro tested the forecast results against actuals over the past years since 2013? If yes, what were the results? If not, why not?

LH Response:

Please reference Exhibit 3 Tab 2 Schedule 1 for detailed discussion on testing of the forecast results.

London Hydro

File Number: EB-2016-0091

Date Filed: January 17, 2017

Tab 3 of 5

Exh 3 LPMA Interrogatories

3-LPMA-23

Ref: Exhibit 3

London Hydro has provided a live Excel model for the power purchase equation, but no live models have been provided that show the calculations for the customer additions, the adjustments made for the calculation of the billed kWh load forecast by rate class or the kW forecasts. Please provide the live Excel spreadsheets that include these calculations.

LH Response:

Please reference response to 3-Staff-41 which provides the update load forecast including the requested model.

3-LPMA-24

Ref: Exhibit 3, Tab 1, Schedule 2

a) At page 2 the evidence indicates an adjustment was made to the historical **purchases for the loss of one large customer. Please confirm that this adjustment removed all of the consumption over this historical period associated with this customer. If this cannot be confirmed, please explain fully what the adjustment was.**

LH Response:

London Hydro confirms that adjustment removed all of the consumption (subject to b) below) over this historical period associated with historical purchases for the loss of one large customer. Please reference live excel model filed LH 3-VECC-23 Adjustment to WM Purchases

b) Did London Hydro estimate the losses associated with the consumption of the large customer and remove these losses from the historical purchases? If yes, please explain how the losses were calculated. If no, please explain why not.

LH Response:

London Hydro did not estimate the losses associated with the consumption of the large customer and remove these losses from the historical purchases. This was an oversight in consideration. Please reference live excel model filed LH 3-VECC-23 Adjustment to WM Purchases for updated values.

c) Please provide a live Excel spreadsheet that shows the calculation of the historical purchases used in the power purchase equation, including the adjustment for the one large user that has ceased operations and any other adjustments made to the historical data.

LH Response:

Please reference live excel model filed LH 3-VECC-23 Adjustment to WM Purchases

d) Please include in the above Excel spreadsheet the monthly consumption over the 2006 through 2015 period for the one large use customer that is now a GS>50 customer. Please confirm that these volumes were retained in the historical data used to estimate the power purchase equation.

LH Response:

Please reference live excel model filed LH 3-LPMA-24d Adjustment to Rate Class Cons for annual consumption of Cust 1, adjusting the appropriate rate classes. Monthly values were not extracted for this purpose. London Hydro would confirm that these volumes were retained in the historical data used to estimate the power purchase equation.

e) Please also include in the above noted Excel spreadsheet the monthly data for the four WMP participants noted on page 17.

LH Response:

Please reference live excel model filed LH 3-VECC-23 WMP Purchases.

3-LPMA-25

Ref: Exhibit 3, Tab 1, Schedule 2, page 6

Please explain what London Hydro means by "Normalized Value" in Table 3.1.2.1. In particular, are the figures shown the forecasted consumption figures based on actual weather or are they the forecasted consumption figures based on normal weather?

LH Response:

"Normalized Value" is really predicted value. London Hydro would submit the forecasted consumption figures are based on the 10 year normalized weather.

3-LPMA-26

Ref: Exhibit 3, Tab 1, Schedule 2, page 7

Please confirm that London Hydro used the average loss factor for 2006 through 2015, not 2007 through 2015 as stated in the evidence. If this cannot be confirmed, please explain why 2006 was omitted from the calculation of the average.

LH Response:

London Hydro would confirm that London Hydro used the average loss factor for 2006 through 2015.

3-LPMA-27

Ref: Exhibit 3, Tab 1, Schedule 2, page 11

Please provide the actual number of customers/connections for each of the rate classes shown in Table 3.1.2.5 for the last month of actuals available for 2016 and the corresponding number of customers for the same month in 2015.

LH Response:

Please see the following for updated customer/connections. Also please reference live excel model 3-LPMA-27.

Attachment 1 of 1

Average Cust Counts

Count Date	RES	G<50	G>50	LRG	UM	RESAnnAvg	G<50AnnAvg	G>50AnnAvg	LRGAnnAvg	UMAnnAvg
Jan-11	133,671	11,915	1,606	4	1,493					
Feb-11	133,719	11,923	1,603	4	1,494					
Mar-11	133,901	11,920	1,609	4	1,494					
Apr-11	133,934	11,903	1,611	4	1,494					
May-11	134,058	11,904	1,614	3	1,494					
Jun-11	134,064	11,864	1,596	3	1,494					
Jul-11	134,218	11,914	1,628	3	1,499					
Aug-11	134,248	11,897	1,629	3	1,498					
Sep-11	134,371	11,907	1,634	3	1,499					
Oct-11	134,526	11,926	1,634	3	1,499					
Nov-11	134,630	11,940	1,651	3	1,498					
Dec-11	134,714	11,962	1,652	3	1,500	134,171	11,915	1,622	3	1,496
Jan-12	134,804	11,960	1,638	3	1,506					
Feb-12	134,869	11,981	1,626	3	1,504					
Mar-12	134,978	11,975	1,629	3	1,500					
Apr-12	135,102	11,982	1,630	3	1,501					
May-12	135,211	11,992	1,633	3	1,502					
Jun-12	135,231	11,972	1,622	3	1,502					
Jul-12	135,391	11,995	1,632	3	1,502					
Aug-12	134,936	12,006	1,630	3	1,502					
Sep-12	135,535	12,069	1,631	3	1,502					
Oct-12	135,828	12,065	1,643	3	1,505					
Nov-12	135,932	12,080	1,645	3	1,506					
Dec-12	136,032	12,058	1,653	3	1,504	135,321	12,011	1,634	3	1,503
Jan-13	136,120	12,109	1,613	3	1,503					
Feb-13	136,140	12,074	1,615	3	1,504					
Mar-13	136,151	12,095	1,612	3	1,506					
Apr-13	136,223	12,098	1,611	3	1,507					
May-13	136,371	12,096	1,617	3	1,510					
Jun-13	136,382	12,098	1,618	3	1,509					
Jul-13	136,607	12,104	1,622	3	1,510					
Aug-13	136,617	12,094	1,624	3	1,510					
Sep-13	136,736	12,090	1,623	3	1,508					
Oct-13	136,921	12,113	1,628	3	1,508					
Nov-13	137,021	12,121	1,636	3	1,508					
Dec-13	137,191	12,084	1,639	3	1,508	136,540	12,098	1,622	3	1,508
Jan-14	137,184	12,137	1,603	3	1,520					
Feb-14	137,291	12,138	1,606	3	1,520					
Mar-14	137,307	12,154	1,603	3	1,520					
Apr-14	137,368	12,170	1,605	3	1,520					
May-14	137,378	12,182	1,607	3	1,520					
Jun-14	137,673	12,234	1,609	3	1,513					
Jul-14	138,018	12,254	1,606	3	1,515					
Aug-14	138,034	12,253	1,607	3	1,520					
Sep-14	138,263	12,299	1,607	3	1,520					
Oct-14	138,450	12,370	1,608	3	1,523					
Nov-14	138,489	12,362	1,608	3	1,523					
Dec-14	138,568	12,368	1,609	3	1,523	137,835	12,243	1,607	3	1,520
Jan-15	138,733	12,417	1,582	3	1,523					
Feb-15	138,796	12,434	1,581	3	1,525					
Mar-15	138,900	12,453	1,584	3	1,526					
Apr-15	138,919	12,446	1,587	3	1,526					
May-15	139,032	12,448	1,584	3	1,527					
Jun-15	139,088	12,455	1,586	3	1,526					
Jul-15	139,173	12,484	1,588	3	1,527					
Aug-15	139,341	12,464	1,584	3	1,526					
Sep-15	139,490	12,482	1,586	3	1,526					
Oct-15	139,583	12,480	1,590	3	1,526					
Nov-15	139,756	12,484	1,593	3	1,524					
Dec-15	139,861	12,485	1,592	3	1,522	139,223	12,461	1,586	3	1,525
Jan-16	139,992	12,527	1,567	2	1,521					
Feb-16	140,044	12,539	1,582	2	1,521					
Mar-16	140,197	12,536	1,586	1	1,522					
Apr-16	140,292	12,542	1,591	1	1,524					
May-16	140,438	12,538	1,596	1	1,521					
Jun-16	140,604	12,533	1,595	1	1,529					
Jul-16	140,693	12,509	1,596	1	1,529					
Aug-16	140,811	12,522	1,601	1	1,529					
Sep-16	141,042	12,549	1,601	1	1,515					
Oct-16	141,161	12,555	1,606	1	1,515					
Nov-16	141,262	12,561	1,605	1	1,513					
Dec-16	141,323	12,556	1,610	1	1,513	140,655	12,539	1,595	1	1,521
Transfer Between Classes							24	-24		
Adjusted 2016						140,655	12,563	1,571	1	1,521

Valid from	Valid to	Read kWh	Billed kWh	Billed kW	Connections	kW per Cc	AVG Conn
12/1/2010	12/31/2010	2,563,110	2,667,941	5,545	33,958	0.1633	
1/1/2011	1/31/2011	2,454,107	2,554,480	5,494	33,970	0.1617	
2/1/2011	2/28/2011	2,068,615	2,153,221	5,505	33,991	0.1620	
3/1/2011	3/31/2011	2,043,646	2,127,231	5,521	33,997	0.1624	
4/1/2011	4/30/2011	1,775,965	1,848,602	5,533	34,084	0.1623	
5/1/2011	5/31/2011	1,580,207	1,644,838	5,535	34,100	0.1623	
6/1/2011	6/30/2011	1,447,873	1,507,091	5,535	34,100	0.1623	
7/1/2011	7/31/2011	1,537,313	1,600,189	5,535	34,100	0.1623	
8/1/2011	8/31/2011	1,708,888	1,778,782	5,535	34,100	0.1623	
9/1/2011	9/30/2011	1,899,503	1,977,193	5,535	34,100	0.1623	
10/1/2011	10/31/2011	2,219,093	2,309,854	5,536	34,112	0.1623	
11/1/2011	11/30/2011	2,352,405	2,448,618	5,538	34,123	0.1623	
12/1/2011	12/31/2011	2,575,616	2,680,959	5,572	34,220	0.1628	34,083
1/1/2012	1/31/2012	2,475,130	2,576,363	5,541	34,246	0.1618	
2/1/2012	2/29/2012	2,161,559	2,249,967	5,554	34,283	0.1620	
3/1/2012	3/31/2012	2,057,206	2,141,345	5,558	34,312	0.1620	
4/1/2012	4/30/2012	1,784,884	1,857,885	5,560	34,331	0.1620	
5/1/2012	5/31/2012	1,598,325	1,663,696	5,598	34,387	0.1628	
6/1/2012	6/30/2012	1,446,651	1,505,819	5,530	34,429	0.1606	
7/1/2012	7/31/2012	1,536,016	1,598,839	5,530	34,429	0.1606	
8/1/2012	8/31/2012	1,707,446	1,777,281	5,530	34,429	0.1606	
9/1/2012	9/30/2012	1,897,900	1,975,524	5,530	34,429	0.1606	
10/1/2012	10/31/2012	2,230,960	2,322,207	5,566	34,441	0.1616	
11/1/2012	11/30/2012	2,341,050	2,436,799	5,511	34,464	0.1599	
12/1/2012	12/31/2012	2,623,680	2,730,988	5,676	34,734	0.1634	34,410
1/1/2013	1/31/2013	2,532,972	2,636,570	5,670	34,737	0.1632	
2/1/2013	2/28/2013	2,133,547	2,220,809	5,678	34,796	0.1632	
3/1/2013	3/31/2013	2,101,933	2,187,902	5,679	34,804	0.1632	
4/1/2013	4/30/2013	1,823,040	1,897,602	5,679	34,809	0.1632	
5/1/2013	5/31/2013	1,621,492	1,678,244	5,679	34,812	0.1631	
6/1/2013	6/30/2013	1,486,856	1,538,896	5,684	34,843	0.1631	
7/1/2013	7/31/2013	1,580,149	1,635,454	5,689	34,875	0.1631	
8/1/2013	8/31/2013	1,759,691	1,821,280	5,699	34,947	0.1631	
9/1/2013	9/30/2013	1,955,972	2,024,431	5,699	34,947	0.1631	
10/1/2013	10/31/2013	2,284,915	2,364,887	5,700	34,951	0.1631	
11/1/2013	11/30/2013	2,426,463	2,511,389	5,712	35,028	0.1631	
12/1/2013	12/31/2013	2,641,009	2,733,444	5,714	35,034	0.1631	34,882
1/1/2014	1/31/2014	2,555,017	2,644,442	5,720	35,070	0.1631	
2/1/2014	2/28/2014	2,149,209	2,224,431	5,720	35,070	0.1631	
3/1/2014	3/31/2014	2,119,015	2,193,181	5,725	35,087	0.1632	
4/1/2014	4/30/2014	1,837,495	1,901,807	5,724	35,085	0.1632	
5/1/2014	5/31/2014	1,634,340	1,691,542	5,724	35,085	0.1632	
6/1/2014	6/30/2014	1,498,152	1,550,588	5,727	35,105	0.1631	
7/1/2014	7/31/2014	1,590,699	1,646,373	5,727	35,105	0.1631	
8/1/2014	8/31/2014	1,769,989	1,831,939	5,733	35,135	0.1632	
9/1/2014	9/30/2014	1,967,419	2,036,278	5,733	35,149	0.1631	
10/1/2014	10/31/2014	2,297,883	2,378,309	5,733	35,153	0.1631	
11/1/2014	11/30/2014	2,436,016	2,521,277	5,735	35,166	0.1631	
12/1/2014	12/31/2014	2,653,437	2,746,307	5,741	35,206	0.1631	35,118
1/1/2015	1/31/2015	2,566,912	2,656,754	5,746	35,237	0.1631	
2/1/2015	2/28/2015	2,162,561	2,238,251	5,755	35,277	0.1631	
3/1/2015	3/31/2015	2,130,217	2,204,775	5,755	35,277	0.1631	
4/1/2015	4/30/2015	1,847,993	1,912,672	5,757	35,291	0.1631	
5/1/2015	5/31/2015	1,646,258	1,703,877	5,766	35,345	0.1631	
6/1/2015	6/30/2015	1,508,392	1,561,186	5,766	35,345	0.1631	
7/1/2015	7/31/2015	1,602,077	1,658,150	5,768	35,359	0.1631	
8/1/2015	8/31/2015	1,780,880	1,843,211	5,768	35,359	0.1631	
9/1/2015	9/30/2015	1,979,525	2,048,808	5,768	35,359	0.1631	
10/1/2015	10/31/2015	2,311,926	2,392,843	5,768	35,359	0.1631	
11/1/2015	11/30/2015	2,450,181	2,535,937	5,768	35,359	0.1631	
12/1/2015	12/31/2015	2,665,956	2,759,265	5,768	35,359	0.1631	35,327
1/1/2016	1/31/2016	2,568,498	2,658,395	5,750	35,540	0.1618	
2/1/2016	2/29/2016	2,118,925	2,193,087	5,445	35,578	0.1530	
3/1/2016	3/31/2016	1,930,526	1,998,094	5,216	35,420	0.1473	
4/1/2016	4/30/2016	1,604,823	1,660,992	4,999	35,867	0.1394	
5/1/2016	5/31/2016	1,339,069	1,385,937	4,690	35,687	0.1314	
6/1/2016	6/30/2016	1,228,017	1,270,998	4,694	35,719	0.1314	
7/1/2016	7/31/2016	1,300,468	1,345,984	4,682	35,764	0.1309	
8/1/2016	8/31/2016	1,446,119	1,496,733	4,684	35,764	0.1310	
9/1/2016	9/30/2016	1,607,125	1,663,374	4,683	35,767	0.1309	
10/1/2016	10/31/2016	1,877,972	1,943,701	4,685	35,790	0.1309	
11/1/2016	11/30/2016	1,991,436	2,061,136	4,688	35,811	0.1309	
12/1/2016	12/31/2016	1,992,548	2,062,287	4,691	35,831	0.1309	35,712

Annual Transfer Between Classes

Rate Class	GS<50	GS>50	CoGen	LU	Total
2011 From	-13	-35			-48
2011 To	35	13			48
Net 2011	22	-22	0	0	0
2012 From	-12	-38			-50
2012 To	38	12			50
Net 2012	26	-26	0	0	0
2013 From		-44			-44
2013 To	44				44
Net 2013	44	-44	0	0	0
2014 From	-9	-53			-62
2014 To	52	9	1		62
Net 2014	43	-44	1	0	0
2015 From	-8	-40			-48
2015 To	40	8			48
Net 2015	32	-32	0	0	0
2016 From	-38	-57		-2	-97
2016 To	57	40			97
Net 2016	19	-17	0	-2	0
Net 2011 to 2016	186	-185	1	-2	0
2017 From	-13	-37			-50
2017 To	37	13			50
Net 2017	24	-24	0	0	0
Net 2011 to 2017	210	-209	1	-2	0

London Hydro
EB-2016-0091
2017 Load Forecast

Forecast Number of Customer/Connections

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Average Annual Customers/Connections									
2006	124,978	11,846	1,562	3	1	31,926	777	1,594	172,686
2007	127,035	11,878	1,582	3	1	32,610	762	1,605	175,475
2008	129,174	11,976	1,589	3	1	33,072	752	1,471	178,038
2009	129,621	11,898	1,592	3	1	33,337	738	1,517	178,706
2010	132,014	11,939	1,619	3	1	33,625	728	1,502	181,432
2011	134,171	11,915	1,615	3	1	34,083	717	1,496	184,001
2012	135,321	12,011	1,627	3	1	34,410	697	1,503	185,573
2013	136,540	12,098	1,615	3	1	34,882	681	1,508	187,328
2014	137,835	12,243	1,600	4	1	35,118	666	1,520	188,986
2015	139,223	12,461	1,578	4	1	35,327	646	1,525	190,765
2016	140,655	12,563	1,562	4	1	35,712	623	1,521	192,641
Customer/Connection Change									
2006	-	-	-	-	-	-	-	-	
2007	2,057	33	20	(0)	-	684	(16)	10	2,789
2008	2,139	97	7	(0)	-	462	(9)	(133)	2,563
2009	447	(78)	3	0	-	265	(14)	46	667
2010	2,393	41	27	-	-	289	(10)	(14)	2,726
2011	2,157	(24)	(4)	-	-	458	(11)	(6)	2,569
2012	1,150	96	12	-	-	327	(20)	7	1,572
2013	1,219	87	(12)	-	-	472	(16)	5	1,755
2014	1,295	145	(16)	1	-	236	(15)	12	1,658
2015	1,388	218	(22)	1	-	209	(20)	5	1,779
2016	1,432	102	(16)	-	-	385	(23)	(4)	1,876
Average (2012 to 2016)	**1,297**	**130**	**(11)**	**0**	**-**	**326**	**(19)**	**5**	
Customer Growth Rate									
2006	-	-	-	-	-	-	-	-	
2007	1.0165	1.0027	1.0129	0.9730	1.0000	1.0214	0.9800	1.0066	
2008	1.0168	1.0082	1.0045	1.0000	1.0000	1.0142	0.9878	0.9169	
2009	1.0035	0.9935	1.0018	1.0000	1.0000	1.0080	0.9808	1.0310	
2010	1.0185	1.0035	1.0170	1.0000	1.0000	1.0087	0.9871	0.9905	
2011	1.0163	0.9980	0.9978	1.0000	1.0000	1.0136	0.9843	0.9957	
2012	1.0086	1.0081	1.0074	1.0000	1.0000	1.0096	0.9721	1.0047	
2013	1.0090	1.0072	0.9926	1.0000	1.0000	1.0137	0.9766	1.0033	
2014	1.0095	1.0120	0.9904	1.1667	1.0000	1.0068	0.9785	1.0080	
2015	1.0101	1.0178	0.9866	1.1429	1.0000	1.0060	0.9700	1.0033	
2016	1.0103	1.0082	0.9899	1.0000	1.0000	1.0109	0.9644	0.9974	
Geomean (2012 to 2016)	**1.0095**	**1.0107**	**0.9934**	**1.0592**	**1.0000**	**1.0094**	**0.9723**	**1.0033**	
Forecasted Customers/Connections									
2016	140,655	12,563	1,562	4	1	35,712	623	1,521	192,641
2017	141,991	12,697	1,552	4	1	36,048	606	1,526	194,425
Add: WMP									
2016	-	-	4	-	-	-	-	-	4
2017	-	-	4	-	-	-	-	-	4
Total Forecasted Customers/Connections									
2016	140,655	12,563	1,566	4	1	35,712	623	1,521	192,645
2017	141,991	12,703	1,556	4	1	36,048	606	1,526	194,435

3-LPMA-28

Ref: Exhibit 3, Tab 1, Schedule 2, page 16

Please explain why London Hydro used 100% of the 2015 savings and 50% of the 2016 savings in Table 3.1.2.12 in the calculation of the 2017 load forecast adjustment rather than 50% of the 2015 savings (since 50% of the 2015 savings are already built into the regression equation) and 100% of the 2016 savings.

LH Response:

London Hydro intends to correct this in an updated load forecast to be filed with the responses to interrogatories. Please see 3-Staff-41.

3-LPMA-29

Ref: Exhibit 3, Tab 1, Schedule 2, pages 9 & 17

a) Please explain how the geometric mean of 99.82% was calculated in Table 3.1.2.14. In particular, please explain how this figure can be less than 100% when the four years of data show an increase in kWh's.

LH Response:

The 99.82% used is the geometric mean for the total GS>50 kW class.

TABLE 3.1.2.18: HISTORICAL KWH USAGE GROWTH RATES BY YEAR

Year	Residential	General Service < 50 kW	Adjusted General Service > 50 kW	Co-Gen	Adjusted Large User	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)
Average Growth per Customer								
2007	100.95%	101.41%	98.00%	123.88%	106.69%	101.43%	102.32%	97.56%
2008	98.57%	99.57%	96.21%	106.83%	98.37%	99.58%	100.09%	99.12%
2009	95.04%	94.47%	92.53%	107.13%	107.01%	99.72%	98.78%	95.68%
2010	105.41%	103.39%	106.80%	107.92%	101.04%	99.72%	100.71%	100.11%
2011	96.49%	99.26%	98.03%	82.49%	100.56%	99.71%	99.30%	100.98%
2012	97.30%	98.11%	98.56%	103.84%	98.56%	99.71%	100.09%	97.82%
2013	97.90%	99.17%	98.73%	109.39%	99.88%	101.01%	100.09%	101.46%
2014	99.50%	100.21%	102.11%	72.61%	96.72%	99.57%	98.59%	98.48%
2015	97.63%	96.73%	99.92%	93.12%	94.85%	99.86%	103.93%	99.39%
Geomean (2012 to 2015)	**98.08%**	**98.55%**	**99.82%**	**93.61%**	**97.48%**	**100.04%**	**100.66%**	**99.28%**

b) The evidence indicates that the regression analysis to derive the forecasted purchased kWh inherently excludes the kWh related to the WMPs (page 17). The evidence also states that these customers were removed from the historical data since becoming WMPs in 2012 (page 9). Did London Hydro remove the historical data from the entire 2006 through 2015 period before using that data to estimate the power purchase equation? If not, please indicate in the response to 3-LPMA-24 part (e) above the kWhs included in the historical data used to estimate the power purchase equation and the kWhs removed from the historical data.

LH Response:

London Hydro did not remove the WMP historical data from the entire 2006 through 2015 period before using that data to estimate the power purchase equation. This will be considered in the updated load forecast as requested in 3-Staff-41.

c) There is a reference to the "WMP" tab of the load forecast model (page 9) for a separate forecast of the WMP customers. This tab cannot be found. Please indicate where it is located, and which live Excel model it is included in.

LH Response:

Please reference 3-Staff-41 for updated model.

TABLE 3.1.2.14: WMP FORECASTED KWH

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Historical kWh									
2011			-						-
2012			12,651,732						12,651,732
2013			17,002,607						17,002,607
2014			16,769,932						16,769,932
2015			17,665,651						17,665,651
Geometric Mean (2012 to 2015)			99.82%						
Forecasted kWh									
2016			17,633,855						17,633,855
2017			17,602,117						17,602,117

TABLE 3.1.2.15: WMP FORECASTED KW

Year	Residential	General Service < 50 kW	General Service > 50 kW	Co-Gen	Large Use	Street Lighting (Conn)	Sentinel Lighting (Conn)	Unmetered Scattered Load (Conn)	Total
Historical kW									
2011			-						-
2012			25,109						25,109
2013			31,196						31,196
2014			30,245						30,245
2015			31,912						31,912
Percentage kW/kWh									
2011									
2012			0.20%						
2013			0.18%						
2014			0.18%						
2015			0.18%						
Average (2012 to 2015)			0.18%						
Total kW Forecast									
2016			32,004						32,004
2017			31,946						31,946

3-LPMA-30

Ref: Exhibit 3, Tab 1, Schedule 2, page 7

a) Please explain why the population variable has been retained in the equation, even though it is not significant at an 80% level of confidence.

LH Response:

Please reference 3-VECC-25 c) for response.

b) In the previous COS application, the equation included the number of customers. Please explain why this variable was not tried in the current equation.

LH Response:

London Hydro would reason that early in the process the number of customers variable was not statistically significant and therefore excluded.

c) Please provide a live Excel spreadsheet that includes both historical (2006 through 2015) and forecast (for 2016 and 2017) data for Ontario Real GDP and the number of customers in addition to the variables used in the power purchased forecast model.

LH Response:

Please reference excel file 3-LPMA-3c.

This is the predicted values and T stats with population included from the original forecast.

TABLE 3.1.2.1: London Hydro FORECAST VS. ACTUAL PURCHASES

Annual Actual vs. Normalized WSkWh

	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,657,286	
2007	3,457,316,677	1.7%	3,439,522,287	0.8%
2008	3,390,352,069	-1.9%	3,374,339,384	-1.9%
2009	3,265,909,314	-3.7%	3,277,065,679	-2.9%
2010	3,374,790,334	3.3%	3,386,793,783	3.3%
2011	3,358,540,971	-0.5%	3,343,370,724	-1.3%
2012	3,307,326,673	-1.5%	3,340,872,292	-0.1%
2013	3,305,662,923	-0.1%	3,296,317,361	-1.3%
2014	3,248,077,232	-1.7%	3,244,458,120	-1.6%
2015	3,247,096,763	0.0%	3,240,128,565	-0.1%
2016			3,237,280,481	-0.1%
2017			3,215,000,040	-0.7%

Statistic	*Value*
R Square	90.1%
Adjusted R Square	89.6%
F Test	172.14
Mean Absolute Percentage Error (Annual)	0.4%
Mean Absolute Percentage Error (Monthly)	2.1%
Variable	***t Stat***
WSkWh	2.63
LonHDD	19.51
LonCDD	29.53
MonthDays	5.25
PeakDays	3.14
Year	- 2.51
Population	1.27

This is the predicted values and t Stats with Ontario Real GDP and the number of customers in addition to the variables used in the power purchased forecast model included from the original forecast.

Annual Actual vs. Normalized WSkWh				
	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,828,308	
2007	3,457,316,677	1.7%	3,442,859,190	0.9%
2008	3,390,352,069	-1.9%	3,379,019,272	-1.9%
2009	3,265,909,314	-3.7%	3,271,478,247	-3.2%
2010	3,374,790,334	3.3%	3,381,209,153	3.4%
2011	3,358,540,971	-0.5%	3,344,857,376	-1.1%
2012	3,307,326,673	-1.5%	3,341,434,697	-0.1%
2013	3,305,662,923	-0.1%	3,293,092,972	-1.4%
2014	3,248,077,232	-1.7%	3,243,727,174	-1.5%
2015	3,247,096,763	0.0%	3,245,019,091	0.0%
2016			3,247,918,432	0.1%
2017			3,229,578,245	-0.6%

Statistic	*Value*
R Square	90.2%
Adjusted R Square	89.5%
F Test	127.76
Mean Absolute Percentage Error (Annual)	0.3%
Mean Absolute Percentage Error (Monthly)	2.1%
Variable	*t Stat*
WSkWh	1.46
LonHDD	18.96
LonCDD	29.16
MonthDays	5.05
PeakDays	2.85
Year	- 1.35
Population	0.17
OntGDP	0.59
Customers	0.568494052

3-LPMA-31

Ref: Exhibit 3, Tab 3, Schedule 1

Please update the table on page 7 to reflect actual data for 2016. If actual data for all of 2016 is not yet available, please provide the most recent year-to-date actual revenues in the same level of detail as found in the table, along with the corresponding figures for 2015.

LH Response:

Actual data for all of 2016 is not yet available. The following table summarizes London Hydro's actual other revenues for January through October 2015 and January through October 2016.

USofA	Account Name	2015 Year to Period 10	2016 Year to Period 10
4082	Retail Services Revenues	78,083	65,978
4084	Service Transaction Requests (STR) Revenues	2,483	1,914
4086	SSS Administration Revenue	367,096	374,911
4210	Rent from Electric Property	436,924	456,021
4225	Late Payment Charges	1,536,615	1,630,491
4235	Miscellaneous Service Revenues	652,048	638,038
4235	Microfit Fees	11,119	14,062
4235	Miscellaneous Service Revenues (recorded as credits in 5330 expenses)	587,871	592,873
4245	Government and Other Assistance Directly Credited to Income	57,755	137,977
4330	Costs and Expenses of Merchandising, Jobbing, Etc.	25,000	65,687
4355	Gain on Disposition of Utility and Other Property	148,088	133,900
4390	Miscellaneous Non-Operating Income	264,708	540,929
4405	Interest and Dividend Income	173,150	125,851
	TOTAL	4,340,939	4,778,632
4235	Less: amounts recorded in account 5330 as credits to expense	(587,871)	(592,873)
	TOTAL REVENUE OFFSETS	3,753,068	4,185,759
OTHER DISTRIBUTION REVENUE			
	Late Payment Charges	1,536,615	1,630,491
	Specific Service Charges	663,166	652,100
	Other Distribution Revenue	1,553,286	1,903,169
		3,753,068	4,185,759

3-LPMA-32

Ref: Exhibit 3, Tab 3, Schedule 1 & Exhibit 4, Tab 1, Schedule 5

For each of the test year cost recoveries shown in Table 4-93, please indicate where they are included in the table on page 7 of Exhibit 3, Tab 3, Schedule 1. For any cost recovery shown in Table 4-93 that is not included in the other operating revenue table, please confirm that the revenues are used as offsets to various OM&A accounts. If this cannot be confirmed, please explain fully.

LH Response:

No amounts listed on Table 4-93 Cost Recoveries by Element are included in the table on page 7 of Exhibit 3, Tab 3, Schedule 1 with respect to Other Revenues. All amounts listed in Table 4-93 are used as an offset to OM&A expenditures, where all amounts listed in Exhibit 3 represent Other Revenue sources offsetting gross revenue requirement.

London Hydro

File Number: EB-2016-0091

Date Filed: January 17, 2017

Tab 5 of 5

Exh 3 VECC Interrogatories

3-VECC-23

Reference: E3/T1/S2, pages 1 - 3 (Charts 3-1 and 3-2) and pages 17-18

a) The predicted values in the Charts 3-1 and 3-2 appear to be different. How were each established?

LH Response:

Chart 3-1 predicted values based on wholesale purchases without the removal of the lost large user. Chart 3-2 predicted values based on wholesale purchases with the removal of the lost large user.

b) Please provide a schedule (or excel file) that for each month of the historic 10 years used sets out:

i. The power purchases per the IESO.
ii. The embedded generation purchased by London.
iii. The specific adjustments made to recognize the one Large User that no longer exists (per page 3).
iv. Any other adjustments made to determine the data used for modelling purposes, with descriptions of specifically what the adjustments were for.

LH Response:

Please reference LH 3-VECC-23 WS kWh Adjustment.xlsx which

a) Sheet “Wholesale Detailed” which breaks out the monthly purchase by type and has been expanded to include 2016 with forecast to end of year to be used in updated load forecast after IR’s.
b) Sheet “Wholesale Data Adjust b4 uplift” which takes wholesale purchases from Sheet “Wholesale Detailed” and removes the lost large user and WMP customers without loss factor applied.

c) Sheet “Wholesale Data Adjust Uplift” takes wholesale purchases from Sheet “Wholesale Detailed” and removes the lost large user and WMP customers with loss factor applied.

3-VECC-24

Reference: E3/T1/S2, pages 1 - 3 and pages 17-18

a) Were any adjustments made to the historical data for those months prior to mid-2012 in order to remove the usage for the four GS>50 kW customers who opted to become wholesale market? If not, why not?

LH Response:

Please reference LH 3VECC23 WS kWh Adjustment.xlsx for this transaction.

b) Please provide a revised series of monthly purchase values where the usage for these four customers is removed for the months prior to mid-2012 when they were not market participants?

LH Response:

Please reference LH 3VECC23 WS kWh Adjustment.xlsx for this transaction.

c) Using the values from part (b), please re-estimate the load forecast model and provide a revised forecast for 2016 and 2017 comparable to that in Table 3.1.2.1. Please provide the supporting excel model.

LH Response:

London Hydro will submit an updated load forecast which will encapsulate this action. See 3-Staff-41.

d) Alternatively, was any consideration to adding the usage for these customers into the adjusted purchase value for the months following mid-2012 when they were market participants? If not, why not?

LH Response:

See responses above.

3-VECC-25

Reference: E3/T1/S2, pages 3-7

a) Please clarify whether London used population or labour force as an explanatory variable. The text on page 4 (lines 5-9) makes reference to both.

LH Response:

London used population as an explanatory variable and excluded labour force.

b) Please provide a copy of the referenced document prepared by the Credit Unions of Ontario and the Ontario Chamber of Commerce (page 4, lines 6-7).

LH Response:

Please see attachment to this interrogatory.

c) It is noted, page 5, that the "Population" variable is not statistically significant. Why was it retained in the equation and what would be the regression model, model statistics and resulting forecast for 2016 and 2017 if it was excluded?

LH Response:

This is the predicted values and T stats with population included from the original forecast.

TABLE 3.1.2.1: London Hydro FORECAST VS. ACTUAL PURCHASES

Annual Actual vs. Normalized WSkWh

	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,657,286	
2007	3,457,316,677	1.7%	3,439,522,287	0.8%
2008	3,390,352,069	-1.9%	3,374,339,384	-1.9%
2009	3,265,909,314	-3.7%	3,277,065,679	-2.9%
2010	3,374,790,334	3.3%	3,386,793,783	3.3%
2011	3,358,540,971	-0.5%	3,343,370,724	-1.3%
2012	3,307,326,673	-1.5%	3,340,872,292	-0.1%
2013	3,305,662,923	-0.1%	3,296,317,361	-1.3%
2014	3,248,077,232	-1.7%	3,244,458,120	-1.6%
2015	3,247,096,763	0.0%	3,240,128,565	-0.1%
2016			3,237,280,481	-0.1%
2017			3,215,000,040	-0.7%

Statistic	*Value*
R Square	90.1%
Adjusted R Square	89.6%
F Test	172.14
Mean Absolute Percentage Error (Annual)	0.4%
Mean Absolute Percentage Error (Monthly)	2.1%
Variable	***t Stat***
WSkWh	2.63
LonHDD	19.51
LonCDD	29.53
MonthDays	5.25
PeakDays	3.14
Year	- 2.51
Population	1.27

This is the predicted values and t Stats without population included from the original forecast.

Annual Actual vs. Normalized WSkWh

	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,402,420,493	
2007	3,457,316,677	1.7%	3,432,018,570	0.9%
2008	3,390,352,069	-1.9%	3,374,029,495	-1.7%
2009	3,265,909,314	-3.7%	3,284,827,620	-2.6%
2010	3,374,790,334	3.3%	3,398,163,512	3.5%
2011	3,358,540,971	-0.5%	3,354,440,911	-1.3%
2012	3,307,326,673	-1.5%	3,346,334,462	-0.2%
2013	3,305,662,923	-0.1%	3,294,441,582	-1.6%
2014	3,248,077,232	-1.7%	3,238,452,222	-1.7%
2015	3,247,096,763	0.0%	3,230,396,613	-0.2%
2016			3,224,372,638	-0.2%
2017			3,196,624,329	-0.9%

Statistic	*Value*
R Square	90.0%
Adjusted R Square	89.6%
F Test	205.16
Mean Absolute Percentage Error (Annual)	0.5%
Mean Absolute Percentage Error (Monthly)	2.1%
Variable	***t Stat***
WSkWh	7.78
LonHDD	19.64
LonCDD	29.59
MonthDays	5.43
PeakDays	3.09
Year	- 7.68

London Hydro was of the opinion that leaving the population variable in made the model modestly stronger.

d) It is noted that the coefficient on the "Time in Years" variable is negative. Is it reasonable to assume that this variable is picking up some/all of the impact of CDM programs initiated during 2006-2015?

LH Response:

London Hydro could concur with that observation.

e) Please explain more fully why (per page 4) CDM Activity was excluded as an explanatory variable when it was included in the model used for London's 2013 COS Application.

LH Response:

In early testing London Hydro determined that the inclusion of CDM as an explanatory variable was not statistically significant reasoning that much of the historical CDM was reflected in the wholesale purchases.

f) Please complete the following chart regarding the verified impact of 2006-2015 CDM programs:

CDM Prog. Year	Verified CDM Program Impacts Calendar Year									
	'06	'07	'08	'09	'10	'11	/12	'13	'14	'15
2006										
2007										
2008										
2009										
2010										
2011										
2012										
2013										
2014										
2015										
Total										

LH Response:

Net Energy Savings (MWh)

#	Program Year	Results Status	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	2006 Programs	Final	10,203	10,203	10,203	10,203	1,772	1,772	1,621	1,621	1,523	1,523
2	2007 Programs	Final	0	11,722	8,953	8,610	8,610	8,608	4,980	4,980	4,980	1,700
3	2008 Programs	Final	0	0	20,381	18,544	18,532	18,532	18,037	18,034	17,521	17,138
4	2009 Programs	Final	0	0	0	20,905	18,663	18,663	18,653	18,342	17,349	15,464
5	2010 Programs	Final	0	0	0	0	18,171	14,002	13,987	13,981	13,683	12,451
6	2011 Programs	Final	0	0	0	0	0	21,135	21,135	21,135	20,632	20,632
7	2011 Programs True Up	Final						347	347	347	314	314
8	2012 Programs	Final	0	0	0	0	0	0	14,401	14,401	12,613	12,613
9	2012 Programs True Up	Final							2,658	2,658	2,581	2,581
10	2013 Programs	Final	0	0	0	0	0	0	0	15,838	11,929	11,929
11	2013 Programs True Up	Final								6,449	4,482	4,482
12	2014 Programs	Final	0	0	0	0	0	0	0	0	20,708	20,708
13	2015 Programs											32,777
Total			**10,202.89**	**21,924.46**	**39,536.57**	**58,261.60**	**65,747.70**	**83,059.30**	**95,817.98**	**117,787.22**	**128,316.26**	**154,313.29**

f) Please confirm whether the "normalized" values shown in Table 3.1.2.1 are based on actual or weather normal values for HDD and CDD.

LH Response:

London Hydro would suggest that the use of the word "Normalized" should be replaced with "Predicted" and those actual values for HDD and CDD were used for historical purposes.

g) Are the "normalized" values shown in Table 3.1.2.1 the same as the "predicted" historic values shown in Chart 3-3? If not, what is the difference in terms of how they were determined?

LH Response:

London Hydro would suggest that the use of the word "Normalized" should be replaced with "Predicted".

h) Please provide the purchase forecast for 2016 and 2017 based the 20-year trend values for HDD and CDD as directed by the Board's Filing Requirements.

LH Response:

Original forecast based on 10 year trend values for HDD and CDD

TABLE 3.1.2.1: London Hydro FORECAST VS. ACTUAL PURCHASES

Annual Actual vs. Normalized WSkWh

	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,657,286	
2007	3,457,316,677	1.7%	3,439,522,287	0.8%
2008	3,390,352,069	-1.9%	3,374,339,384	-1.9%
2009	3,265,909,314	-3.7%	3,277,065,679	-2.9%
2010	3,374,790,334	3.3%	3,386,793,783	3.3%
2011	3,358,540,971	-0.5%	3,343,370,724	-1.3%
2012	3,307,326,673	-1.5%	3,340,872,292	-0.1%
2013	3,305,662,923	-0.1%	3,296,317,361	-1.3%
2014	3,248,077,232	-1.7%	3,244,458,120	-1.6%
2015	3,247,096,763	0.0%	3,240,128,565	-0.1%
2016			3,237,280,481	-0.1%
2017			3,215,000,040	-0.7%

Local	Month	Norm HDD	Norm CDD	Count
LONDON	1	718.98	0	10
LONDON	2	685.73	0	10
LONDON	3	555.3	0.22	10
LONDON	4	318.32	0.32	10
LONDON	5	135.36	20.57	10
LONDON	6	29.3	55.03	10
LONDON	7	8	102.02	10
LONDON	8	10.93	74.5	10
LONDON	9	76.63	25.59	10
LONDON	10	249.9	2.55	10
LONDON	11	420.8	0	10
LONDON	12	597.8	0	10

Original forecast based on 20 year trend values for HDD and CDD

Annual Actual vs. Normalized WSkWh

	WSkWh	% Change	Normalized Value	% Change
2006	3,400,452,526		3,412,657,286	
2007	3,457,316,677	1.7%	3,439,522,287	0.8%
2008	3,390,352,069	-1.9%	3,374,339,384	-1.9%
2009	3,265,909,314	-3.7%	3,277,065,679	-2.9%
2010	3,374,790,334	3.3%	3,386,793,783	3.3%
2011	3,358,540,971	-0.5%	3,343,370,724	-1.3%
2012	3,307,326,673	-1.5%	3,340,872,292	-0.1%
2013	3,305,662,923	-0.1%	3,296,317,361	-1.3%
2014	3,248,077,232	-1.7%	3,244,458,120	-1.6%
2015	3,247,096,763	0.0%	3,240,128,565	-0.1%
2016			3,236,427,293	-0.1%
2017			3,214,146,852	-0.7%

Local	Month	Norm HDD	Norm CDD	Count
LONDON	1	730.42	0	20
LONDON	2	650.055	0	20
LONDON	3	558.63	0.2	20
LONDON	4	327.22	0.515	20
LONDON	5	152.935	14.955	20
LONDON	6	33.26	59.265	20
LONDON	7	7.755	97.7	20
LONDON	8	11.675	74.18	20
LONDON	9	73.45	27.81	20
LONDON	10	254.56	2.405	20
LONDON	11	420.855	0	20
LONDON	12	613.97	0	20

Attachment 1 of 1

Population Report

ONTARIO ECONOMIC UPDATE 2016

LONDON
ECONOMIC REGION

Presented by the Credit Unions of Ontario and the Ontario Chamber of Commerce

1 The regional economy underwent moderate growth in 2015.

2 The economy ispoised to continue growing as a result of a stabilizing manufacturing sector and a stronger housing market.

3 Major auto investments in Ingersoll and Woodstock will help sustain employment numbers in the region.

Credit Unions of Ontario

ontario chamber of commerce

The London Economic Region (ER) covers Oxford, Elgin, and Middlesex counties and is home to over 670,000 residents. The region's economic base is relatively more concentrated in manufacturing and agriculture, its primary export industries, and it has a fairly broad service industry base led by financial services, education and health. Its principal centre is the London Census Metropolitan Area (CMA), comprised of the cities of London and St. Thomas and their neighbouring urban jurisdictions. The CMA contains most of the region's manufacturing base and is home to over 500,000 residents.

The region's economy has experienced a slow but improving recovery from the last recession with several key economic indicators still below pre-recession levels. Much of this performance is linked to the region's declining manufacturing sector and the resulting negative spinoffs to the broader economy. External conditions such as the depreciated Canadian dollar, stronger U.S. growth, and lower oil prices seem to have begun to stimulate more manufacturing exports from the region.

Key indicators suggest economic performance in the London ER has been moderate overall in 2015 compared to 10-year historical trends. Headline labour market indicators have performed the best since the recession with employment growth tracking above two percent led by full-time employment and the unemployment rate falling to nearly six percent. The labour force participation rate has actually bumped up after dropping for 10 straight years, likely due to increased employment opportunities. Headline housing market indicators have been robust with sales on track for the largest gain in several years and more new construction has materialized. Non-residential building permits have increased substantially for the first time in four years.

The London CMA has accounted for all of the region's employment growth so far in 2015 with a near four percent gain putting total employment very close to the 2007 pre-recession high. London's housing market has been more active this year as has non-residential building construction.

Employment in goods-producing industries outpaced service-producing industries by a wide margin. At the regional level, goods employment led by manufacturing and construction jumped about 14 percent over the same period last year. Service industry employment is down slightly so far in 2015 though financial services, real estate, business services, and professional, scientific and technical services had notable gains.

Manufacturing employment in the London CMA has surged more than 20 percent to well above 30,000 persons so far in 2015. While very positive, it is not certain that the entire increase is due to a real upshift or partly due to sample variability in the Labour Force Survey (LFS). Historically, large swings in LFS sample results at the CMA industry level are often reversed the next year, which requires some caution interpreting these results.

This year's gain in construction employment is supported by more residential and non-residential investment as evidenced by building permits and housing starts activity. London CMA housing starts were up 11 percent through to October this year. Non-residential building construction investment spending was up more than 20 percent from the beginning of this year to the third quarter in the London CMA.

The London region has seen substantial tightening in housing market conditions since the beginning of 2015. The sales-to-new listings ratio is at a post-recession high and prices are beginning to accelerate. Since the recession, London's market has been fairly stable at lower sales levels with modest price increases. The larger sales jump in 2014 was a harbinger of a market change and with sales up over 10 percent in 2015 and new listings lagging well behind, prices are forecast to climb at a faster pace. A more robust supply response from the existing housing stock and new construction is very likely to continue.

Investment in non-residential building construction in the London CMA was little changed through the third quarter of 2015 compared to last year. Commercial building construction was up, while institutional and government building construction was down. Non-residential building permits were up 51 percent on the same basis. Permit growth, an indicator of near term investment spending, was mainly in institutional, government and commercial projects.

Recent economic trends in Ontario's farm production reveal modestly upward trends in overall price, quantity, and revenue. Livestock and related products are performing better than crops and related products. Aggregate farm cash sales, production, value added and product prices will likely continue to set new record highs. The Canada-EU trade agreement (CETA) will come into effect in 2016 presenting opportunities and challenges to this industry. It is expected to present headwinds for dairy and cheese producers, which will be ameliorated by subsidies, while exporters of pork and beef are expected to benefit.

The economic outlook through 2017 is for moderate growth in employment and a declining unemployment rate, but rising housing market activity and more residential and non-residential building construction. Population growth is expected to gradually increase.

The outlook for manufacturing in the region is more positive than at any time since the recession because the Canadian dollar is low, the U.S. economy is trending higher, and the restructuring and consolidation by foreign-owned firms is mostly completed. In addition, General Motors is investing $560 million in its Ingersoll plant and expects to hire more than 200 workers over the next year. An example of a negative development is Caterpillar's decision to lay off the remaining 50 employees at its Electro-Motive Diesel rail locomotive office in London.

The outlook is positive for further gains in the housing market against the backdrop of low mortgage rates and some improvement in economic and income growth in 2016 and 2017. In the London ER, housing sales via the Multiple Listing Service (MLS®) are forecast to rise 10.3 percent in 2016 and 4.7 percent in 2017, following estimated growth of 11.5 percent in 2015. The average MLS sale price is forecast to rise 6.5 percent in 2016 and 7.2 percent in 2017, following an estimated gain of 3.7 percent in 2015. Residential building permits are forecast to increase 13.8 percent in 2016 and 12.1 percent in 2017, following an estimated contraction 6.5 percent in 2015. The London CMA housing forecast is highly similar to the ER forecast.

Non-residential building permits in the London CMA are forecast to slip 5.1 percent in 2016 and rebound 14.7 percent in 2017, following an estimated increase of 44.7 percent in 2015. Non-residential building and engineering construction could receive a lift from federal government investment in infrastructure projects.

Population in the London CMA is forecast to grow at 0.8 percent in 2016 and 0.9 percent in 2017, on par with estimated growth of 0.8 percent in 2015. Net in-migration, mostly from other parts of Ontario, will pick up and account for more than half of total growth. The composition of growth is expected to shift towards international sources and less interprovincial out-migration.

Job growth in the London ER is forecast at 0.9 percent in 2016 and 1.2 percent in 2017, compared to an estimated 2.2 percent in 2015. The slower 2016 growth rate is an adjustment to the likely LFS sample-induced spike in 2015 and not to deterioration in fundamentals. Forecast job growth is led by manufacturing, construction and real estate services. Labour force growth will be aided by a rising participation rate and is forecast at 0.5 percent in 2016 and 0.7 percent in 2017, up from an estimated 1.3 percent in 2015. The region's unemployment rate will decline to 5.8 percent in 2016 and 5.3 percent in 2017 from an estimated 6.2 percent in 2015. The London CMA will continue to generate the bulk of regional jobs given its more diversified industry base than in the rest of the region.

Read on to find out how the LONDON economic region stacks up against the rest of Ontario >>>

ONTARIO ECONOMIC UPDATE 2016

LONDON

ECONOMIC REGION

	2013	2014	2015	2016	2017
Labour Force (000s)	351.3	349.3	354.0	355.6	358.0
% change	*0.1*	*-0.6*	*1.3*	*0.5*	*0.7*
Total Employment (000s)	323.7	324.8	332.0	335.0	339.0
% change	*0.3*	*0.3*	*2.2*	*0.9*	*1.2*
Unemployment Rate	7.9	7.0	6.2	5.8	5.3
MLS® Residential Sales	9,783	10,405	11,600	12,800	13,400
% change	*0.0*	*6.4*	*11.5*	*10.3*	*4.7*
MLS® Residential Average Price	243,155	251,964	261,300	278,200	298,100
% change	*2.4*	*3.6*	*3.7*	*6.5*	*7.2*
Residential Permits (units)	2,971	3,100	2,900	3,300	3,700
% change	*-4.8*	*4.3*	*-6.5*	*13.8*	*12.1*
Non-Residential Permits ($ millions)	479	420	490	500	550
% change	*1.1*	*-12.4*	*16.7*	*2.0*	*10.0*
Private Non-Residential Building Permits ($ millions)	364	292	300	350	380
% change	*6.7*	*-19.7*	*2.7*	*16.7*	*8.6*
Public Non-Residential Building Permits ($ millions)	116	128	190	150	170
% change	*-13.2*	*10.6*	*48.4*	*-21.1*	*13.3*
Population (000s)	662.3	666.4	670.9	675.8	681.5
% change	*0.8*	*0.6*	*0.7*	*0.7*	*0.8*
Net Migration	2,724	2,187	2,700	3,500	4,000
Net International	*2,718*	*2,355*	*2,000*	*2,200*	*2,400*
Net Interprovincial	*-1,423*	*-1,597*	*-800*	*-200*	*-100*
Net Intraprovincial	*1,429*	*1,429*	*1,500*	*1,500*	*1,700*

Source: Statistics Canada, CREA, Central 1 Credit Union forecasts.
Notes: Housing sales and prices represent combined activity in real estate boards within the region.

ONTARIO ECONOMIC UPDATE 2016

LONDON

CENSUS METROPOLITAN AREA

	2013	2014	2015	2016	2017
Total Employment (000s)	240.4	243.0	252.0	255.0	260.0
% change	*-0.8*	*1.1*	*3.7*	*1.2*	*2.0*
Unemployment Rate	8.6	7.5	6.8	6.3	5.9
MLS® Residential Sales	8,113	8,751	9,700	10,700	11,200
% change	*-1.9*	*7.9*	*10.8*	*10.3*	*4.7*
MLS® Residential Average Price	246,943	255,453	264,000	280,900	300,800
% change	*2.4*	*3.4*	*3.3*	*6.4*	*7.1*
Residential Permits (units)	2,317	2,442	2,200	2,500	2,800
% change	*3.3*	*5.4*	*-9.9*	*13.6*	*12.0*
Non-Residential Permits ($ millions)	287	273	395	375	430
% change	*-17.9*	*-5.0*	*44.7*	*-5.1*	*14.7*
Population (000s)	498.7	502.4	506.3	510.5	514.9
% change	*0.8*	*0.7*	*0.8*	*0.8*	*0.9*

Source: Statistics Canada, CREA, Central 1 Credit Union forecasts.
Notes: Housing sales and prices represent combined activity in real estate boards within the region.
*Approximated with data from the London & St. Thomas Association of REALTORS®



ONTARIO ECONOMIC UPDATE 2016

ONTARIO

1 Improving overall growth prospects

2 Regional growth differentials will narrow

3 Northern regions will lag due to poor mining prospects

Credit Unions of Ontario

ontario chamber of commerce

SUMMARY

Ontario's economic performance is not shared equally in all regions in the province due to differences in their economic makeup or base. External macro factors play an important role not only in Ontario's economic performance but also in each region to varying degrees. Economic prospects for Ontario are improving aided by positive externals such as a low dollar, faster U.S. growth, and low interest rates.

Regional growth performances during 2015 were led by the Toronto and Hamilton-Niagara regions, with the Kitchener-Waterloo-Barrie and London regions close behind. At the other end of the growth spectrum were the northern regions and to a lesser extent Windsor-Sarnia and Stratford-Bruce. A narrowing of growth differentials amongst regions was evident, though small, and made more apparent by the large discrepancy that materialized following the 2008-09 recession.

Further convergence in regional growth performances is expected during the next two years with some of the laggards closing the gap rather than the leaders surging further ahead. Exceptions are the northern regions, which are heavily dependent on mining and resources but face a weak outlook for metal markets, where growth will remain low and possibly negative.

All regions will see more housing activity, in varying degrees, depending on local economic and market conditions. Some previously slower regional markets such as London and Windsor-Sarnia are poised to have substantial gains. Toronto and Hamilton-Niagara markets will generate the largest price increases.

Projected population growth in 2016 and 2017 gradually edges higher in most regions, except in the north. Low growth will continue to prevail in the Kingston-Pembroke, Stratford-Bruce, and Windsor-Sarnia regions. A notable pickup is forecast for the Muskoka-Kawarthas region.

REPORT FRAMEWORK

The regional areas in this report follow Statistics Canada's 11 Economic Region boundaries for Ontario. The principal main metropolitan area in each region is covered. The principal economic indicators used to track regional economic performance are employment, unemployment, housing sales, housing prices, residential and non-residential building permits, and population. Other data sets, such as housing starts and non-residential building construction investment spending, are referred to in the text, but no data is presented in tables. Gross Domestic Product (GDP) data are not available by region.

The labour market is a key indicator of regional performance and Statistics Canada's Labour Force Survey (LFS) is the main source of this information. Regional LFS data has issues with sample errors making it difficult to separate underlying movements from sample noise, which is more problematic in smaller regions. Employment Insurance (EI) data is helpful to verify labour market changes, but it too has limitations.

RECENT PERFORMANCE VARIED

The province's variable, but overall, moderate growth performance so far in 2015 has been mirrored in most regions. Provincial real GDP growth in the first quarter was minimal followed by a modest rebound the second quarter and very likely a stronger performance in the third quarter. Fourth quarter real GDP growth will probably ease.

Ontario's employment profile generally tracked real GDP with a dip in the first quarter of 2015 and faster growth thereafter. Regionally, employment turned up during 2015 in Toronto, Hamilton-Niagara, and London, but declined in the Ottawa, Kingston-Pembroke, Muskoka-Kawarthas, Windsor-Sarnia, Stratford-Bruce, Northeast, and Northwest regions and as a result they will have lower employment for the year than in 2014. Kitchener-Waterloo-Barrie region employment was little changed.

In more than one instance, the 2015 LFS results were at odds with EI data, or with recent trends, and were interpreted as sample variability rather than a fundamental change in the labour market. The regions in question were Kingston-Pembroke, Muskoka-Kawarthas and Stratford-Bruce for doubtful downside shifts and London's sharp increase was a questionable upside move.

Unemployment rates in most regions will close out the year lower than in 2014. The exceptions are the Muskoka-Kawarthas, Windsor-Sarnia, Stratford-Bruce and the Northeast. EI data did not corroborate the unemployment rate jump in the Muskoka-Kawarthas and Stratford-Bruce regions, leaving LFS sample variability as the likely cause.

While there was some divergence in regional labour market performance in 2015, this was not the situation in the housing market. All regional housing markets expanded with more sales, higher prices (except for the Northeast), and more new construction. The degree of market expansion varied with larger gains in the central and southwest regions and smaller gains in the eastern and northern regions.

Non-residential construction was less robust than residential construction in most regions. The Toronto region will post a 17 percent rise in 2015 mainly due to a 53 percent jump in public permits, with private permits, industrial and commercial buildings up eight percent. The London and Northwest regions will also have double-digit gains this year, led by public permits as well. Regions with less activity this year, such as Ottawa and Kingston-Pembroke, are coming off a public permit surge in 2014.

The latest regional population data is as of July 1, 2014. Statistics Canada's 2015 estimates will be released in 2016. At the provincial level, population growth slowed in the year ending June 30, 2015 to less than one percent on fewer immigrants and net non-permanent residents. Net interprovincial migration remained negative, though the outflow slowed.

IMPROVING OUTLOOK

The performance of Ontario's regional economies depends on external and domestic factors as well as on a region's industry and demographic composition. Several regions in Ontario are quite dependent on external export-driven factors. The northern regions with their considerable dependence on forestry, mining, and metal products are at one end of this spectrum, while Ottawa and the Muskoka-Kawarthas regions are more domestically driven and less exposed to export markets.

The external environment for Ontario will turn more positive during the next two years due to a better performance in its largest export market, the U.S., a low Canadian dollar, low interest rates, and low oil prices. Working against these positives will be low metal prices, geopolitical events, and potential disruptions in financial markets emanating from emerging markets. Global economic growth will remain modest and below potential, mainly due to the slowdown in China.

Exports play a key role in Ontario's economic performance and while international goods and services exports have better prospects ahead, interprovincial exports will be constrained by the negative fallout from the poor oil and natural gas markets that is affecting energy producing provinces such as Alberta.

On the domestic front, government fiscal policy will be more stimulative with time as the impact of more infrastructure spending will be felt to a greater degree. Private investment spending is set to build momentum, while residential investment spending will remain at a robust pace with some slowing into 2017.

Ontario's real GDP growth is forecast at 2.6 percent in 2016 and 3.0 percent in 2017, following an estimated 2.5 percent expansion in 2015. Statistics Canada's preliminary 2014 estimate is 2.7 percent. Ontario's economy has upshifted from its slow growth phase of 2012 and 2013 to moderate growth and, if the forecast proves accurate, will shift to a more robust phase in 2017.

Economic performance across Ontario's regions during the next two years will continue on recent trends, resulting in a greater divergence between some regions. The northern regions will post slight growth, while the central and southwestern regional economies will be the province's main growth drivers. In the absence of GDP data for the regions, employment is the best single available economic indicator of a region's overall performance.

Growth in most regions will increase over 2015 and continue their cyclical expansion from the last recession. The Toronto and Hamilton-Niagara regions also are expected to perform above the provincial growth rate, while the Kitchener-Waterloo-Barrie and Ottawa regions look to perform similar to Ontario's pace, which is estimated at 1.5 percent in 2016 and 1.4 percent in 2017.

The London region, which was hard hit by the recession and restructuring of its manufacturing base, will continue to regain lost economic output and post growth above the provincial average in 2016 and 2017. In the last year of the forecast, employment will be above the 2007 pre-recession high.

Another manufacturing region hard hit by the recession was Windsor-Sarnia and employment has slowly advanced from its recession low. Forecast employment growth will be close to but below the provincial average and in 2017 employment will be at its highest level since the recession, but still well below the pre-recession high.

The three remaining regions – Kingston-Pembroke, Muskoka-Kawarthas, and Stratford-Bruce – are expected to grow in line with the recent modest trend growth. For example, 2017 employment in these regions is forecast at levels comparable to or slightly higher than those that existed five years ago. In contrast, employment in Toronto, Kitchener-Waterloo-Barrie, and Hamilton-Niagara will be six to nine percent higher, with Toronto leading this group.

All but one region is expected to see lower unemployment rates in 2016 and 2017 compared to this year. The exception is Kingston-Pembroke but this is due more to LFS sample issues than to underlying performance. Ontario's unemployment rate at 6.6 percent and 6.3 percent in 2016 and 2017, respectively, would be the lowest since the recession. The lowest regional unemployment rate will be in Kitchener-Waterloo-Barrie, followed by London and Windsor-Sarnia. The Stratford-Bruce and Northwest regions will also have low unemployment rates due to low population growth and lack of employment opportunities. The highest unemployment rate will prevail in Windsor-Sarnia at 8.0 percent in 2017.

Regional housing markets will continue on their expansion phase during the next two years. The low interest rate environment is a strong stimulus to all regional housing markets. No recession in Ontario's housing market is foreseen until the next global economic recession and regional markets will expand reflecting their own local economic circumstances. Housing markets in stronger economies and with higher population growth outperform those with weaker demand conditions.

MLS® residential sales growth is predicted to be most robust and above the provincial averages during the next two years in the Windsor-Sarnia and London regions. These two regions will post the fastest sales growth in 2015 and this momentum carries into the forecast, which is supported by improved economic performance and the release of pent-up demand following the lean post-recession years.

Another more active regional market is Muskoka-Kawarthas. Residential sales are predicted well above provincial sales growth rate at 9.1 percent in 2016 and 6.7 percent in 2017. In this region, labour market performance is less of a housing driver than the influx of retiree migrants from other parts of the province, notably Toronto, in addition to low interest rates. Robust market conditions in Toronto and other regions facilitate and encourage migration.

Less active markets look to be in the northern regions and in Stratford-Bruce, while the remaining regions will perform around the provincial sales pace. The Toronto and Hamilton-Niagara markets have outperformed in recent years and are seen expanding at a slower but still substantial pace.

As for price performance, Toronto and Hamilton-Niagara will still lead all regions and outpace provincial increases. The MLS® residential average sale price will climb in every region during the next two years with the slowest increases in those regions with the lowest sales gains.

Residential construction, as captured by building permits, tracks housing market conditions and most regions will see higher levels during the next two years. Residential construction can be a significant local economic driver.

Non-residential building permits will rise in this forecast with 2017 considerably more active than 2016. Private non-residential building permits will outperform public permits mainly because of higher 2015 levels and the 'lumpy' nature of large building projects. Investment on commercial and industrial buildings has been below trend since the recession and the predicted pickup in non-residential private permits will be in response to improved market conditions. Public permits are expected to receive a boost in 2017 when increased government infrastructure spending translates into project development.

Ontario's population growth will edge higher due to more immigration and a lower net outflow to other provinces during the next two years. Toronto will continue as the main destination for immigrants and will lead the regional growth rankings. Near-zero growth rates will extend in the two northern regions, Kingston-Pembroke, Windsor-Sarnia, and Stratford-Bruce.

There are substantial differences in economic performance within some regions. The main metropolitan area in the region, which is the service, distribution, and administrative centre, can have a different economic structure than in the rest of the region. This is evident in several regions, notably in the Kingston-Pembroke region wherein the economy of the Kingston Census Metropolitan Area (CMA) bears little resemblance to the economic base in the rest of the region. Other examples are the Ottawa, Peterborough, and Thunder Bay CMAs, which are distinct from the rest of their regions.

Ontario Forecast Table

ECONOMIC REGION	2013	2014	2015	2016	2017
Real GDP, expenditure-based (percentage growth)	1.3	2.7	2.5	2.6	3.0
Net exports, $2007 bil.	*10.4*	*13.3*	*11.2*	*16.5*	*20.4*
Employment change (%)	1.8	0.8	0.8	1.5	1.4
Labour force change (%)	*1.5*	*0.5*	*0.3*	*1.2*	*1.1*
Unemployment rate (%)	7.6	7.3	6.9	6.6	6.3
MLS residential unit sales change (%)	*0.4*	*3.7*	*9.4*	*6.4*	*4.6*
MLS residential average sales price change (%)	4.7	7.1	7.3	7.7	6.6
Population change (%)	*1.1*	*0.9*	*0.8*	*0.9*	*0.9*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

Employment (000s), Regional Summary

ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	684.5	697.8	688.5	696.0	708.0
% change	*-1.5*	*1.9*	*-1.3*	*1.1*	*1.7*
Kingston-Pembroke	213.9	210.1	203.0	207.0	211.0
% change	*0.1*	*-1.8*	*-3.4*	*2.0*	*1.9*
Muskoka-Kawarthas	168.5	186.3	168.6	174.0	176.0
% change	*-1.5*	*10.6*	*-9.5*	*3.2*	*1.1*
Toronto	3,240.2	3,241.1	3,320.0	3,375.0	3,425.0
% change	*4.1*	*0.0*	*2.4*	*1.7*	*1.5*
Kitchener-Waterloo-Barrie	693.5	704.5	712.0	720.0	729.0
% change	*2.8*	*1.6*	*1.1*	*1.1*	*1.3*
Hamilton-Niagara Peninsula	697.5	706.4	722.0	734.0	744.0
% change	*-1.2*	*1.3*	*2.2*	*1.7*	*1.4*
London	323.7	324.8	332.0	335.0	339.0
% change	*0.3*	*0.3*	*2.2*	*0.9*	*1.2*
Windsor-Sarnia	295.1	299.1	293.0	297.0	300.0
% change	*-0.8*	*1.4*	*-2.0*	*1.4*	*1.0*
Stratford-Bruce Peninsula	150.6	151.1	144.5	147.0	149.5
% change	*-1.4*	*0.3*	*-4.4*	*1.7*	*1.7*
Northeast	253.7	256.8	250.5	251.5	252.5
% change	*-0.6*	*1.2*	*-2.5*	*0.4*	*0.4*
Northwest	102.2	99.8	97.3	97.1	97.3
% change	*0.2*	*-2.3*	*-2.5*	*-0.2*	*0.2*
Ontario	6,823.4	6,877.8	6,931.4	7,033.6	7,131.3
% change	*1.8*	*0.8*	*0.8*	*1.5*	*1.4*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

Labour Force (000s), Regional Summary					
ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	731.7	746.9	736.0	743.0	752.0
% change	*-1.5*	*2.1*	*-1.5*	*1.0*	*1.2*
Kingston-Pembroke	230.2	229.3	218.0	223.0	228.0
% change	*0.0*	*-0.4*	*-4.9*	*2.3*	*2.2*
Muskoka-Kawarthas	182.9	198.8	182.9	189.0	190.0
% change	*-1.2*	*8.7*	*-8.0*	*3.3*	*0.5*
Toronto	3,528.8	3,524.7	3,580.0	3,625.0	3,670.0
% change	*3.4*	*-0.1*	*1.6*	*1.3*	*1.2*
Kitchener-Waterloo-Barrie	741.2	747.8	753.0	760.0	768.0
% change	*2.6*	*0.9*	*0.7*	*0.9*	*1.1*
Hamilton-Niagara Peninsula	751.2	755.9	770.0	779.0	786.0
% change	*-1.3*	*0.6*	*1.9*	*1.2*	*0.9*
London	351.3	349.3	354.0	355.6	358.0
% change	*0.1*	*-0.6*	*1.3*	*0.5*	*0.7*
Windsor-Sarnia	322.2	325.3	320.6	323.4	326.2
% change	*-1.6*	*1.0*	*-1.4*	*0.9*	*0.9*
Stratford-Bruce Peninsula	159.8	158.7	153.5	156.0	158.0
% change	*-0.4*	*-0.7*	*-3.3*	*1.6*	*1.3*
Northeast	274.3	275.8	272.0	272.5	273.0
% change	*-0.5*	*0.5*	*-1.4*	*0.2*	*0.2*
Northwest	110.2	106.2	103.5	103.1	102.9
% change	*0.6*	*-3.6*	*-2.5*	*-0.4*	*-0.2*
Ontario	7,383.8	7,418.7	7,443.5	7,529.6	7,612.1
% change	*1.5*	*0.5*	*0.3*	*1.2*	*1.1*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

Unemployment Rate (%), Regional Summary

ECONOMIC REGION	2013	2014	2015	2016	2016
Ottawa	6.5	6.6	6.5	6.3	5.9
Kingston-Pembroke	7.1	8.4	6.9	7.2	7.5
Muskoka-Kawarthas	7.9	6.3	7.8	7.9	7.4
Toronto	8.2	8.0	7.3	6.9	6.7
Kitchener-Waterloo-Barrie	6.4	5.8	5.4	5.3	5.1
Hamilton-Niagara Peninsula	7.1	6.5	6.2	5.8	5.3
London	7.9	7.0	6.2	5.8	5.3
Windsor-Sarnia	8.4	8.1	8.6	8.2	8.0
Stratford-Bruce Peninsula	5.8	4.8	5.9	5.8	5.4
Northeast	7.5	6.9	7.9	7.7	7.5
Northwest	7.3	6.0	6.0	5.8	5.4
Ontario	7.6	7.3	6.9	6.6	6.3

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

MLS Residential Sales (units), Regional Summary

ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	16,539	16,472	17,900	18,500	19,500
% ch.	*-3.8*	*-0.4*	*8.7*	*3.4*	*5.4*
Kingston-Pembroke	7,272	7,095	7,700	8,200	8,500
% ch.	*-5.4*	*-2.4*	*8.5*	*6.5*	*3.7*
Muskoka-Kawarthas	6,728	7,095	8,250	9,000	9,600
% ch.	*0.1*	*5.5*	*16.3*	*9.1*	*6.7*
Toronto	94,588	99,193	1,07,400	1,14,300	1,19,200
% ch.	*0.9*	*4.9*	*8.3*	*6.4*	*4.3*
Kitchener-Waterloo-Barrie	21,374	21,831	24,000	25,300	26,400
% ch.	*3.7*	*2.1*	*9.9*	*5.4*	*4.3*
Hamilton-Niagara Peninsula	21,048	22,274	25,000	26,500	28,000
% ch.	*2.3*	*5.8*	*12.2*	*6.0*	*5.7*
London	9,783	10,405	11,600	12,800	13,400
% ch.	*0.0*	*6.4*	*11.5*	*10.3*	*4.7*
Windsor-Sarnia	8,110	8,255	9,300	10,200	10,900
% ch.	*3.5*	*1.8*	*12.7*	*9.7*	*6.9*
Stratford-Bruce Peninsula	3,700	4,017	4,300	4,500	4,650
% ch.	*-2.8*	*8.6*	*7.0*	*4.7*	*3.3*
Northeast	6,167	5,842	6,300	6,600	6,500
% ch.	*-5.3*	*-5.3*	*7.8*	*4.8*	*-1.5*
Northwest	2,053	2,264	2,300	2,400	2,500
% ch.	*-0.1*	*10.3*	*1.6*	*4.3*	*4.2*
Ontario	197,362	204,743	224,050	238,300	249,150
% ch.	*0.4*	*3.7*	*9.4*	*6.4*	*4.6*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

MLS Residential Average Sale Price ($), Regional Summary

ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	334,320	339,785	346,000	355,000	365,000
% ch.	*2.0*	*1.6*	*1.8*	*2.6*	*2.8*
Kingston-Pembroke	247,163	247,935	260,000	275,000	285,000
% ch.	*2.8*	*0.3*	*4.9*	*5.8*	*3.6*
Muskoka-Kawarthas	302,268	320,936	337,000	360,000	375,000
% ch.	*3.3*	*6.2*	*5.0*	*6.8*	*4.2*
Toronto	529,948	573,183	625,800	680,400	730,100
% ch.	*5.1*	*8.2*	*9.2*	*8.7*	*7.3*
Kitchener-Waterloo-Barrie	311,530	328,492	348,000	370,000	390,000
% ch.	*3.9*	*5.4*	*5.9*	*6.3*	*5.4*
Hamilton-Niagara Peninsula	333,673	352,833	380,000	410,000	440,000
% ch.	*6.1*	*5.7*	*7.7*	*7.9*	*7.3*
London	243,155	251,964	261,300	278,200	298,100
% ch.	*2.4*	*3.6*	*3.7*	*6.5*	*7.2*
Windsor-Sarnia	179,294	186,650	193,000	205,000	220,000
% ch.	*4.1*	*4.1*	*3.4*	*6.2*	*7.3*
Stratford-Bruce Peninsula	226,108	233,598	245,000	254,000	263,000
% ch.	*2.9*	*3.3*	*4.9*	*3.7*	*3.5*
Northeast	212,386	216,113	212,500	219,300	224,125
% ch.	*1.2*	*1.8*	*-1.7*	*3.2*	*2.2*
Northwest	195,100	208,909	220,000	225,000	230,000
% ch.	*6.9*	*7.1*	*5.3*	*2.3*	*2.2*
Ontario	4	431,543	463,123	498,701	531,532
% ch.	*4.7*	*7.1*	*7.3*	*7.7*	*6.6*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

RESIDENTIAL BUILDING PERMITS (UNITS), REGIONAL SUMMARY

ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	6,643	8,391	5,700	6,300	6,800
% ch.	*-19.1*	*26.3*	*-32.1*	*10.5*	*7.9*
Kingston-Pembroke	2,050	1,850	2,100	2,300	2,500
% ch.	*6.3*	*-9.8*	*13.5*	*9.5*	*8.7*
Muskoka-Kawarthas	1,819	2,208	1,850	2,000	2,250
% ch.	*4.7*	*21.4*	*-16.2*	*8.1*	*12.5*
Toronto	40,256	35,136	42,000	46,500	48,500
% ch.	*3.6*	*-12.7*	*19.5*	*10.7*	*4.3*
Kitchener-Waterloo-Barrie	7,084	9,204	9,400	10,200	11,000
% ch.	*12.0*	*29.9*	*2.1*	*8.5*	*7.8*
Hamilton-Niagara Peninsula	4,975	5,091	6,000	6,500	7,000
% ch.	*-8.1*	*2.3*	*17.9*	*8.3*	*7.7*
London	2,971	3,100	2,900	3,300	3,700
% ch.	*-4.8*	*4.3*	*-6.5*	*13.8*	*12.1*
Windsor-Sarnia	1,492	1,371	1,400	1,550	1,700
% ch.	*13.6*	*-8.1*	*2.1*	*10.7*	*9.7*
Stratford-Bruce Peninsula	1,088	1,096	1,325	1,500	1,650
% ch.	*0.8*	*0.7*	*20.9*	*13.2*	*10.0*
Northeast	1,305	1,043	1,100	1,000	1,050
% ch.	*-12.1*	*-20.1*	*5.5*	*-9.1*	*5.0*
Northwest	450	389	400	425	400
% ch.	*4.9*	*-13.6*	*2.8*	*6.3*	*-5.9*
Ontario	70,133	68,879	74,175	81,575	86,550
% ch.	*0.4*	*-1.8*	*7.7*	*10.0*	*6.1*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

POPULATION (000S), REGIONAL SUMMARY

ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	1,309.1	1,320.3	1,331.0	1,343.0	1,358.0
% ch.	*0.9*	*0.9*	*0.8*	*0.9*	*1.1*
Kingston-Pembroke	467.7	468.7	470.0	471.4	473.1
% ch.	*0.2*	*0.2*	*0.3*	*0.3*	*0.4*
Muskoka-Kawarthas	380.0	381.5	383.0	385.5	388.5
% ch.	*0.5*	*0.4*	*0.4*	*0.7*	*0.8*
Toronto	6,268.8	6,357.7	6,439.8	6,530.3	6,626.1
% ch.	*1.6*	*1.4*	*1.3*	*1.4*	*1.5*
Kitchener-Waterloo-Barrie	1,285.1	1,297.9	1,308.5	1,319.0	1,332.0
% ch.	*1.1*	*1.0*	*0.8*	*0.8*	*1.0*
Hamilton-Niagara Peninsula	1,435.0	1,445.9	1,456.2	1,467.9	1,483.1
% ch.	*0.9*	*0.8*	*0.7*	*0.8*	*1.0*
London	662.3	666.4	670.9	675.8	681.5
% ch.	*0.7*	*0.6*	*0.7*	*0.7*	*0.8*
Windsor-Sarnia	638.2	637.4	637.0	637.5	637.9
% ch.	*0.0*	*-0.1*	*-0.1*	*0.1*	*0.1*
Stratford-Bruce Peninsula	300.3	300.5	300.7	301.2	301.7
% ch.	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*
Northeast	564.3	562.6	560.9	559.0	557.3
% ch.	-0.2	-0.3	-0.3	-0.3	-0.3
Northwest	240.1	239.8	239.4	239.1	239.1
% ch.	*-0.1*	*-0.1*	*-0.2*	*-0.1*	*0.0*
Ontario	13,550.9	13,678.8	13,797.4	13,929.7	14,078.3
% ch.	*1.1*	*0.9*	*0.9*	*1.0*	*1.1*

Source: Statistics Canada, Central 1 Credit Union. Forecasts 2015 to 2017

Note: As of July 1, latest actual 2014.

Non-residential Building Permits ($ mil.), Regional Summary					
ECONOMIC REGION	2013	2014	2015	2016	2017
Ottawa	1,179	1,180	1,074	1,115	1,190
% ch.	*-8.2*	*0.1*	*-9.0*	*3.8*	*6.7*
Kingston-Pembroke	238	495	270	280	300
% ch.	*-20.5*	*108.3*	*-45.5*	*3.7*	*7.1*
Muskoka-Kawarthas	129	235	130	150	180
% ch.	*-24.0*	*81.6*	*-44.7*	*15.4*	*20.0*
Toronto	6,193	5,985	7,000	6,900	7,500
% ch.	*3.3*	*-3.4*	*17.0*	*-1.4*	*8.7*
Kitchener-Waterloo-Barrie	982	1,308	1,200	1,300	1,550
% ch.	*-0.5*	*33.1*	*-8.2*	*8.3*	*19.2*
Hamilton-Niagara Peninsula	1,264	889	960	1,000	1,200
% ch.	*-15.2*	*-29.7*	*8.0*	*4.2*	*20.0*
London	479	420	490	500	550
% ch.	*1.1*	*-12.4*	*16.7*	*2.0*	*10.0*
Windsor-Sarnia	363	347	375	425	475
% ch.	*-39.2*	*-4.6*	*8.1*	*13.3*	*11.8*
Stratford-Bruce Peninsula	263	350	315	310	335
% ch.	*0.4*	*33.2*	*-10.0*	*-1.6*	*8.1*
Northeast	381	447	300	350	400
% ch.	*6.2*	*17.3*	*-32.9*	*16.7*	*14.3*
Northwest	194	86	110	140	140
% ch.	*-21.8*	*-55.6*	*27.9*	*27.3*	*0.0*
Ontario	11,666	11,742	12,224	12,470	13,820
% ch.	*-4.1*	*0.7*	*4.1*	*2.0*	*10.8*

Source: Statistics Canada, Central 1 Credit Union. 2015 estimated, forecasts 2016 and 2017

3-VECC-26

Reference: E3/T1/S2, pages 7-8

a) Please confirm whether the average loss factor used to convert to billed kWh was based on 2006-2015 (as suggested by Table 3.1.2.30) or 2007-2015 (as stated in the text at page 7, line 9).

LH Response:

London Hydro confirms the average loss factor used to convert to billed kWh was based on 2006-2015 (as suggested by Table 3.1.2.30).

3-VECC-27

Reference: E3/T1/S2, pages 8-13

a) Does the data used in determining the values in Table 3.1.2.5 for the GS>50 class for the period up to the start of 2012 include the 4 customers that are now market participants?

LH Response:

London Hydro would confirm that the data used in determining the values in Table 3.1.2.5 for the GS>50 class for the period up to the start of 2012 included the 4 customers that are now market participants

b) Does the data use in determining the values in Table 3.1.2.5 for the GS>50 class for period after mid-2012 include the 4 customers that are now market participants?

LH Response:

London Hydro would confirm that the data used in determining the values in Table 3.1.2.5 for the GS>50 class for period after mid-2012 did not include the 4 customers that are now market participants

c) If the response to either (a) and/or (b) is yes, what would be the geomean growth rate for the class for the four years 2012-2016 (per Table 3.2.1.6) if these four customers were excluded from the determination of the 2011-2015 average customer counts?

LH Response:

London Hydro in response to these interrogatories has determined that an alternate customer count document will be used and that the new calculations will accommodate the removal of WMP from the GS>50 class. See 3-Staff-41.

d) What was the customer/connection count for each class as of June 30, 2016? For the GS>50 class, please indicate whether the response includes or excludes the four market participants.

LH Response:

London Hydro is filing a new customer count document which shall provide customer counts to the end of 2016. See 3-Staff-41.

3-VECC-28

Reference: E3/T1/S2, pages 13-16
IESO 2015 Verified CDM Savings Excel File
Appendix 2-I

a) Please provide a copy of London's 2015-2020 CDM Plan as submitted to the IESO.

LH Response:

London Hydro has attached London's 2015-2020 CDM Plan as submitted to the IESO.

b) Please explain why, for the impact of 2015 CDM programs, London has used the "planned" program savings of 35,386,333 kWh as opposed to the actual IESO verified 2015 savings of 31,995,332 kWh.

LH Response:

London Hydro's load forecast was completed in March 2016, before final 2015 values were published, recognizing that updates would be completed later in the application process.

c) It is noted that in the Application (page 16) the CDM adjustment for 2017 is based on 100% of 2015 CDM program savings, plus 50% of 2016 CDM program savings plus 50% of 2017 CDM program savings. However, in Appendix 2-I the adjustment is based on 50% of 2015, plus 100% of 2016 plus 50% of 2017. Please explain why the Application did not use 50%, 100% and 50% for 2015, 2016 and 2017 respectively.

LH Response:

London Hydro's will correct this in the amended Load forecast to be completed and submitted with filing of these responses to interrogatories. See 3-Staff-41.

Attachment 1 of 1

London Hydro 2015-2020 CDM Plan

London Hydro Report EM-14-03, *Integrated Resource Planning: Forecasts of Energy Efficiency Program Outcomes as a Demand-Side Resource (Volume 1 – Articulation of the Vision)*

Issued: April 2015

EXECUTIVE SUMMARY

The Minister of Energy's March 31st, 2014 directive to the Ontario Power Authority entitled: *2015 – 2020 Conservation First Framework*, defines the CDM delivery framework for the next six (6) years. Specific passages that relate to a Distributor CDM targets have been replicated following for convenience of reference:

> *Therefore, pursuant to my authority under section 25.32 of the Act, I hereby direct the OPA to coordinate, support and fund the delivery of CDM programs through Distributors to achieve a total of 7 TWh of reductions in electricity consumption between January 1, 2015 and December 31, 2020 in accordance with the following guiding principles and requirements.*

Note that the foregoing target is not a "*cumulative net*" energy reduction target, but rather a "*net*" energy reduction target, which is a subtle but significant change from the 2011 – 2014 CDM delivery framework. An analysis contained herein shows that the annual energy savings target is approximately double the target that was established under the previous framework – this "*approximate doubling of targets*" is consistent with informal feedback received from other LDC's.

Based on its reported population of residential and non-residential customers, London Hydro's allocation of the provincial target is 196.66 GWh (to be achieved over the 6-year framework).

This Volume 1 (*Articulation of the Vision*) of the overall report is intended to show how London Hydro intends to meet or exceed these aggressive CDM targets via:

- The continuation of provincial CDM programs (that are within the saveONenergy FOR HOMES and saveONenergy FOR BUSINESS portfolios); and
- The introduction of new CDM programs that are local to London Hydro, or perhaps created as regional CDM offerings.

The predicted outcomes of energy conservation and demand-side management programs are intended to be an input to the creation and update of regional supply plans (which in turn are intended to identify future needs to reinforce the provincial transmission grid, and increase the capacity of existing transformer stations or construct new ones). Unfortunately, CDM targets are defined in terms of energy savings (in kilowatt-hours or megawatt-hours or gigawatt-hours) whereas system planning professionals are more interested in predicted increases or decreases in load coincident with the summer or winter peak loading conditions. This report also presents a methodology for converting London Hydro's CDM targets into predictions of summer and winter peak demand reductions.

♣ - ♣ - ♣

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Background

1.1.1 The Changing Roles and Responsibilities in Energy Conservation

In the late 1990s, the province was preparing for a competitive electricity market. With the *Energy Competition Act, 1998*, electric utilities became "*wires only*" companies. LDCs were restricted to distributing electricity, leaving CDM to the market as a response to market price. It was not until the passage of the *Electricity Restructuring Act, 2004* that LDCs were permitted to re-engage in CDM activities.[1]

The roles and responsibilities for designing, delivering, and funding energy conservation programs changed throughout the years as described below:

- 2005-2007: The Ontario Energy Board Framework -

  From 2005 to 2007, 85 LDCs designed and delivered CDM programs referred to as "*third tranche*" conservation programs. Distributors were granted increases in their 2005 rates if an equivalent amount was spent on CDM by the end of September 2007. Some distributors were granted extensions to continue programs into 2008. Under this framework, distributors prepared and submitted CDM plans and budgets for approval and provided regular reports on the progress of CDM programs to the OEB.

- 2007-2010: The Ontario Power Authority Framework

  In 2007, the framework for CDM programs changed. The June 2006 Supply Mix Directive to the OPA required that conservation be a key component of the province's electricity plan. A month later, the Minister of Energy directed the OPA to co-ordinate and fund conservation programs for LDCs by establishing a three-year fund of up to $400 million. The directive was silent on the role of LDCs in CDM and their source of funding beyond 2010.

  From 2007 to 2010, electricity distributors could either: contract with the OPA to deliver standard CDM programs; apply to the OPA for funding of custom programs; or apply to the OEB for CDM initiatives targeted at consumers within the distributor's service area. The process for OEB-approved programs remained the same, that is, CDM was funded through distribution rates and a performance incentive called the Shared Savings Mechanism continued to apply. This financial incentive allowed distributors to share 5 per cent of the net savings resulting from CDM programs they initiated. An additional source of funding

[1] Environmental Commissioner of Ontario report: *Managing a Complex Energy System; Annual Energy Conservation Progress Report – 2010 (Volume One)*; June 2011; Section 5, *Conservation and Demand Management Code and Targets for Electricity Distributors*; pg 32-33.

was created for OPA programs and this operated independently of the OEB framework's funding. Funding was provided through the Global Adjustment, and the performance incentive was paid either per participant or per kW of savings achieved, depending on the program.

During this period, it was expected that LDCs would act primarily as delivery agents for the OPA's standard CDM programs. Only a few OEB-approved and OPA-funded LDC custom programs were offered.

- 2011-2014: Mandated LDC Delivery Framework

The provincial Green Energy & Green Economy Act, 2009 (GEGEA) once again shifted the CDM framework in significant ways. The GEGEA allowed for LDCs to be given mandatory conservation targets as part of their licence condition. In the March 31, 2010 CDM Directive, the Minister of Energy specified the total province-wide reductions for both electricity consumption and peak demand that LDCs must achieve by 2014. The directive also required the OEB to allocate the province-wide targets among LDCs and to issue a Code with rules to govern how LDC targets are met. Unlike previous directives, the CDM Directive was prescriptive. The Minister laid out a list of specific rules the OEB must consider in developing the Code.

On April 23, 2010, the Minister directed the OPA to provide advice to the OEB on LDC CDM activities and targets, and also to design, deliver and fund OPA-Contracted Province-Wide programs.

Distributors must meet their CDM targets by delivering either: unique CDM programs approved by the OEB (referred to as Board-Approved Programs); province-wide CDM programs designed by the OPA (referred to as OPA-Contracted Province- Wide Programs); or a combination of the two. The CDM framework allows for Board-Approved Programs to be designed by individual LDCs or co-operatively between multiple LDCs. In keeping with the Minister's directive, all CDM programs must start on January 1, 2011 and end on December 31, 2014.

The 2011 to 2014 framework adopts elements from previous frameworks. Oversight of some CDM activities has been shifted back to the OEB, as was the case in the 2005 to 2007 period. A significant difference from the previous framework is that there is now a single funding approach. In the 2007 to 2010 framework, funding and performance incentives differed according to the approving agency (i.e., the OPA or OEB). Under the mandated LDC delivery framework, all CDM programs are now funded through the Global Adjustment, and the performance incentive is based on the amount of kWh and kilowatt (kW) savings achieved within a distributor's service territory, regardless of whether those savings result from province-wide programs or custom programs. In this sense, given that it is a licence condition, responsibility for conservation success lies with each individual LDC.

- 2015 – 2020 Conservation First Framework[2]

  The Ministry of Energy established a short-term electricity conservation target for 2020 that is derived only from LDC conservation program savings. The government directed the OPA and OEB to establish a new framework for electricity conservation and demand management (CDM) programs between 2015 and 2020. Under this framework, electricity distributors must make CDM programs available to all customers to reduce consumption by 7 terawatt-hours (TWh). This target will require LDCs to conserve an average annual incremental savings of 1.2 TWh of electricity in each of the 6 years, which is more than double what was achieved under the previous 2011-2014 CDM Framework.

  The 2015-2020 framework incorporates several lessons learned from the 2011-2014 framework. LDCs will assume a more prominent role and will create CDM plans comprised of province-wide programs jointly designed by the OPA and distributors, and custom programs solely designed by an LDC and approved by the OPA. The OEB's role in the facilitation of LDC conservation program delivery is substantially reduced by the 2015-2020 framework; the Board will no longer be responsible for custom program approval but will publish LDC annual program results. The OPA will complete a mid-term review of the framework in 2017.

  Conservation programs offered under the framework must be cost-effective (with certain exceptions). Calculation of conservation program cost-effectiveness must include a 15 per cent adder to account for the environmental, economic and social (i.e., non-energy) benefits of conservation. The adder should enable more potential CDM programs to meet the framework's cost-effectiveness requirements. The Ministry's decision to account for non-energy benefits in the calculation of cost-effectiveness is laudable and in line with best practices in other jurisdictions.

1.2 Purpose

This report is intended to serve three (3) distinct but interrelated purposes, namely:

- to satisfy a regulatory requirement under the 2015 – 2020 CDM delivery framework for submission of an LDC-specific CDM Plan,
- as one of several reference documents that will be used by the Ontario Power Authority (OPA) within its *Integrated Regional Resource Planning* (IRRP) process in the development of a resource plan for the London area region, and
- as a companion document to the City of London's *Community Energy Action Plan*.

These objectives are outlined in the subsections below.

[2] Environmental Commissioner of Ontario report: *Planning to Conserve – 2014 Annual Energy Conservation Progress Report*; January 2015; page 4.

1.2.1 London Hydro's 2015 – 2020 CDM Delivery Plan

The Minister of Energy's March 31, 2014 directive entitled: *2015 – 2020 Conservation First Framework*, defines the CDM delivery framework for the next six (6) years. Specific passages that relate to a Distributor CDM Plan have been replicated following for convenience of reference:

1.2 The OPA shall provide support to Distributors to assist then in submitting their CDM Plans, as outlined in Section 3, to the OPA no later than May 1, 2015 for approval. …

:

1.5 The OPA shall establish a budget allocation for each Distributor in consideration of the Distributor CDM Target and CDM Plan as outlined in sections 2.2 and 3.

3.4 The OPA shall require each Distributor to submit a CDM Plan to the OPA for approval.

3.5 The OPA shall establish a streamlined review and approval process for Distributor CDM Plans and proposals for Province-Wide Distributor CDM Programs and Local Distributor CDM Programs. To facilitate this process, the OPA in consultation with Distributors, shall establish guidelines that include rules relating to the streamlined review and approval of CDM Plans and proposals for Province-Wide Distributor Programs and Local Distributor CDM Programs. In establishing such guidelines, the OPA shall have regard to the following objectives in addition to such other factors as the OPA considers appropriate:

i. Distributor CDM Plans must provide a description of how the Distributor will achieve its Distribution CDM Target, including but not limited to, a description of the Distributor's year-by-year plan, including milestones for achieving its Distributor CDM Target, a description of Province-Wide Distributor CDM Programs and any Local Distributor CDM Programs, and projected budgets and electricity savings by sector.

ii. The OPA shall establish a service standard of no more than 60 days for review and approval of Distributor CDM Plans and program. Any request by the OPA for additional information during its review will cause the remaining period of approval to be paused and shall resume at such time as the request is satisfied.

:

v. The OPA shall ensure that there is a positive benefit-cost analysis of each CDM Plan and each Province-Wide CDM Program and Local Distributor CDM Program using the OPA's Total Resource Cost Test and the Program Administrator Cost Test found in the OPA's Cost-Effectiveness Guide, dated October 15, 2010 (OPA Cost-Effectiveness Tests), which many be updated by the OPA from time to time. …

:

vi. The OPA shall, despite section 3.5 (v), allow Distributors to apply to the OPA for approval of Province-Wide Distributor CDM Programs and

Local Distributor CDM Programs where cost effectiveness is not demonstrated if the program is:

a) targeted to on-reserve First Nation customers
b) designed for educational purposes
c) a low-income program

:

ix. The OPA shall allow Distributors to propose changes and modifications to its CDM Plan on an annual basis or more frequently.

These principles are articulated in the template Energy Conservation Agreement (ECA).

1.2.2 An Input to the London Area Region Integrated Resource Plan

An integrated resource plan, or IRP, is a utility plan for meeting forecasted annual peak and energy demand, plus some established reserve margin, through a combination of supply-side and demand-side resources over a specified future period. Steps taken in the creation of an IRP include:

- forecasting future loads,
- identifying potential resource options to meet those future loads,
- determining the optimal mix of resources based on the goal of minimizing future electric system costs,
- receiving and responding to public participation (where applicable), and
- creating and implementing the resource plan.

Integrated resource planning has many benefits to consumers and other positive impacts on the environment. This is a planning process that, if correctly implemented, locates the lowest practical costs at which a utility can deliver reliable energy services to its customers. IRP differs from traditional planning in that it requires utilities to use analytical tools that are capable of fairly evaluating and comparing the costs and benefits of both demand- and supply-side resources. The result is an opportunity to achieve lower overall costs than might result from considering only supply-side options. In particular, the inclusion of demand-side options presents more possibilities for saving fuel and reducing negative environmental impacts than might be possible if only supply-side options were considered.[3]

Since its inception in 2005, the Ontario Power Authority (OPA) has been carrying out regional planning activities to address bulk and regional supply adequacy and reliability needs.

[3] Synapse Energy Economics report: *Best Practices in Electric Utility Integrated Resource Planning - Examples of State Regulations and Recent Utility Plans*; Rachel Wilson and Bruce Biewald; June 2013. Document available at URL:: www.raponline.org/document/download/id/6608

In October 2012, the Ontario Energy Board released a report entitled *Renewed Regulatory Framework for Electricity: A Performance-Based Approach (RRFE)*. The RRFE Board Report was the result of a consultation process aimed at promoting the cost-effective development of electricity infrastructure through coordinated planning on a regional basis.

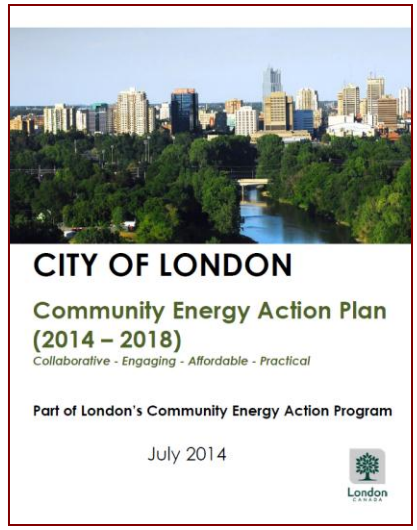
The regional planning process begins with a needs assessment performed by the transmitter, which determines whether a regional plan is required or not. If a regional plan is required, the OPA then conducts a scoping assessment to determine whether a more comprehensive Integrated Regional Resource Plan is required (led by the OPA), or a more transmission- and distribution-focused Regional Infrastructure Plan is required (led by the transmitter).

The province is divided into twenty-one (21) electricity planning regions. The London Area region includes the franchise service territories of the distributors listed below:

- Entegrus Power Lines Inc. (Middlesex)
- Erie Thames Power Lines Corporation
- Hydro One Networks Inc.
- London Hydro Inc.
- Norfolk Power Distribution Inc.
- St. Thomas Energy Inc.
- Tillsonburg Hydro Inc.
- Woodstock Hydro Services Inc.

Energy conservation is a demand-side resource and this document is intended to identify the potential electrical energy savings and demand reductions likely to be achieved within London Hydro's franchise service territory throughout the 2015 to 2020 timeframe. As such, this document will serve as but one of the inputs to the Integrated Resource Plan for the London area region.

1.2.3 A Companion to the London Community Energy Action Plan



The overall goals of London's *Community Energy Action Program* are to:

1. Increase the local economic benefit of sustainable energy use through:
   a. Cost savings from energy conservation and energy efficiency,
   b. Revenue from local production of clean & green energy products, and
   c. Job creation associated with product and service providers engaged in these activities.
2. Reduce the environmental impact associated with energy use, through the use of greenhouse gas emission reduction targets consistent with the Province of Ontario's goals, namely:
   a. 6 percent reduction in total greenhouse gas emissions from 1990 levels by 2014,
   b. 15 percent reduction in total greenhouse gas emissions from 1990 levels by 2020, and
   c. 80 percent reduction in total greenhouse gas emissions from 1990 levels by 2050.

The Community Energy Action Plan correctly notes:

> *The Corporation of the City of London does not have a lot of direct control over how much energy is used in London, but it does have a lot of influence. The control over energy use in London rests primarily with our citizens, visitors, employers and employees. Individual and collective action with respect of sustainable energy use, energy management, and energy conservation is the key to our future.*

This document serves as a companion to London's Community Energy Action Plan to show London Hydro's contributions (with respect to the conservation of electrical energy) to the overall goals of the community.

1.3 Scope

This scope of this document is:

- Providing background information to assist the reader in understanding the derivation of the CDM targets assigned to London Hydro;
- Providing the reader with insight into the past performance of various provincial CDM programs within London Hydro's franchise service territory as a predictor of future performance;

- Predicting the gap between London Hydro's assigned CDM targets and describing the new (local or regional) CDM programs that London Hydro plans to introduce to address the gap and thereby achieve its assigned CDM targets;
- Setting forth a methodology for predicting the summer and winter peak reductions anticipated (with respect to electricity procurements from the provincial transmission grid and interconnection facilities, such as transformer station) with attainment of the assigned CDM targets. This insight is necessary for system planning professionals involved in the Regional Integrated Supply Planning process.
- Finally, providing local insight and commentary on the perceived accuracy and shortcomings of the various *Achievable Potential* studies [Ref 2, 3, 4] that may be useful in informing future Achievable Potential studies (that need to be updated by the OPA every 3 years pursuant to clause 6.2 within the Minister's March 31st, 2014 directive).

1.4 Documentation Structure

The overall CDM Plan spans three (3) documents as described following:

- This Volume 1 – *Articulation of the Vision*, identifies London Hydro's assigned CDM targets for the 2015 – 2020 CDM framework; and indicates the manner in which these targets are anticipated to be achieved, both via the continuation of provincial CDM programs complimented by the introduction of new local or regional CDM programs.
- Volume 2 – *Resource & Funding Budget* – identifies the resources that London Hydro believes is necessary to deliver the various CDM programs, various management intentions (e.g. ongoing skills development plan, internal change management, etc.), a budget projection to fund CDM delivery, and finally the cost effectiveness of London Hydro's plan.
- Volume 3 – *Tillsonburg Hydro's CDM Plan*, indicates the CDM programs that London Hydro will deliver under a partnership arrangement with Tillsonburg Hydro within that franchise service territory in a cost-effective manner.

1.5 References

[1] Ontario Energy Board publication: *2013 Yearbook of Electricity Distributors*; published on August 14, 2014.

[2] ICF Marbek report: *Achievable Potential - Estimated Range of Electricity Savings Through Future Ontario Conservation Programs - Residential Sector - Final Report*; March 26, 2014.

[3] ICF Marbek report: *Achievable Potential - Estimated Range of Electricity Savings Through Future Ontario Conservation Programs - Commercial Sector - Final Report*; March 26, 2014.

[4] ICF Marbek report: *Achievable Potential - Estimated Range of Electricity Savings Through Future Ontario Conservation Programs - Industrial Sector - Final Report*; March 26, 2014

1.6 Terminology

The definitions given below are not intended to embrace all legitimate meanings of the terms. They are applicable to the subject matter treated in this report.

Achievable Potential Forecast is a study or assessment of the estimated range of electrical energy savings attainable through programs that encourage the adoption of energy-efficient technologies, taking into consideration technical, economic, and market constraints. Such studies generally recognize that new technology does not replace existing equipment instantaneously or prematurely, but rather is "*phased-in*" over time as existing equipment reaches the end of its useful life.[4]

There are a variety of types of potential studies, as outlined below.

- ***Technical Potential*** represents the savings due to energy efficiency and demand response programs that would result if all homes and businesses adopted the most efficient, commercially available technologies and measures, regardless of cost. Technical Potential provides the broadest and largest definition of savings since it quantifies the savings that would result if all current equipment, processes, and practices in all sectors of the market were replaced at the end of their useful lives by the most efficient available options. Technical Potential does not take into account the cost-effectiveness of the measures.
- ***Economic potential*** represents the savings due to programs that would result if all homes and business adopted the most efficient, commercially available, cost-effective measures. It is a subset of the Technical Potential and is quantified only over those measures that pass a widely recognized economic cost-effectiveness screen. The cost-effectiveness screen often applied is a variation of the Participant Test, which compares the incremental cost to a consumer of an efficient technology relative to its baseline option, and the bill savings expected from that technology over its useful life. Only those technologies for which the net present value of benefits exceeds its incremental cost to consumers pass the test.

In the Ontario context Economic Potential is subdivided into two categories by taking into account various barriers to customer adoption, namely:

- ***Upper Achievable Potential*** — takes into account market, societal, and attitudinal barriers that limit customer participation in utility- or government- administered voluntary programs. These barriers reflect, among other phenomena, customers' resistance to doing more than the absolute minimum required or a dislike of a

[4] Electric Power Research Institute (EPRI) report 1018363, *Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010–2030) - Executive Summary*; January 2009. Document available at URL:: http://www.edisonfoundation.net/iee/Documents/EPRI_SummaryAssessmentAchievableEEPotential0109.pdf

given efficiency option. Upper achievable potential presumes no impediments to the effective implementation and delivery of programs, such as perfect information, and essentially extrapolates the impacts of the best run, most effective programs throughout the continent.

- ***Lower Achievable Potential*** — discounts the Upper Achievable Potential by taking into account impediments to program implementation, including financial, political, and regulatory barriers that are likely to limit the amount of savings that might be achieved through energy efficiency and demand response programs. Lower Achievable Potential considers recent utility experience and reported savings, and as such represents a forecast of likely customer response to programs.

Energy Conservation Agreement is a document that sets out the contractual relationship between the Ontario Power Authority and each Local Distribution Company under the new Conservation First Framework.

Interactive Effects means the energy impacts to one system resulting from changes made to another building system. Reduced lighting loads, for example, can reduce air conditioning energy consumption (a cooling bonus), but increase heating consumption (a heating penalty)

Local improvement charge is a mechanism available to municipalities, to recover the costs of capital improvements made on public or privately owned land from property owners who will benefit from the improvement. If a property owner sells their property before the local improvement charges are fully paid off, the new property-owner assumes responsibility for making the remaining payments.

Note: In October 2012, the Ministry of Municipal Affairs and Housing made regulatory changes that enable Ontario municipalities to use Local Improvement Charges (LICs) to finance energy retrofits on private property. In effect, the LIC can act as a loan from the municipality to the homeowner, recovered by the municipality in installments through the property tax administrative system over many years.

Re-commissioning (also referred to as ***retro-commissioning***) is a systematic process that identifies low-cost operational and maintenance improvements in existing buildings and equipment that brings the buildings and equipment up to the design intentions of its current usage. It focuses on optimizing existing system performance, rather than relying on major equipment replacement.

Standby power consumption (also called vampire power, vampire draw, phantom load, or leaking electricity) is electrical power used by appliances and equipment while switched off or not performing their primary function, often waiting to be activated by a remote controller. That power is consumed by internal or external power supplies, remote control receivers, text or light displays, circuits energized when the device is plugged in even when switched off, etc.

1.7 Acronyms, Abbreviations and Symbols

1.7.1 Acronyms

Acronyms used in this report are presented following in alphabetic order:

BPS	=	Broader Public Sector
CDM	=	Conservation and Demand Management
CIS	=	Customer Information System
ECA	=	Energy Conservation Agreement
EMIS	=	Energy Management Information System
EM&V	=	Evaluation, Measurement and Verification
GEGEA	=	Green Energy and Green Economy Act, 2009
IESO	=	Independent Electricity System Operator
IoT	=	Internet of Things
IRP	=	Integrated Resource Plan
IRRP	=	Integrated Regional Resource Planning
LDC	=	Local Distribution Company
LIC	=	Local Improvement Charge
LPMA	=	London Property Management Association
MURB	=	Multi-Unit Residential Building
MUSH	=	Municipalities, Universities/Colleges, Schools, and Hospitals
M2M	=	Machine to machine
NAICS	=	North American Industry Classification System
OPA	=	Ontario Power Authority (now amalgamated with IESO pursuant to Schedule 7 of Ontario Bill 194)
PCT	=	Programmable Communicating Thermostat
PTAC	=	Packaged Terminal Air Conditioner
RCx	=	Retro-commissioning
RRFE	=	Renewed Regulatory Framework for Electricity
TOU	=	Time-of-Use

1.7.2 Abbreviations

Abbreviations used in this report are presented following in alphabetic order:

GWh	=	Gigawatt-hour
kW	=	kilowatt
kWh	=	kilowatt-hour
MW	=	Megawatt
MWh	=	Megawatt-hour
TWh	=	Terawatt-hour

These abbreviations are consistent with CSA Standard Z85-1983, *Abbreviations for Scientific and Engineering Terms*.

2 LONDON HYDRO'S CDM TARGET

This section identifies London Hydro's net energy reduction target within the 2015 – 2020 CDM delivery framework and provides a synopsis of the methodology used to develop this LDC-specific target.

2.1 Collective Target Set Forth in the Minister of Energy's Directive

The Minister of Energy's March 31, 2014 directive entitled: *2015 – 2020 Conservation First Framework*, defines the CDM delivery framework for the next six (6) years. Specific passages that relate to a Distributor CDM targets have been replicated following for convenience of reference:

> *Therefore, pursuant to my authority under section 25.32 of the Act, I hereby direct the OPA to coordinate, support and fund the delivery of CDM programs through Distributors to achieve a total of 7 TWh of reductions in electricity consumption between January 1, 2015 and December 31, 2020 in accordance with the following guiding principles and requirements.*

Note that the foregoing target is not a "*cumulative net*" energy reduction target, but rather a "*net*" energy reduction target, which is a change from the 2011 – 2014 CDM delivery framework. This basically means that the LDC community could achieve 7 TWh in the first year and nothing in the remaining 5 years, nothing in the first 5 years and all 7 TWh in the sixth year, or 1.16 TWh in each of the six years, and in all cases meet the collective CDM target.

2.2 LDC-Specific CDM Targets

2.2.1 CDM Target Expectation

Clause 2.1 of the Minister of Energy's directive has been replicated below for convenience of reference:

> *2.1 The OPA, in consultation with Distributors, shall develop an allocation methodology to allocate the full 7 TWh among Distributors. The allocation methodology may take into consideration Distributor CDM potential as a local and/or regional level as identified in the OPA's 2014 energy efficiency achievable potential study, and other factors as appropriate.*

As a rough estimate of London Hydro's portion of this provincial target, the *Yearbook of Electricity Distributors* [Ref 1] reveals that:

- The total energy delivered by all LDC's: ....119,995,730,310 kWh
- The total energy delivered by London Hydro:...............3,251,924,158 kWh

Note: Both energy delivery quantities above exclude losses.

From a simple apportioning approach, London Hydro's portion of the provincial 7 TWh target is:

$$\frac{3{,}251{,}924{,}158\ kWh}{119{,}995{,}730{,}310\ kWh} \times 7{,}000{,}000{,}000\ kWh$$

Thus London Hydro's 6-year energy reduction target is 189,702,326 kWh or 31,617,054 kWh per year (i.e. 31.6 GWh per year).

Note: Under the 2011 – 2014 CDM delivery framework, London Hydro's accumulated net energy savings target was 156.640 GWh.[5] If this target had been achieved equally over the 4-year timeframe then the annual target would have been 15.6 GWh/year.

As a general observation, the annual LDC-specific energy targets under the 2015 – 2020 CDM delivery framework will be about double annual targets under the current 2011 – 2014 CDM delivery framework.

The actual target setting methodology is necessarily more complex than the simple apportioning method noted above. To provide equity, it has to consider the nature of the LDC (i.e. largely urban versus rural customers), so-called "*bedroom communities*" with no industrial or large commercial customers, opportunity saturation due to previous energy-efficiency successes, etc.

Note: Throughout the province are numerous largely industrial customers with such large loads that they are supplied directly from the provincial transmission system, and hence are referred to as "*transmission-connected customers*". Such transmission-connected customers can access the Ontario Power Authority's *Industrial Accelerator Program* directly. The target net energy savings over the 2015 – 2020 timeframe is 1.7 TWh.[6]

2.2.2 Actual CDM Target

The actual methodology for allocating CDM targets amongst the community of LDC's is somewhat more complex than indicated in Section 2.2.1 above.

The starting point is the achievable potential studies [Ref 2, 3 and 4] wherein the province was divided into ten (10) zones (for compatibility with the End-Use Forecast model), whereas as previously noted in Section 1.2.2 herein, the province is divided into twenty-one (21) zones for the purposes of regional supply planning.

For the purposes of the "*achievable potential*" studies, London Hydro is in the "*west*" zone that also includes:

- Bluewater Power Distribution Corp.
- E.L.K. Energy
- Hydro One Networks Inc.
- St. Thomas Energy

[5] Ontario Energy Board Decision and Order EB-2010-0215 / EB-2010-0216, *CDM Targets for Licensed Electricity Distributors*, dated November 12, 2010.

[6] Ministry of Energy directive to Ontario Power Authority, dated July 25, 2014; re: *Industrial Accelerator Program*. Electronic version posted on Ontario Power Authority website at URL:: http://www.powerauthority.on.ca/sites/default/files/news/Jul-25-14-Industrial-Accelerator-Program.pdf

- Entegrus Power Lines Inc.
- EnWin Utilities Ltd.
- Essex Powerlines Corp.
- Tillsonburg Hydro Inc.
- Woodstock Hydro Services Inc.

The "west" zone is illustrated in Figure 2-1 below.

Figure 2-1, IESO Zones Used in Achievable Potential Study

Note: Hydro One Networks Inc. is an interesting anomaly. As primarily a "*rural*" electricity distributor, it has a facilities and customers in every "*zone*" within the province.

The 3-step "*target allocation*" methodology is illustrated in Figure 2-2 below:[7]

	Step #1: Distribute 7 TWH across by 10 IESO zones and sector based on AP Study		**Step #2**: Determine LDC's Share of Sector-Level Consumption by IESO Zone using 2012 OEB Yearbook data						**Step #3**: Allocate CDM Target based on LDC's share of sector-load by IESO Zone	
	Provincial CDM Sector-Level Targets (GWh)		*2012 Residential Energy Consumption (GWh)*			*2012 Non-Residential Energy Consumption (GWh)*			*Allocation of CDM Targets (GWh)*	
IESO Zone	**Res**	**Non-Res**	LDC Data	IESO Zone	Share %	LDC Data	IESO Zone	Share %	Res	Non-Res
BRUCE	4	8		116			127			
EAST	148	234		3,859			4,434			
ESSA	174	231		3,400			4,074			
NIAGARA	67	180	422	1,422	30%	981	2,449	40%	19.9	72.1
NORTHEAST	119	76		2,387			2,581			
NORTHWEST	52	52		879			1,127			
OTTAWA	235	278		3,399			6,219			
SOUTHWEST	452	863	1,238	7,996	15%	2,875	14,701	20%	69.9	168.8
TORONTO	929	2,200		12,786			35,539			
WEST	234	463		4,102			7,448			
Total	**2,415**	**4,585**	**1,661**	**40,344**		**3,856**	**78,700**		**89.8**	**240.9**
Provincial Total CDM Target		**7,000**						LDC's Total CDM Target		**330.7**
								Share of Provincial Target		**4.7%**

Distribute 7 TWh by IESO Zone

Distribute LDC's share of consumption by sector and zone to determine LDC's share of load within each Zone

Multiply LDC's share of load by IESO Zone target

Figure 2-2, Illustration of Target Allocation Methodology

[7] Ontario Power Authority document: *Target and Budget Allocation Methodology*; Conservation First Framework – LDC Toolkit; Final V1; October 31, 2014.

The steps are described below:

- Step #1: The provincial 7 TWh CDM target is first distributed across the 10 IESO zones based on the "*residential*" and "*non-residential*" opportunities identified in the achievable potential study. It can be seen from Figure 2-2 above that the 234 GWh of residential electricity savings and 463 GWh of non-residential electricity savings have been allocated to the "*west*" zone.
- Step #2: Determine LDC's share of residential and non-residential electricity consumption by zone using statistics from the OEB publication: *2012 Yearbook of Electricity Distributors*. It can be seen from Figure 2-2 above that the composite electricity consumption throughout the "*west*" zone by residential customers was 4,102 GWh and by non-residential customers was 7,448 GWh.

  Note: For LDC's such as Hydro One Networks that cross multiple zones, their 2012 Yearbook data is allocated proportional to that LDC's 2012 consumption by transformer station within each zone.
- Step #3: Allocate CDM Target based on LDC's share of sector-load by zone. For London Hydro, the 2012 Yearbook of Electricity Distributors,[8] shows:

Table 2-1, 2012 Electricity Sales Data for London Hydro

Customer Class	Billed kWh
Residential	1,103,889,962
Non-Residential:	
▪ General Service < 50 kW	400,003,533
▪ General Service > 50 kW & Large User	1,717,827,442
▪ Unmetered Scattered Load Connections	5,600,414
Non-Residential Total:	2,123,431,389

As such, London Hydro's CDM target allocation can be calculated as:

$$\text{CDM target} = 234\text{ GWh x } \frac{1{,}103\ GWh}{4{,}102\ GWh} + 463\text{ GWh x } \frac{2{,}123\ GWh}{7{,}448\ GWh}$$

$$= 195\text{ GWh}$$

London Hydro's CDM target for the 2015 – 2020 CDM delivery framework is 196.66 GWh.[9]

Note: The difference between the two numbers (i.e. the estimated and assigned CDM target) is small and likely attributable to rounding errors, i.e. the values given in Figure 2-2 are likely rounded (in the conversion from kWh to GWh).

Although CDM targets are allocated based on residential and non-residential consumption, LDC's are responsible for achieving only the total CDM target, i.e. the entire 196.66 GWh target could be achieved entirely in the residential sector, or entirely in the non-residential sector, or the more likely case being some combination thereof.

[8] Ontario Energy Board publication: *2012 Yearbook of Electricity Distributors*; August 22, 2013; page 89.

[9] Ontario Power Authority document: *Conservation First Framework LDC Tool Kit Final v1 - October 31, 2014*.

3 RESIDENTIAL SECTOR SITUATION ANALYSIS

This section profiles the residential sector within London Hydro's franchise service territory, describes the outcome of energy conservation programs that have been operated in recent years, and provides insight into the remaining opportunities for new or continued energy conservation programs in the forthcoming years.

3.1 Characterization of London Hydro's Residential Sector

3.1.1 Residential Sector Demography

For convenience of reference, 2011 housing data for the London census metropolitan area presented in Table 3-1 below has been replicated from a recent Canada Mortgage and Housing Corporation publication.[10]

Table 3-1, Dwelling Unit Type and Tenure for London Census Metropolitan Area, 2011

Dwelling Type					Tenure	
All Dwellings	Single-Detached	Semi-Detached and Duplex	Row Housing	Apartment and Other	Owner-Occupied	Rental
195,055	56.8%	4%	10.4%	28.8%	66.7%	33.3%

The London census metropolitan area extends beyond the geographic boundaries of the city of London. Statistics Canada has an online data extract that is specific to the city of London for the census year 2011.[11] For convenience of reference, this data (and specifically Table 11) is replicated in Table 3-2 below.

Table 3-2, Distribution of Households by Structural Type of Dwelling for London

Total	Single-detached house	Semi-detached house	Row house	Apartment building with 5 or more storeys	Apartment building with fewer than 5 storeys	Duplex	Other single-attached house	Moveable dwelling
153,630	77,860	5,860	19,085	30,935	15,620	3,965	150	160
100%	50.7%	3.8%	12.4%	20.1%	10.2%	2.6%	0.1%	0.1%

[10] Canada Mortgage and Housing Corporation publication: *Housing and Market Information; CHS – Demography, 2013*; Released June 2014.

[11] Statistics Canada website; 2011 Census –Analytic Products - Census subdivision of London, CY – Ontario; see URL: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3539036

The value of Table 3-1 is that it provides insight into the ratio of "*owner occupied*" dwelling units to "*rental*" units. Implementing energy-efficiency measures in "*rental*" units is often challenging – the landlord often isn't responsible for tenant's utility bill and hence doesn't realize a return for investments in energy-efficiency.

According to the *2011 Yearbook of Electricity Distributors*,[12] London Hydro had 134,714 residential customers in 2011. The discrepancy between this number and the 153,630 dwelling units shown in Table 3-2 is due to multi-unit residential buildings (i.e. apartment buildings). London Hydro has historically offered the developer the choice of a bulk metering or tenant metering arrangement. As such an apartment building with 100 individually metered suites would be identified as 100 residential customers, whereas the same building with a bulk metering arrangement would be identified as one (1) commercial service.

3.1.2 The Declining Trend in Residential Energy Consumption

The red line in Figure 3-1 shows the average monthly billed energy consumption (in kWh) per residential customer over the timeframe from 2006 to 2013. It will be seen that in 2006 the average monthly billed energy consumption was 717 kWh and in 2013 the average monthly billed energy consumption declined to 663 kWh.

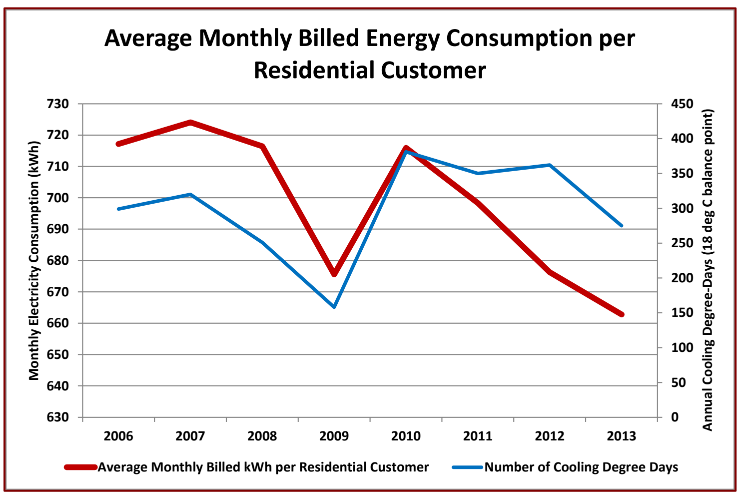


Figure 3-1, Trends in Residential Energy Consumption

As with most LDC's in southwestern Ontario, air conditioning has a significant impact on summer energy sales. The blue line in Figure 3-1 shows the number of cooling degree-days (using an 18°C balance point) for each of the years. It will be observed that 2009 was characterized by an unseasonably cool summer and hence energy sales were significantly lower than in other years.

It is interesting to note that 2010, 2011 and 2012 can be characterized as having hot summers with 350 or greater cooling degree-days, and yet the average monthly billed

[12] Ontario Energy Board publication: *2011 Yearbook of Electricity Distributors*; September 13, 2012; pg 61

energy consumption throughout this period steadily decreased from 716 kWh per month in 2010 to 698 kWh per month in 2011 to 676 kWh per month in 2012.

So not only are residential customers becoming more energy-efficient in general, the relationship between energy consumption and extreme weather is becoming weaker (likely due to higher Seasonal Energy-Efficiency Ratings of newer air conditioners as there is a turn-over in the marketplace).

3.2 Review of Energy-Efficiency Achievements to Date

In the residential sector, energy-efficiency occurs via three (3) distinct channels, namely:

- Updates to codes and standards –

  Two (2) recent examples of updates to codes and standards that impact household energy-efficiency (within Ontario) are:

  - The Ontario Minister of Municipal Affairs and Housing's publication entitled: Supplementary Standard SB-10, *Energy Efficiency Supplement*, dated July 1, 2011, amended the 2006 edition of the Ontario Building Code and came into effect for all buildings constructed after December 31, 2011. Specifically:
    - The energy-efficiency performance (of the building envelope) that was formerly associated with an ENERGY STAR qualified building or dwelling unit became the baseline requirement of the Ontario Building Code.
    - As of January 1, 2015, all furnaces installed in new-construction homes need to be equipped with an electronically commutated motor (ECM) for the air circulation blower fan.
  - The federal government phase-out of incandescent light bulbs.

    Canada announced it would improve lighting efficiency in 2008 in an amendment to regulations in the Energy Efficiency Act. With this revision, the standards will allow only light bulbs that use at least 28 percent less electricity than the traditional incandescent bulb (e.g. incandescent halogen lamp, light-emitting diodes, and compact fluorescent lamps) to be manufactured or imported into Canada. To achieve alignment with other jurisdictions, Amendment 12B subsequently delayed the phase-in dates as follows:
    - January 1, 2014 for 75 and 100 watt incandescent bulbs; and
    - December 31, 2014 for 40 and 60 watt incandescent bulbs.

    In the marketplace, CFL's are now commonplace and have passed the "*tipping point*" with respect to consumer acceptance, and LED's are new market entrants quickly gaining momentum.

  Such updates to codes and energy-efficiency performance standards have an immediate effect for new homes and new appliance purchases, but a much longer implementation period in the replacement marketplace. For example, although the requirement for an energy-efficient ECM furnace blower motor comes into effect on January 1, 2015, furnaces with traditional blower motors that were installed prior to this date will not generally need to be upgraded until natural turn-over occurs, i.e. the existing furnace fails and needs to be replaced with a new furnace (which could well be ten years or so after the effective date for the new regulation).

- Natural conservation due to technological progress –

  Modern flat-panel television sets and computer monitors, based on LED backlighting technology, deliver vibrant colors and good contrast. The maturity of the technology has resulted in plunging marketplace prices and consequently high consumer demand. Coincidentally these flat-panel television sets and computer monitors consume significantly less energy than the cathode ray televisions and computer monitors that they replace.

  Note: It is difficult to find a definitive and credible source of information concerning the average household energy savings associated with such technological progress due to a number of factors that tend to confuse the matter. Modern flat-panel television sets tend to have a larger viewing surface than the CRT-based units they replace, and the average number of televisions per household has increased. Conversely, with home computer systems, there is a transition away from a workstation to smaller portable computing devices such as the Apple iPad®. It is probably safe to suggest that the average household energy consumption associated with home entertainment systems is less than half of what it was a decade ago.

  Similar advances have been made with respect to white goods. For example, with electrically-heated clothes dryers, the timer has been replaced with a moisture sensor so that the appliance automatically shuts off when the clothes are dry, not after some arbitrary time period has elapsed.

- Energy conservation programs –

  Energy conservation programs, operated by utilities or government agencies, are intended to encourage residential consumers to implement an energy-efficiency measure via an incentive or behavioral change via education.

  Over the 2011 to 2014 time period, there has been a portfolio of provincial energy-conservation programs available within the saveONenergy FOR HOME brand. The effect of these provincial CDM programs is further described in Section 3.2.2 herein.

The subsections that follow further describe other initiatives and their expected contribution to further decline in residential energy consumption in the forthcoming years.

3.2.1 Effect of Time-of-Use Electricity Pricing

The provincial Smart-metering program was intended to encourage residential and small business customers to shift their energy consumption from defined "*on-peak*" periods to the lower cost "*mid-peak*" and "*off-peak*" hours.

For convenience of reference, the following graphic has been replicated from London Hydro's Annual CDM Report for 2012.[13]

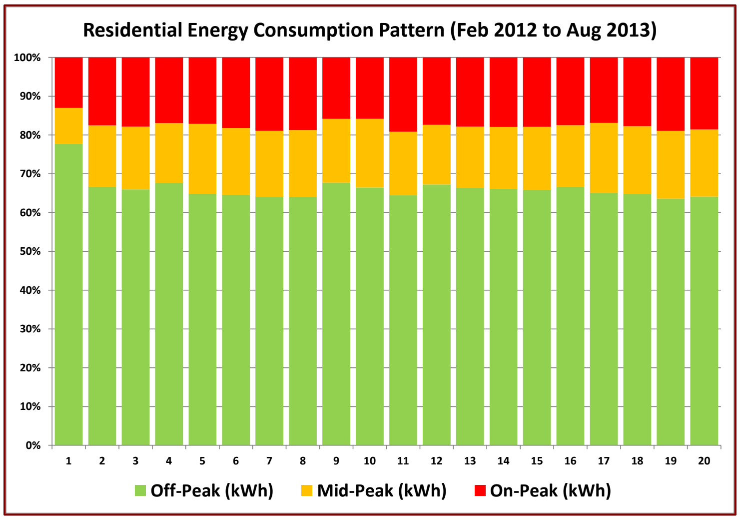


Figure 3-2, Residential Energy Consumption Pattern

It can be observed from Figure 3-2 that, for the residential sector, the proportion of on-peak consumption (as depicted by the "*red*" segment on the stacked bar graph) has remained relatively constant at about 17.7%. Clearly no discernible load shifting by residential customers is occurring.

Note: The Ontario Energy Board and Ontario Power Authority each engaged consulting firms to carry out more sophisticated statistical analyses of the effect of Smart-meters and time-of-use electricity rates.[14] [15]

Both studies compare the electricity consumption patterns of residential and small business customers before and after the introduction of TOU pricing, controlling for the effect of other variables that might influence electricity consumption. The OPA study is based on data from more than 100,000 customers from four local distribution companies (LDCs), while the OEB study uses data from 14,000 customers from 16 LDCs.

Both studies conclude that, despite the small difference between on-peak and off-peak prices, TOU pricing has had a small but definite impact in leading residential electricity consumers to shift some of their consumption away from periods of peak demand. The OPA estimates1 reductions in residential electricity consumption during the summer "on-peak" period (weekdays from 11 am to 5 pm) ranging from 2.8% to 5.6% among the 4 LDCs in its study. The OEB estimates a reduction in residential consumption of 3.3% in summer on-peak hours …[16]

[13] London Hydro Report EM-13-04, *Energy Conservation and Demand Management – Annual Report of London Hydro's 2012 Activities & Achievements*; September 2013; Section 2.1.3.2, *The Shifting of Electricity Usage*; pg 11.

[14] Navigant report entitled: *Time of Use Rates in Ontario; Part 1: Impact Analysis*; prepared for the Ontario Energy Board; December 20, 2013.

[15] The Brattle Group report entitled: *Impact Evaluation of Ontario's Time-of-Use Rates: First Year Analysis*; prepared for Ontario Power Authority; November 26, 2013

[16] Environmental Commissioner of Ontario blog posting: *Is Time-of-Use Pricing Reducing Ontario's Electricity Demand?*; January 15, 2014. See URL:: http://www.eco.on.ca/blog/2014/01/15/time-use-pricing-reducing-ontarios-electricity-demand/

Aside from the adage from social science that "*information by itself rarely motivates*",[17] Deloitte's most recent annual predictions[18] concerning the *Internet of Things* (IoT) offers an interesting perspective replicated below for convenience of reference:

> *Finally, the powerful customization and data analysis that is possible through IoT is not of interest to most customers: they are not looking for numbers, they are looking for insights. Even then, behavior is a limiting factor: humans are resistant to modifying their behavior to fit with systems; they prefer that systems adapt to meet their needs with minimal change in human behavior. As an example, an electrical utility installed smart meters in millions of homes, expecting that (among other benefits) consumers could look at an online dashboard of their monthly usage, and modify their behavior to save money and benefit the environment. Three years after the meters were deployed, about six percent of households had viewed the dashboard at all, and fewer than two percent had done so more than once.*

3.2.2 Effect of Provincial Incentive Programs

This section examines the provincial incentive-based CDM programs that were in-market for the 2011-2014 time period, what each program has achieved within London Hydro's franchise service territory, and some commentary as to whether the program has "*run its course*" or could be continued perhaps with some tweaking.

3.2.2.1 saveONenergy FRIDGE & FREEZER PICKUP Program

Residential customers with a fridge or freezer that is 15 years or older can have the OPA's provincial contractor pick the unit up for free from the customer's home and recycle the unit in an environmentally-friendly manner. Window air conditioners and dehumidifiers will also be picked up by the contractor if a refrigerator or freezer is being picked up.

Figure 3-3 below shows the annual results (in terms of numbers of refrigerated appliance pick-ups, as well as net annual demand reduction) of the saveONenergy FRIDGE & FREEZER PICKUP program within London Hydro's franchise service territory.

[17] *Motivating Home Energy Action - A handbook of what works*; Michelle Shipworth; April 2000 - for the Australian Greenhouse Office; *Information by itself rarely motivates action*; page 55.

[18] Deloitte, Touche Tohmatsu Ltd. publication: *Technology, Media & Telecommunications Predictions – 2015*; page 7. Document available in electronic format at URL:: http://www2.deloitte.com/content/dam/Deloitte/ru/Documents/technology-media-telecommunications/ru_tmt_predictions_2015_full_report_eng.pdf

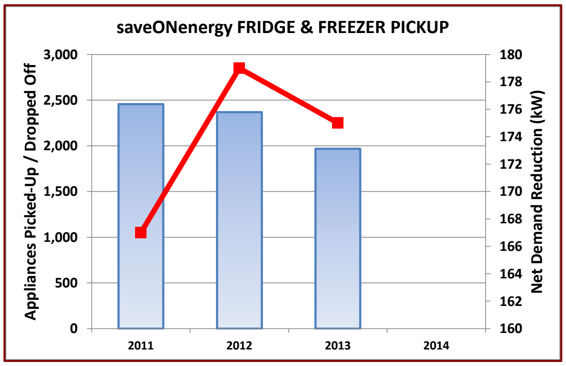


Figure 3-3, Participation in FRIDGE & FREEZER PICKUP Program

Although not shown in the graphic, the net annual energy savings associated with this program is about 700 MWh. This is about 360 kWh per refrigerated appliance.

Note: For the saveONenergy HOME ASSISTANCE program that is operated by London Hydro (refer to Section 4 herein), the FRIDGE & FREEZER PICKUP program is an integral operating element. For participants that qualify for a new energy-efficient refrigerator, London Hydro has the provincial contractor drop off a new refrigerator and pick-up the old refrigerator. The refrigerators replaced under the HOME ASSISTANCE program are not included in Figure 3-3 but rather the savings are accounted for in the HOME ASSISTANCE program.

Note: London Hydro's participation in the provincial FRIDGE & FREEZER PICKUP program may be very different from other jurisdictions. As a "*third tranche*" program, London Hydro ran its comprehensive and highly successful "*Chill Out London*" residential appliance recycling program wherein 14,463 refrigerators, freezers and room air conditioners were harvested. Given London Hydro's residential customer base at the time of 127,000 accounts, this represented an uptake in excess of 11%.[19]

As illustrated in Table 3-3 below,[20] with the passage of time and more stringent federal energy performance regulations, the saveONenergy FRIDGE & FREEZER PICKUP program becomes less valuable, i.e. the pickup and decommissioning costs are likely unchanged, but the energy consumption of 15-year old appliances is greatly diminished. For example, a 15-year old refrigerator picked up in 2005 would have been manufactured in or prior to 1990 with an annual electricity consumption of approximately 1,044 kWh/yr. By contrast, a 15-year old refrigerator picked up in 2016 would have been manufactured in or prior to 2001 with an annual electricity consumption of approximately 572 kWh/yr. Unless there is a significant increase in participation rate year-over-year to compensate of the decline in energy savings associated with harvested appliances, the program will gradually become less cost-effective as time progresses.

---

[19] London Hydro Report EM-12-04, *Energy Conservation and Demand Management – Annual Report of London Hydro's 2011 Activities and Achievements*; September 2012; Section 3.3.1.2, *saveONenergy FRIDGE & FREEZER PICKUP Participation Insight*; pg 26.

[20] Natural Resources Canada publication: *Choosing and Using Appliances with EnerGuide*; 2013; page 3. Document available in electronic format at URL:: http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/EnerGuideappliances.pdf

Table 3-3, Typical Major Appliance Energy Consumption

Residential Major Appliance	Average Annual Energy Consumption of New Major Appliances, kWh/yr			
	1990	1997	2001	2010
Refrigerators - standard	1,044	664	572	427
" - ENERGY STAR qualified	--	--	440	369
Freezers	658	342	337	295
Dishwashers - standard	1026	649	634	310
" - ENERGY STAR qualified	--	--	534	309

It is understood that the OPA intends to suspend the saveONenergy FRIDGE & FREEZER PICKUP program in early 2015 on the basis that it is no longer cost-effective as a provincial CDM program.

3.2.2.2 saveONenergy HEATING & COOLING INCENTIVE Program

Residential and small business customers are eligible for a rebate if they purchase and arrange for a participating HVAC contractor to replace central heating or cooling equipment with premium-efficiency units. A premium-efficiency unit would be a natural gas furnace with a high-efficiency blower motor (often referred to as an electronically-commutated motor or ECM blower motor) or a central air conditioner unit that is ENERGY STAR qualified.

Figure 3-4 below shows the annual results (in terms of numbers of upgraded central air conditioners and furnace blower motors, as well as net annual demand reduction) of the saveONenergy HEATING & COOLING INCENTIVES program within London Hydro's franchise service territory.

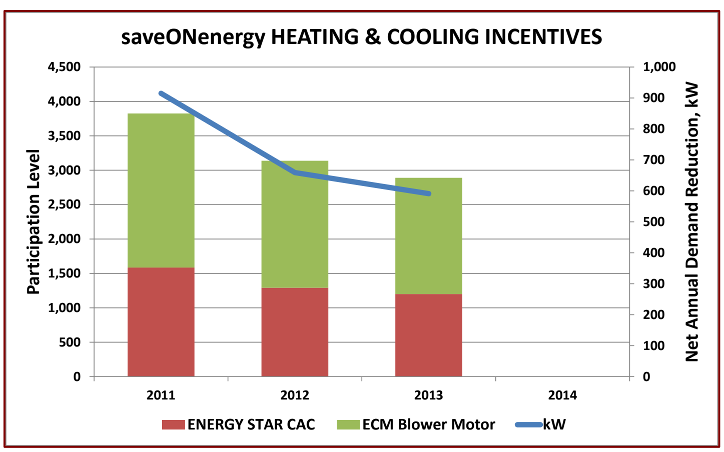


Figure 3-4, Participation in HEATING & COOLING INCENTIVE Program

Although not shown in the graphic, the net annual energy savings associated with this program is about 1,000 MWh.

This program provides incentives to participants that invest in central air conditioner systems that meet or exceed the ENERGY STAR performance requirements, and for natural gas fired furnaces with an energy-efficiency ECM blower motor. However, a recent change to the Ontario building code stipulates:[21]

Add new Article 12.3.1.4. as follows:

12.3.1.4 Residential Furnaces after December 31, 2014

(1) A space heating furnace serving a dwelling unit shall be equipped with an electronically commutated motor (ECM).

In time, the program will become less valuable as ECM blower motors become the baseline offering for all furnaces, both new and replacement. London Hydro intends to offset this diminishing program value by greater participation levels via the development of effective sales tools as outlined in Section 13.5 (starting on page 101 herein).

3.2.2.3 saveONenergy COUPON EVENT Program

Coupon events are held in both the Spring and Fall each year. Coupons provide discounts for the purchase of a variety of energy-efficient products (e.g. compact fluorescent lamps, weather stripping, hot water pipe wrap, timers, programmable thermostats for baseboard heaters, etc.) from participating retailers.

Figure 3-5 below shows the annual results (in terms of number of coupons redeemed, as well as net annual demand reduction) of the saveONenergy COUPON EVENT program within London Hydro's franchise service territory.

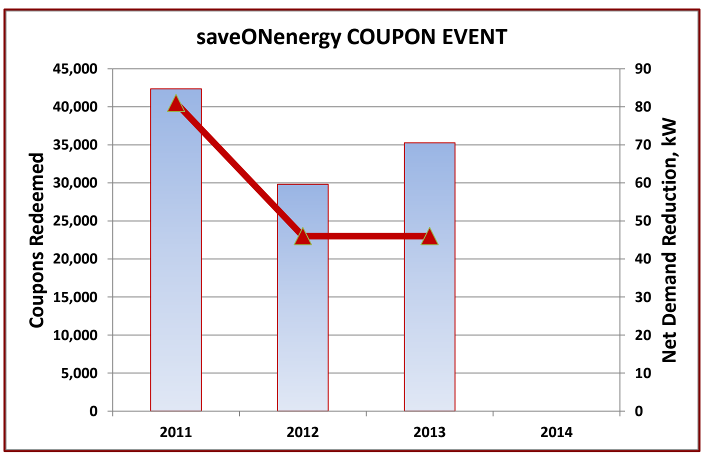


Figure 3-5, Participation in saveONenergy COUPON EVENT Program

Although not shown in the graphic, the net annual energy savings associated with this program is about 700 MWh. This is about 20 kWh per redeemed coupon.

[21] Ontario Ministry of Municipal Affairs and Housing publication E-B-12-03-01, *Proposed Change to the 2006 Building Code*; January 2011; Available in electronic format at URL:: http://www.mah.gov.on.ca/AssetFactory.aspx?did=8819

It is anticipated that the COUPON program will evolve in step with advances in technology, e.g. coupons to promote the adoption of CFL's will give way to coupons to promote the adoption of LED bulbs.

3.2.2.4 saveONenergy *peaksaver* PLUS Program

The *peaksaver* initiative involves the installation of a remotely-activated load control switch (by London Hydro's contractor) to control the operation of central air conditioners for short periods of time when there is a generation shortfall or constraint on the provincial transmission grid.

Participants in the program receive an in-home electricity monitor that provides near real-time feedback on the amount of electricity the participant is consuming at any particular time, and the amount of money the participant is spending on electricity consumption, based on the prevailing electricity rates.

Due to a number of unanticipated technical barriers, London Hydro wasn't able to move forward with its original deployment strategy.[22] However as part of the Green Button initiative (described in Section 13.1.1 starting on page 98 herein) a number of Energate programmable communicating thermostats (as illustrated in Figure 3-6) were installed and enrolled in the *peaksaver* PLUS program (to provide participants with additional perceived value). The display on this thermostat can serve as an in-home display.

Figure 3-6, Energate Programmable Communicating Thermostat

As a continuation of the Green Button initiative, a number of Energate programmable thermostats will be installed in 2015 (and enrolled in the peaksaver PLUS program), but no estimate of energy savings will be made in this CDM Plan for reasons highlighted below:

- With respect to the requisite in-home display element of the peaksaver PLUS program, Freeman, Sullivan & Co. note on page 4 in their EM&V report:[23]

  > *FSC's overall conclusion is that there is no measurable, statistically significant conservation effect from the IHDs over the period investigated to date.*

- There are many instances of small "*proof of concept*" projects involving advanced technology (such as programmable communicating thermostats) and advanced

[22] London Hydro Report EM-12-01, *Strategy for Supplying In-Home Displays for the peaksaver-PLUS® Residential CDM Program*; Issued: February 13, 2012.

[23] Freeman, Sullivan & Co report: *peaksaverPLUS® Program Load Impact and Process Evaluation*; prepared for Ontario Power Authority by: Stephen George, Candice Churchwell, Jeeheh Oh, and Christine Hartmann, all of FS&C; September 30, 2013

analytics that have shown very promising early results when the small group of participants are self-selected, hyper-engaged customers. However, when the pilot is expanded to the general population, the results are usually disappointing – the participant recruitment cost can be significant, the experience isn't engaging enough to maintain savings rates, and the program cost-effectiveness plummets. Such was the case with the Pacific Gas & Electric's (PG&E) Opower/Honeywell thermostat trial involving Honeywell programmable communicating thermostats and OPower's behavourial software.[24] Although when surveyed, the participants in this trial expressed the belief that the technology helped them manage their electricity consumption, reality is somewhat different with the key program evaluation verdict: "… *The findings of this study do not show statistically significant energy savings attributable to the smart thermostat system tested here…*".[25]

Pursuant to Clause 9, *Peaksaver Plus Program*, of the Ministry directive of March 31st, 2014, "*A transition plan is currently being developed to evolve existing programs, potentially including the peaksaver PLUS program, to an IESO administered market. Until such time as the transition plan has been finalized … the OPA shall continue to make the program available to Distributors to deliver to customers in their licensed service areas*."

Note: Various EM&V reports have shown programmable communicating thermostats to be an effective technology for residential demand response (during times of constrained system operation or generation shortfall), but not for electricity savings. The existing fleet of thermostats will have residual value should London Hydro pursue the future demand response marketplace.

3.2.2.5 saveONenergy EXCHANGE EVENT Program

Customers with dehumidifiers and window air conditioners that are at least 10 years old and in working condition can drop off their old units at participating retailers (on defined dates each Spring) and receive a $50 coupon towards the purchase of a new ENERGY STAR® qualified window air conditioner or dehumidifier.

Figure 3-7 below shows the annual results (in terms of number of appliances exchanged, as well as net annual demand reduction) of the saveONenergy EXCHANGE EVENT program within London Hydro's franchise service territory.

---

[24] Pacific Gas & Electric report ET11PGE3073, *Opower/Honeywell Thermostat Trial – Interim Findings*; Prepared by: Michael Perry and Jeeheh Oh, both of Freeman, Sullivan & Co.; December 12, 2012.

[25] PG&E's Emerging Technologies Program; Project Number: ET11PGE3074; *Findings from the Opower/Honeywell Smart Thermostat Field Assessment;* prepared by: Candice Churchwell and Michael Sullivan, both of Nexant, Inc.; July 24, 2014; pg 31.

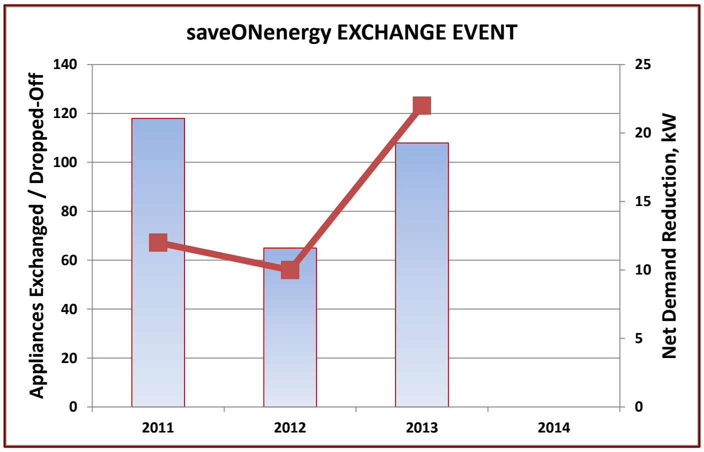


Figure 3-7, Participation in saveONenergy APPLIANCE EXCHANGE Program

Although not shown in the graphic, the net annual energy savings associated with this program is about 39 MWh. This is about 370 kWh per turned-in appliance.

This provincial CDM program has now come to an end.[26]

3.2.2.6 saveONenergy NEW HOME CONSTRUCTION Program

The saveONenergy NEW HOME CONSTRUCTION program is designed to encourage home builders to construct energy efficient homes in Ontario that exceed the minimum energy performance requirements set forth in the Ontario Building Code.

Figure 3-8 below shows the annual results (in terms of number of participating new homes, as well as net annual demand reduction) of the saveONenergy NEW HOME CONSTRUCTION program within London Hydro's franchise service territory.

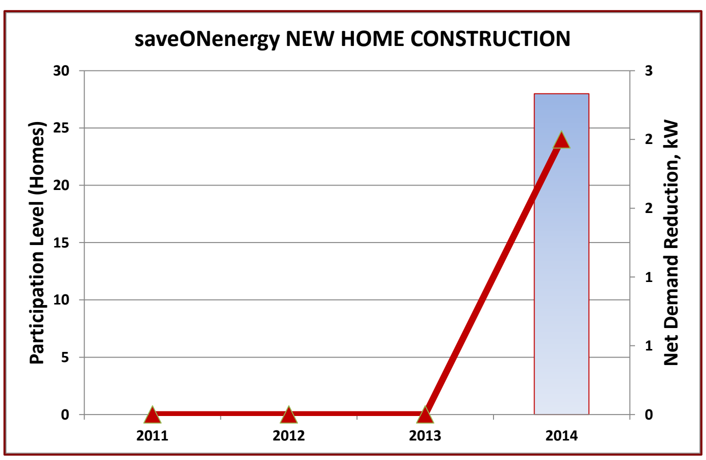


Figure 3-8, Participation in saveONenergy NEW HOME CONSTRUCITON Program

[26] See notice on OPA website at URL:: https://saveonenergy.ca/consumer/programs/exchange-event.aspx

Note: There were significant program design shortcomings with the provincial NEW HOME CONSTRUCTION program, and hence London Hydro's lack of uptake for the first three years, as depicted in Figure 3-8 above, mirrored the lack of participation across the province until program corrections were implemented prior to the 2014 construction year.

Although not shown in the graphic, the net annual energy savings associated with this program is about 209 MWh. This is about 7,500 kWh per participating home.

3.2.3 Review of Energy-Efficiency Achievements in the MURB Sector

Over the years, London Hydro has enjoyed great success (and garnered many awards) for its energy-efficiency programs targeted at the multi-unit residential building (i.e. apartment building) sector. London Hydro has traditionally treated such projects as "*commercial*" endeavors as all dealings are with the building owner or the building's property manager (as opposed to the individual tenants). However, since the "*achievable potential*" studies (referenced in Section 3.3 herein) categorize apartments as residential opportunities, for consistency apartments will be considered residential opportunities herein.

With respect to achievable potential within the MURB sector in London, a listing of all multi-unit residential buildings was first created. Then information derived from the incentive applications from the third-tranche era (e.g. reflecting upgrades of apartment refrigerators to ENERGY STAR qualified unit under London Hydro's comprehensive *Chill Out – London* appliance replacement program), the subsequent *Electricity Retrofit Incentive Program* era (reflecting London Hydro's *Incandescent for CFL Replacement* sub-program), and the most recent saveONenergy RETROFIT PROGRAM era (reflecting the London Hydro's *ENERGY STAR Lighting Fixture* sub-program) was next captured in the electronic listing. Finally, "*other factor*" information, such as building ownership, membership in the local London Property Management Association (LPMA), type of revenue metering system (i.e. bulk metered versus individual or tenant metering system) was added to produce Table 3-4 below.

Table 3-4, Market Opportunity Assessment for MURBs in London

Units Per Building	Total Number of Buildings	Total Rental Units	Total Buildings Touched	Market Opportunity	Rental Units Untouched	Effort Index
(Col 1)	(Col 2)	(Col 3)	(Col 4)	(Col 5)	(Col 6)	(Col 7)
1-19	593	4,696	20	97%	4,538	12.20
20-79	500	21,800	56	89%	19,538	2.04
80-139	147	15,661	47	68%	10,654	0.64
140-179	59	9,084	23	61%	5,543	0.40
180-300	32	6,819	18	44%	2,983	0.21
Totals:	**1,331**	**58,060**	**164**		**43,076**	

Note: It is not clear why the total number of apartment units identified in Column 3 of Table 3-4 above is different than the overall number of apartment units identified in Table 3-2 (on page

16 herein). This will need to be clarified in the development of customer engagement strategies going forward.

Although it may not be readily apparent from Table 3-4, the appropriate interpretation is as summarized following:

- London Hydro's previous successes on the energy-efficiency front (in the MURB sector) have been skewed toward the larger apartment buildings, with bulk electricity metering systems, within the portfolio of a large landlord or property management organization, wherein the portfolio owner or property management company is likely to be a member of LPMA.
- The greatest residual opportunity is with multi-unit residential buildings having less than 80 apartment units. However there are a multitude of factors that collectively substantially increase the difficulty and conversely effort required to achieve success on the energy-efficiency front, namely:
  - In contrast to the larger buildings that are in the portfolio of a large developer or managed by a large property management company, the ownership of smaller apartment buildings tends to be numbered companies, meaning it is challenging to ascertain contact information for the owner or other "*decision-maker*".
  - London Hydro normally deals with the "*decision-maker*" of the MURB portfolio (e.g. owner or CFO) with a value proposition that resonates with that sector (e.g. If retrofitting your building with ENERGY STAR lighting fixtures made the same net contribution to your bottom line as adding two additional floors of rental apartments to your building but without the administrative overhead and inconvenience of tenant turn-over, etc. would you make this investment?) that is used to dealing with such financial propositions and has the authority to commit the organization to large undertakings. Dealing with condominium boards, by contrast, tends not to be so straightforward and rapid.
  - Tenant metering versus bulk metering – there has been very little activity on the energy-efficiency front for apartment buildings with tenant metering systems; the problem being the landlords incur the expenses, but the tenants reap the reward. London Hydro has achieved some success with the value proposition that ENERGY STAR lighting fixtures can improve the "*curb appeal*" of "*tired*" apartment buildings.

To summarize, whilst theoretically there is still significant remaining potential in the MURB sector, the nature of those buildings is such that it will require significantly more effort than in the past to enroll such customers in energy-efficiency upgrade programs, and the projects themselves will be much smaller scale than in the past.

As an interesting aside, in the summer of 2014, London Hydro contemplated developing a sub-program that would focus on domestic water pressure booster pumps in apartment buildings using VFD technology (i.e. retrofitting traditional booster pumps with VFD-driven booster pumps) and set about to conduct a series of baseline measurements of water flows and booster pump operating characteristics. Interestingly, it was found that (i) domestic water consumption was much reduced from the design parameters in use when the building was originally constructed (due to low-flow shower heads, faucet aerators, low-flow toilets, etc.), (ii) the water pressure in London is higher than in many other communities, and (iii) London Hydro has very few "*high-rise*" apartment buildings (in comparison to communities such as Toronto). Collectively, these factors means that there are so few buildings in London of sufficient height to even require a domestic water pressure booster pump, that the idea for a VFD-based pressure booster pump sub-program was suspended.

3.2.4 Overall Assessment of Energy Efficiency Achievements to Date

With reference to Figure 3-1, *Trends in Residential Energy Consumption* (on page 17 herein), clearly energy-efficiency is occurring amongst the residential sector, but this downward trend clearly preceded the introduction of Smart meters and time-of-use electricity pricing. Some of this observed decrease is attributable to residential energy conservation programs (such as the saveONenergy HEATING & COOLING INCENTIVE program), but it is likely that a greater share was the result of natural events, e.g. the adoption of CFL's had reached the tipping point in the marketplace, customers were replacing their traditional cathode-ray tube television sets with large flat-panel liquid crystal display televisions due to plummeting prices, customers were replacing their first generation home computer systems (with CRT screens and power hungry printers) with modern home computer systems (with flat screen monitors and more energy-efficient printers), various household appliances (e.g. refrigerators, dishwashers, etc.) that had reached end-of-life were being replaced with household appliances that are inherently more energy-efficient (due to more stringent energy performance standards for consumer appliances), etc.

3.3 Identification of Potential Energy-Efficiency Opportunities

3.3.1 Synopsis of Achievable Potential Report

The Ontario Power Authority (OPA) commissioned the consulting firm ICF Marbek to prepare an estimate of electricity and energy efficiency potential in Ontario. This study was intended to inform both the development of Ontario's updated *Long-Term Energy Plan, Achieving Balance*, and energy conservation programs for the 2015 to 2020 CDM delivery framework.

Achievable potential is the proportion of feasible gains in energy efficiency that can realistically be achieved within the study period. The overall study includes details on the achievable potential in each of the residential, commercial and industrial sectors.

The ICF Marbek report that deals specifically with the residential sector [Ref 2] was reviewed with the following observations:

- The report considers multi-unit residential buildings (MURBs, i.e. apartment buildings) to be residential [Ref 2, pg 2]. It is presumed that all apartment buildings are considered "*residential*" regardless of the metering arrangement and to whom the benefits of energy conservation accrue.

Note: London Hydro services both bulk-metered apartment buildings (in which the electricity bill is paid for by the landlord or property manager and the tenant's cost for electricity is included in the monthly rental amount) and individually-metered apartment buildings (wherein each tenant is individually invoiced for their electricity costs based on the prevailing residential class tariffs).

Note: From a CDM perspective, London Hydro has traditionally considered apartment buildings to be commercial, whether they were outfitted with bulk electricity metering systems or individual tenant metering systems, since in both cases in-suite energy-efficiency upgrades tend to be promoted on a building-wide basis and through the landlord or property manager (i.e. a single decision-maker as opposed to individual tenants).

- Year-over-year projections of changes in overall residential energy consumption within a geographic region (or even the province itself) will be a function of both the anticipated population growth and declines or increases in the projected average per household energy consumption. Within the report:
  - Exhibit 10 (on page 28) is a stacked bar chart that shows overall predicted residential electricity consumption by year (starting with 2012 as the base year) and residential subsector (i.e. single family dwelling, row house, apartment building, etc.).
  - Exhibit 11 (on page 29) is a stacked bar chart that shows overall predicted residential energy consumption (again starting with 2012 as the base year) and end-use (e.g. lighting, computers, refrigerators, etc.)
  - Exhibit 12 (on page 30) is a stacked bar chart that shows overall predicted residential energy consumption (again starting with 2012 as the base year) and IESO zone (e.g. Ottawa, Southwest, Toronto, etc.)

  These charts show predicted overall load growth, but not expected population increases throughout the study period (i.e. 2012 to 2032). As such it becomes difficult to apply these charts to London (primarily to observe differences in annual energy consumption between the province and London Hydro's customers.

  Note: The 2012 Yearbook of Electricity Distributors[27] indicates, on page 10, that in 2012 there were 4,406,331 residential customers in the province of Ontario.

- The report introduces the term "*technical potential*" as the level of electricity consumption that would occur if all equipment and building envelopes were upgraded with the most energy efficient, commercially available technologies and behavioral practices. [Ref 2, pg 32]

- By contrast, the term "*achievable potential*" is considered the proportion of the savings identified in the technical potential forecasts that could realistically be achieved within the study period. Achievable potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the technical potential forecast. [Ref 2, pg 42].

[27] Ontario Energy Board publication: *2012 Yearbook of Electricity Distributors*; August 22, 2013.

- Exhibit 23 (on page 44) shows relationship between technical potential and achieved savings via OPA CDM programs to 2012. Of the 4,994 GWh/yr in technical potential savings, provincial CDM programs delivered 1,259 GWh/yr, or about 25%.
- The report introduces the concept of "*energy efficiency measure clusters*". This is a grouping of energy efficiency measures because of perceived similarities or because a common supply channel can deliver them to the market.
- Exhibit 35 (on page 64) is an assessment of many energy-efficiency measures that examines the energy savings potential, when the savings will occur (e.g. off-peak or on-peak, summer or winter), a level of confidence rating in the savings expected of the measure, a factor that reflects whether the measure is considered niche or of widespread applicability, and finally a risk factor indicating the likelihood that the measure will be superseded by upcoming regulations. Finally the energy-efficiency measures are assembled into "*clusters*" within an overall score and electricity savings potential assigned to each cluster.

The germane information from Exhibit 35 has been replicated in Table 3-5 below for convenience of reference.

Table 3-5, Residential Energy Conservation Clusters

Cluster Name	Cluster Total Score	Electric Savings Potential	Measure
Next Generation Lighting Equipment	770	29.8%	CFL LED common area lighting LED
Space Heating	370	18.2%	Programmable thermostats (baseboard heating) Air leakage sealing and insulation (old home) Programmable thermostats (central heating) Basement (foundation) insulation Crawl space insulation
Phantom Load	328	18.1%	Smart power bars (computers & peripherals) Activate PC power management Smart power bars (televisions and home entertainment)
Other Behaviour	280	7.5%	Minimize hot and warm wash Increase temperature of AC Maintain proper refrigerator temperature Turn off TV's when not in use Temperature setback (overnight) Maintain weather-stripping Temperature setback (during day)

Cluster Name	Cluster Total Score	Electric Savings Potential	Measure
			Close windows and blinds
Lighting Behaviour	29	1.2%	Turn off lights in unoccupied rooms Only necessary outdoor lighting

It will be seen in Table 3-5 above that the values in column 3 don't sum to 100%. This is due to some measures with energy savings potential (e.g. refrigerators 9% more energy efficient than ENERGY STAR qualified units, etc.) being dismissed in the evaluation phase.

- In a move that conjures up images of the "*squirrel*" scenes in the Disney Pixar movie UP!, it is noted in Section 7.1.2 (on page 63) and Section 7.2 (on page 65) that there was a meeting involving OPA and ICF Marbek personnel to discuss the results (summarized in Table 3-5 above) whereupon it was decided to (change direction entirely and) continue the analysis with a single top priority cluster for the residential sector, namely a "*Home Energy Management System*" (HEMS). The savings from this new home automation cluster is to come from controls aimed at reducing phantom loads, turning off lights of unoccupied spaces, and setting back thermostats to saving heating, ventilation, and air-conditioning energy.
- A jurisdictional scan of HEM technologies [Ref 2, pg 88] raises certain questions about the wisdom of this approach. Specifically:
  - *Xcel Energy in Colorado piloted HEM technologies …*
    - *At no cost to the customer, the following components were installed in 1,100 customer homes …*
    - *The utility has learned many interesting lessons:*
      - *No statistically-significant savings.*
      - *Demand reductions between 7.6% and 19.2% …*

Note: The "*no statistically-significant savings*" statement should come as no real surprise. In spite of great promise and inflated claims, the provincial Smart-metering initiative has yielded almost imperceptible load shifting and the requisite in-home display element of the saveONenergy peaksaver PLUS program has yielded no persistent savings.[28]

Note: In spite of initial enthusiasm and hope, other recently published EM&V studies[29] are showing "*… no significant electricity or natural gas energy savings were found at the 95% confidence level …*".

[28] Freeman, Sullivan & Co report: *peaksaver PLUS® Program Load Impact and Process Evaluation*; prepared for Ontario Power Authority; September 30, 2013; Section 1.2, *IHD Impact Summery*; pg 4.

[29] PG&E Emerging Technologies Program report ET11PGE3074, *Findings from the Opower / Honeywell Smart Thermostat Field Assessment*; prepared by Candice Churchwell and Michael Sullivan of Nexant Inc; July 24, 2014.

3.3.2 Results of OPA's Prediction Tool for London's Residential Sector

The Ontario Power Authority's *Conservation First Framework LDC Tool Kit - Regional Potential Calculator* (V3) defines the following upper achievable potential for London Hydro's residential sector:

Table 3-6, Upper Achievable Potential for London's Residential Sector

Upper Achievable Potential for Residential Sector, GWh					
2015	**2016**	**2017**	**2018**	**2019**	**2020**
12	25	42	52	62	75

The values in Table 3-6 are understated. Recall from Section 3.3.1 herein that the achievable potential study considers multi-unit residential buildings to be "*residential*", but from a tariff perspective, LDC's classify "*tenant-metered*" apartments as "*residential*" customers and bulk-metered apartment buildings as "*General Service*" customers. As such, the "*residential energy sales*" field that is entered into the calculator is understated (since it doesn't include "*bulk-metered*" apartment buildings).

Given that the achievable potential study doesn't separate the predictions for apartment buildings from other types of houses (e.g. single family dwellings, town houses, etc.), it is difficult to ascertain how great a stretch target is Table 3-6.

3.4 Situation Analysis

The declining trend in residential energy consumption was presented earlier as Figure 3-1, *Trends in Residential Energy Consumption*. The following subsections provide some insight into the appliances and systems that are consuming this electricity, the trends in household electricity consumption, and some understanding of the underlying reasons for a diminishing household electricity consumption pattern.

3.4.1 Residential Energy Consumption by End-Use

In the last couple of decades, residential electricity use has drastically changed. In addition to major appliances such as ranges, refrigerators, dishwashers, clothes washer and dryers, houses commonly have large numbers of small appliances, home entertainment, computer and communication devices, and other gadgets. These include such things as microwave ovens, counter-top appliances, flat-screen televisions, digital cable boxes, satellite tuners, video players, digital video recorders, home theatre components, iPod®/MP3 docks, video games, computers, notebooks, tablets, in-home wireless networks, printers, multi-function devices, cordless telephone, cell phones, etc.

Since Canada is a northern nation with an inclement cold climate, homeowner electricity usage patterns are somewhat different than other jurisdictions, and it is imperative to develop electricity-usage profiles for Canadian homes which can be used to target efficiency improvements.

During 2010-2012, Natural Resources Canada performed detailed field assessments of electricity consumption in over 700 Canadian homes using their Residential Electricity Audit Tool (REAT). Some of the findings, published in the literature,[30] [31] are reproduced following for convenience of reference.

Figure 3-9 below shows typical household electricity usage by end-use device. This is significant because it is relatively recent data and it depicts "*electricity usage*" whereas most pie charts in the literature depict "*energy usage*" (i.e. electricity and natural gas combined).

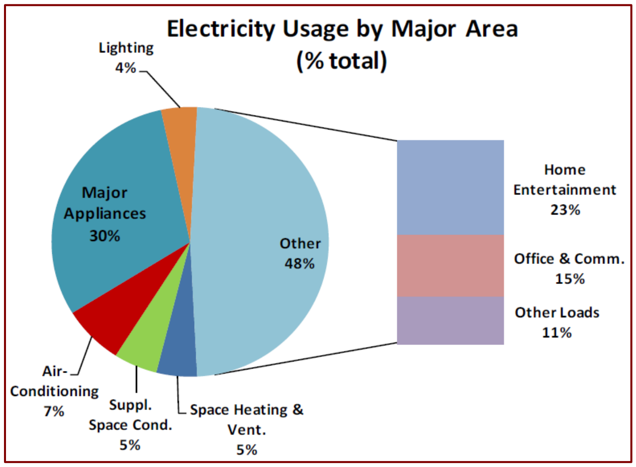


Figure 3-9, Typical Canadian Household Electricity Usage

The NRCan study defines "*base-load electricity usage*" as consisting of all uses within and outside the home that are not part of the primary space-heating, domestic hot water heating and space cooling systems. Base-load uses include lighting, major appliances, common-plug loads that are found in almost every home, plus "atypical" loads that are found in only some homes

Figure 3-10 below indicates some very interesting findings.

[30] *Survey Results of User-Dependent Electricity Loads in Canadian Homes*; Anil Parekh and Philip Wang, Natural Resources Canada and Terry Strack, Strack & Associates; 2012 ACEEE Summer Study on Energy Efficiency in Buildings; pages 9-240 to 9-251.

[31] *Base-Load Electricity Usage - Results from In-home Evaluations*; Anil Parekh, Natural Resources Canada and Terry Strack, Strack & Associates; Presented at the Conservation & Demand Management in a Sustainable Energy Future Conference, Burlington Ontario, June 11, 2012

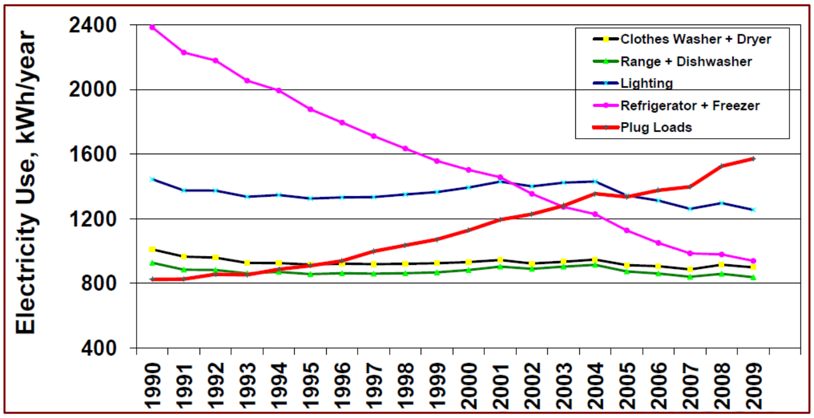


Figure 3-10, Canadian Household Base Loads (kWh/yr) for 2011

The nation-wide REAT evaluations showed an average base electricity use, excluding heating and cooling loads, of about 6,920 kWh per year. Historical comparisons showed that there is a significant increase in the energy use associated with plug loads; however, energy use associated with major appliances has reduced. The energy consumption due to stand-by usage accounts for about 9% of base-load electricity consumption.

Refrigerators and freezers have significantly improved in energy efficiency since 1990 (-61% change). The energy used for lighting has decreased modestly over the years (-13% change), as has the energy used by clothes washers and dryers (-11% change), and ranges and dishwashers (-10% change). In contrast, there has been a dramatic rise in plug-load consumption (+91% change) which includes entertainment devices, computers, cordless phones, cell phones counter-top appliances and other personal devices. The overall base-load electricity usage in homes has changed by about -17%. Much of the efficiency gains of major appliances have been offset by increases in user-dependent plug loads.

3.4.2 Effect of Codes and Standards

There are three (3) changes to the Ontario Building Code and prevailing energy-efficiency standards that will have an effect on existing provincial CDM programs, namely:

- The requirement that all new homes be equipped with furnaces having energy-efficient ECM motors (refer to Section 3.2.2.2 starting on page 23 herein) will diminish the energy savings potential obtainable from the saveONenergy HEATING & COOLING INCENTIVE program on a go-forward basis;
- Building code changes with respect to the minimum energy efficiency performance (refer to Section 3.2 starting on page 18 herein) will diminish the number of cost-effective incentive measures for the NEW HOME CONSTRUCTION program on a go-forward basis; and
- The federal phase-out of incandescent bulbs (refer to Section 3.2 starting on page 18 herein) will diminish the energy savings potential obtainable mostly from

lighting fixture upgrades in apartment building under the saveONenergy RETROFIT PROGRAM on a go-forward basis.

In time, these factors should diminish the average monthly billed energy consumption per residential customer (as depicted in Figure 3-1 on page 17 herein).

3.4.3 Effect of Program Saturation

There are only so many lighting fixtures in a home. Once the incandescent bulbs have been replaced with CFL's, the incremental savings in converting the CFL's to LED technology is very small (and not likely worth the investment).

Similarly, homeowners with a spare refrigerator (the "*beer fridge*") can only dispose of this extra appliance once.

3.4.4 Effect of Natural Conservation

Aside from the changes to building codes and product standards (previously discussed in Section 3.4.2 above), there is natural conservation that is occurring to diminish average household energy consumption. Specifically:

- Residential customers are replacing their CRT-based televisions with modern flat-screen televisions based on LED, LCD or similar technologies. It is unlikely that customers are motivated by the energy savings associated with such upgrades.
- Similar equipment upgrades are occurring with home computer systems, wherein customers are motivated by the desire for faster processors to support modern Internet browsers, wireless connectivity, and more powerful applications (as opposed to the energy savings inherent with such upgrades).
- As illustrated in Figure 3-10 (on page 36 herein), the natural turn-over of refrigerated appliances (e.g. refrigerators, freezers and air conditioners) inherently yields appreciable energy savings due to significant improvement in the technology.

3.4.5 Other Considerations

There is much ado in various trade magazines and other literature concerning *Smart Homes*, *Connected Homes*, and similar handles equipped with a variety of Smart appliances and similar systems (e.g. Smart lighting controls).

Although many emerging household technologies that bear the "*Smart*" handle are intriguing, it is perhaps not surprising that these concepts remain little more than fanciful notions, i.e. they are not in great demand in the consumer marketplace nor yielding significant or measurable energy savings for consumers. Deloitte's most recent annual predictions[32] concerning the Internet of Things (IoT) offers an interesting perspective replicated below for convenience of reference:

> *In the consumer context, machine-to-machine (M2M) usually solves only part of the problem. Turning a washing machine ON remotely, being notified when the cycle is finished offers some level of convenience compared to pushing a button on a machine in the basement. But the clothes still need to be sorted, carried to the laundry room, pre-treated, placed in the machine and soap added. In other words, the portion of the task that M2M improves is trivial.*

3.5 Assessment

In 2013, the saveONenergy FOR HOME portfolio of CDM programs yielded only about 20% of the net energy savings associated with the saveONenergy FOR BUSINESS portfolio of CDM programs.[33]

Although it would probably be more cost effective to simply operate only CDM programs targeted at businesses, the decision-makers in a business are simply consumers outside of business hours. From a persuasion perspective, consumers that are engaged with energy conservation in the home are more likely to be predisposed to being concerned about energy conservation in the work place. As such, this CDM Plan targets both consumers and businesses.

In reviewing household electricity usage by major area (as depicted in Figure 3-9 on page 35 herein) and the trends in household energy consumption by major area (as depicted in Figure 3-10 on page 36 herein), one can formulate some general conclusions, namely:

- Major appliances – as indicated in Figure 3-9 major appliances consume on average about 30% of the overall electricity consumption. The natural turn-over of refrigerated appliances such as refrigerators and freezers and room air conditioners will reduce household energy consumption due to energy efficiency improvements in these appliances as indicated in Figure 3-10. Promoting ENERGY STAR qualified dishwashers, clothes dryers and clothes washing machines will make a small improvement in household energy performance as indicated in Table 3-3 on page 23 herein.
- Lighting – as indicated in Figure 3-9 household lighting consumes only about 4% of the overall electricity consumption, but as indicated in Figure 3-10 (which only goes up to 2009), it is on a downward trend, likely reflecting product improvements, reduced retail prices, and greater customer acceptance of CFLs.

---

[32] Deloitte, Touche Tohmatsu Ltd. publication: *Technology, Media & Telecommunications Predictions – 2015*; page 7. Document available in electronic format at URL:: http://www2.deloitte.com/content/dam/Deloitte/ru/Documents/technology-media-telecommunications/ru_tmt_predictions_2015_full_report_eng.pdf

[33] Source: Ontario Energy Board publication EB-2010-0215: *Conservation and Demand Management Report – 2013 Results*; December 17, 2014; Table 2, *Net Incremental Energy Savings (kWh)*

Figure 3-11, Typical Recessed Ceiling-Mounted Lighting Fixture

The recent advancements with LED lighting technology have opened up some opportunities for household energy-efficiency upgrades. Since LED lamps are generally dimmable and available in a multitude of form factors (e.g. MR-16 style), such opportunities are not as a replacement for CFL's but rather in household applications where CFL's aren't appropriate, such as in dimmable recessed ceiling-mounted lighting fixtures, as depicted in Figure 3-11 above (where a 6 W LED bulb can replace each 50 W halogen bulb).

- Space heating, ventilation and air conditioning (HVAC) systems – as indicated in Figure 3-9 household HVAC systems collectively consume about (7% + 5% + 5% =) 17% of the overall household electricity consumption. The natural turn-over of refrigerated appliances such as central air conditioners will reduce household energy consumption due to energy efficiency improvements in refrigerated appliances as indicated in Figure 3-10. The recent changes to the Ontario Building Code (previously discussed in Section 3.2 starting on page 18 herein) really only apply to new dwelling units, so the provincial saveONenergy HEATING & COOLING INCENTIVE program will continue to be effective in the replacement market for a few years.
- Other plug loads – as indicated in Figure 3-9, household plug loads collectively consume about (23% + 15% + 11% =) 39% over the overall household electricity consumption and as indicated in Figure 3-10, plug load is growing. There are a number of things that can be done or are occurring to not only reduce plug loads but also the standby power consumed by many plug loads when the entertainment system or home computer system isn't being used. Specifically:
  - Natural conservation – As described in 3.4.4 (starting on page 37 herein), with the natural turnover of consumer entertainment systems and home computer systems – the new devices inherently consume less energy than the obsolete devices they replace.
  - The cluster identified as "*phantom load*" in Table 3-5 (on page 32 herein) is already covered under the existing saveONenergy COUPONS program. The value of this program will diminish however. Significant strides have been made with respect to the issue of standby power consumption. Up to the middle of the decade, standby power was often several watts or even tens of watts per appliance. By 2010, regulations were in place in most developed countries restricting standby power of devices sold to one watt (and half that from 2013).[34] The literature suggests that energy improvements can be made with home computers simply by appropriate selection of the inherent "*power management*" features available on home computers.[35]

[34] Source: http://en.wikipedia.org/wiki/Standby_power

[35] California Energy Commission report CEC-500-2014-093, *A Survey of Computer Power Modes Usage in a University Population*; October 2014.

Regardless of what incentive programs or awareness programs are brought to the residential marketplace, the per-household energy-efficiency gains will likely be small.

3.5.1 Opportunities for New Residential CDM Offerings

There are a number of opportunities for new or re-formulated energy-efficiency programs targeted to the residential marketplace. These are outlined in Section 11.1, *Opportunities for New Residential CDM Offerings* (starting on page 80 herein) along with a projection of energy savings for each new or reformulated program.

4 LOW-INCOME HOUSEHOLD SITUATION ANALYSIS

Low-income households are simply a subsector of the overall residential sector.

4.1 Characterization of London's Low-Income Sub-Sector

Canada does not have an "*official*" poverty line, but it has a number of related statistical indicators which are sometimes used to measure poverty. The most popular measures include the Low Income Cut-Off (LICO), the Low Income Measure (LIM) and the Market Basket Measure (MBM).

In 2011, 16.7 per cent of people living in London were living below the LIM threshold.[36]

4.2 Review of Energy-Efficiency Achievements to Date

The objective of the turnkey saveONenergy HOME ASSISTANCE program is to offer the free installation of energy efficiency measures to income-qualified households for the purpose of achieving electricity and peak demand savings.

Figure 4-1 below shows the annual results (in terms of numbers of participants as well net annual demand reduction) of the saveONenergy HOME ASSISTANCE program within London Hydro's franchise service territory.

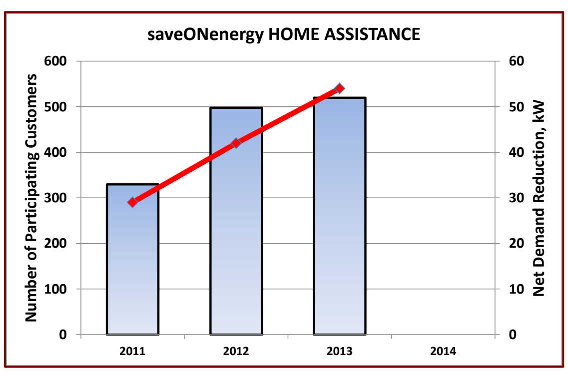


Figure 4-1, Participation in HOME ASSISTANCE Program

Although not shown in this graphic, the net annual savings associated with this program is about 450 MWh.

[36] Source: City of London website; page *Poverty and Income*; see URL:: https://www.london.ca/About-London/community-statistics/social-issues/Pages/Poverty.aspx

4.3 Identification of Potential Energy-Efficiency Opportunities

There are at least two (2) energy-efficiency opportunities that can be considered for low-income households, as described below.

4.3.1 Introduction of ENERGY STAR Qualified Lighting Fixtures

London Hydro has been an long-standing advocate of incorporating ENERGY STAR lighting fixtures, with the GU-24 2-pin lamp interface (as opposed to simply retrofitting incandescent lighting fixtures with CFL's) into the provincial saveONenergy HOME ASSISTANCE program, without success. The basic problem with achieving consensus for provincial programs is mediocrity is often the lowest common denominator for achieving widespread agreement – and this isn't necessarily what is best for the customer or the industry.

Note: ENERGY STAR qualified lighting fixtures don't provide greater energy savings than retrofitting incandescent fixtures with CFL's, but rather the measure persistence is significantly different. The basic design of the ENERGY STAR qualified lighting fixture ensures that only energy-efficient lamps are ever installed, i.e. it precludes installation of an incandescent lamp.

While London Hydro is an active participant on the Working Group that is examining improvements to the HOME ASSISTANCE program, it may be necessary to contemplate local or regional "add-ons" to the provincial HOME ASSISTANCE program.

4.3.2 Potential Improvements to Heating Systems

A significant number of cooperative and social housing townhouses are equipped with electric baseboard heating systems (supplemented with generally vintage window-style room air conditioners in the summer months).

One CDM program that is presently under development is the replacement of electric baseboard heaters with cold-climate air-source heat pumps. A program outline, including uptake expectations and anticipated energy savings, is included as Section 11.1.5 (starting on page 85 herein).

4.4 Situation Analysis

As shown in Figure 4-1, London Hydro's saveONenergy HOME ASSISTANCE program has been steadily gaining momentum since its introduction to the marketplace. Given the estimated population of income-qualifying households in London (given in 4.1 above), it is likely that an annual participation rate of 500 households per year can be maintained over the 2015 – 2020 timeframe.

4.5 Assessment

Given the net annual savings of about 450 MWh (as previously identified in Section 4.2 herein), and the expectation that there will be sufficient demand to run the provincial saveONenergy HOME ASSISTANCE for the full six years of the 2015 – 2020 CDM delivery framework, then the projected energy savings is:

Projected net energy savings	=	*450 MWh/yr x 6 years*
	=	*2700 MWh*
	=	*2.7 GWh*

The savings projections associated with a new cold-climate heat pump offering (outlined in Section 4.3.2 above) will be additional and is projected later in Section 11.1.5 (starting on page 85 herein).

5 SMALL BUSINESS SECTOR SITUATION ANALYSIS

This section profiles the small business sector within London Hydro's franchise service territory, describes the outcome of energy conservation programs that have been operated in recent years, and provides insight into the remaining opportunities for new or continued energy conservation programs in the forthcoming years.

5.1 Characterization of London's Small Business Sector

The North American Industry Classification System (NAICS) is used by business and government to classify business establishments according to type of economic activity (process of production). Each establishment is classified to an industry according to the primary business activity taking place there. For example, the 44- and 45-series of codes identify "*Retail Trade*" businesses, the 52-series of codes identify "*Finance and Insurance*" businesses, the 72-series of codes identify "*Accommodation and Food Services*" businesses, etc.

Like most LDC's, London Hydro doesn't have any business reasons for obtaining and maintaining the NAICS code for each industrial, institutional and commercial customer as an attribute within its *Customer Information System* (CIS) database. Rather the closest attribute that is maintained is each customer's electricity tariff classification, e.g. residential, general service less than 50 kW, general service greater than 50 kW, large user, etc.

The tariff classification "*general service less than 50 kW*" is largely made up of business customers that would be considered "*small businesses*". However, this tariff classification also includes the "*house service*" in apartment buildings and other multi-tenant retail spaces, illuminated billboards (as illustrated in Figure 5-2 below), railway signals, Bell and CATV amplifier enclosures (as illustrated in Figure 5-1 below), emergency fire pump services, etc. As such, the tariff classification "*General Service Less Than 50 kW*" will overstate the number of "*small business*" customers.

Figure 5-1, Bell Communications Enclosure

Figure 5-2, Illuminated Billboard

Note: For outdoor billboards (approximately 175) with photocell-controlled floodlighting, once the PAR-38 lamps are converted to energy-efficient LED technology, there are no remaining opportunities for energy-efficiency.

Note: The padmounted Bell communications enclosures (approximately 300 in-service) similarly have no opportunity for energy-efficiency.

As of December 31, 2013, London Hydro reported 12,084 customers in the "*General Service < 50 kW*" tariff classification [Ref 1].

5.2 Review of Energy-Efficiency Achievements to Date

The first direct-install CDM program to be offered to the small business sector was *Power Savings Blitz*. At the time, compact fluorescent lamps (CFL's) were a mature technology so most of the work was conversion of T-12 fluorescent fixtures (with magnetic ballasts) to T-8 fluorescent lamps with electronic ballasts, and replacement of incandescent lamps with CFL's. The limitations of the technology however limited the application; retail showcase lighting needs a narrow-beam PAR-lamp whereas CFL's in a PAR form had a wide-beam; CFL's were generally not dimmable, and there wasn't anything available to replace the prevalent MR-16 lamps.

The successor program, saveONenergy SMALL BUSINESS LIGHTING, had wider technology choices to offer. LED lamps are generally dimmable, have a narrow-beam light dispersion characteristic in PAR forms, and are available in MR-16 forms.

Table 5-1 below shows the participation of small business customers in the *Power Savings Blitz* and saveONenergy SMALL BUSINESS LIGHTING programs by year.

Table 5-1, Participation in Small-Business Direct-Install Programs

Type of Business	Power Savings Blitz			SMALL BUSINESS LIGHTING					Total
	2008	2009	2010	2011	2012	2013	2014	2015	
Bakery		3	9						12
Conv. Store		112	31						143
Food Service				3	5	28	43	10	89
Grocery		7	11						18
Office	1	90	583	7	22	34	107	2	846
Other		61	350	8	17	24	55	6	521
Restaurant		135	144						279
Retail	5	359	370	6	7	36	80	11	874
Services	4	590	2,002	22	34	49	113	10	2,824
	10	1,357	3,500	46	85	171	398	39	**5,606**

Note: In the above tabulation, the entries in the column labeled "*2015*" reflect year-to-date statistics. By year end, the number of participants may be closer to 100, but the opportunities are few and far between.

Figure 5-3 below shows the annual results (in terms of number of participants as well as net annual demand reduction) of the saveONenergy SMALL BUSINESS LIGHTING program within London Hydro's franchise service territory.

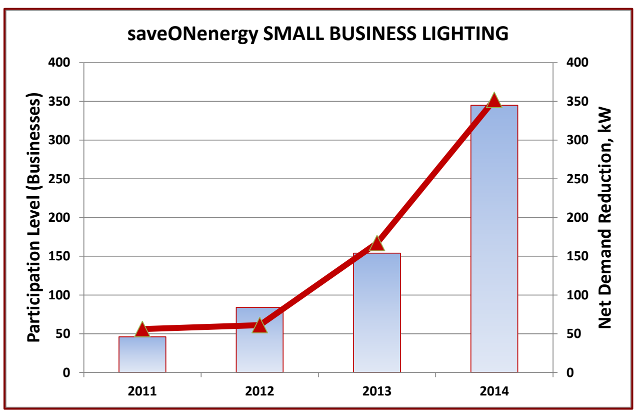


Figure 5-3, Participation in saveONenergy SMALL BUSINESS LIGHTING

Although not shown in the graphic, the net annual energy savings associated with this program is about 565,600 kWh (i.e. 565 MWh or 0.56 GWh).

Note: The increasing participation levels in the latter years shouldn't be misconstrued as increasing opportunities or participation levels. Rather it is a reflection of better "*data mining*" capabilities by London Hydro to seek out customers that haven't previously participated in a small business direct install program or for which there were no viable technology solutions (i.e. in the infancy period of LED lighting when this technology was too expensive and very limited with respect to available bases and form factors, e.g. A19, BR-30, PAR-38, MR-16, etc.).

5.3 Identification of Potential Energy-Efficiency Opportunities

There are three (3) energy-efficiency opportunities worthy of further consideration for small business customers.

5.3.1 Retrofitting Outdoor Illuminated Retail Signage

Most retail stores have an illuminated light-box sign affixed to the front façade of their building (as depicted in Figure 5-4 below) or are identified on a structure-mounted light-box (as depicted in Figure 5-5 below) that promotes several retailers.

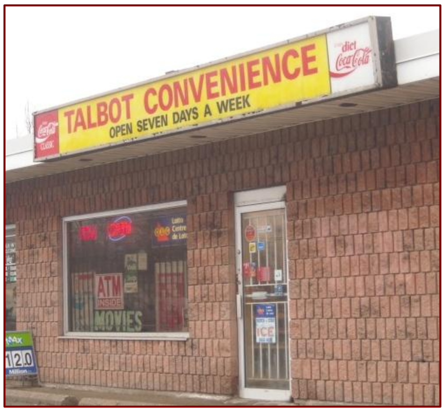


Figure 5-4, Typical Facade-Mounted Illuminated Sign

Figure 5-5, Typical Structure-Mounted Illuminated Sign

Most light-box retail signs are controlled by a photocell relay or timer switch.

There is an opportunity to retrofit the linear fluorescent lamps within these illuminated retail signs with energy-efficient LED technology, with the main selling feature being a much longer life-time, i.e. extended period between sign re-lamping.

While retrofitting the lighting in a single retail sign probably fits within the parameters of the saveONenergy RETROFIT PROGRAM, London Hydro's proposed program will have to target retrofitting the lighting in hundreds or thousands of retail light-box signs in a short period of time (i.e. a blitz strategy) with minimum associated administrative overhead costs.

Note: This is an initiative whereby an on-bill financing option may increase participation levels. However consideration of such a financing option will be deferred until the program design phase.

For the purposes of this CDM Plan, the base case illuminated store front sign is assumed to house 4 x 8 foot long T12 high-output linear fluorescent lamps with an outdoor-rated electromagnetic ballast and load on the order of 250 W. Retrofitting this sign with LED lighting will reduce the load to something on the order of 100 W. Further assuming that half the signs are timer-controls (and hence automatically shut off at 11:00 pm) and the other half the population is equipped with photocells (and thereby operate all night, then the projected overall energy savings for a participation level of illuminated retail 300 signs is calculated to be:

Projected Energy Savings = *150 W x 1 kW/1000 W x 365 d/yr x 12 hr/d x (150 signs + @ 12 hr/d + 150 signs @ 4h/d)*
= *131,400 kWh*
= *0.131 GWh*

The projected annual savings and expected participation levels will be refined as program design work progresses, and future revisions of this CDM Plan will provide updated information.

5.3.2 Refrigerated Display Case Tune-Up

Many convenience stores, grocery stores and restaurants are equipped refrigerated display cases and similar refrigerated units that may not be operating at peak efficiency. Powerstream has a custom CDM program underway, that received OEB approval (under the 2011 – 2014 CDM delivery framework), and is referred to as their *Direct Install Refrigeration* program.[37] Once the program has been subject to the EM&V assessment, and cost-effectiveness tests are carried out, then this program may be rolled out as another offering in the saveONenergy FOR BUSINESS portfolio.

5.4 Situation Analysis

Essentially, this marketplace is almost saturated, and there are no new emerging energy-efficiency technologies evident on the horizon that would make a significant impact.

It is understood that the saveONenergy SMALL BUSINESS LIGHTING is no longer considered "*cost effective*" (using the OPA's updated Avoided Supply Costs) so won't be continued as a provincial CDM program into the 2015 – 2020 CDM Framework. However, a working group is presently examining modifications to this program to make it "*cost effective*". The nature of the program enhancements being contemplated is unknown at this time to London Hydro.

5.5 Assessment

While London Hydro will continue to offer direct-install CDM programs to this sector, uptake is expected to be fairly small and this program won't make much of a dent in London Hydro's overall CDM target.

---

[37] Environmental Commissioner of Ontario blog: *PowerStream to Launch New Custom Electricity Conservation Program*; June 2013. See URL:: http://www.eco.on.ca/blog/2013/06/24/powerstream-to-launch-new-custom-electricity-conservation-program/

6 COMMERCIAL SECTOR SITUATION ANALYSIS

This section profiles the commercial sector within London Hydro's franchise service territory, describes the outcome of energy conservation programs that have been operated in recent years, and provides insight into the remaining opportunities for new or continued energy conservation programs in the forthcoming years.

6.1 Characterization of London's Commercial Sector

Unlike for the residential sector, London Hydro is unaware of any public repository of commercial building data specific to London, e.g. floor area, tenancy, year of construction, etc.

6.2 Review of Energy-Efficiency Achievements to Date

6.2.1 Effect of Provincial Incentive Programs

6.2.1.1 saveONenergy RETROFIT PROGRAM

Historically, the so-called "*workhorse*" CDM program for the business sector (i.e. commercial, institutional and industrial customers) has been the saveONenergy RETROFIT PROGRAM.

Figure 6-1 below shows the annual results (in terms of number of participants as well as net annual demand reduction) of the saveONenergy RETROFIT PROGRAM within London Hydro's franchise service territory.

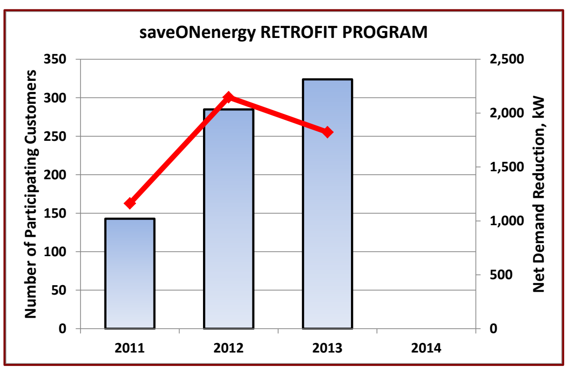


Figure 6-1, Participation in saveONenergy RETROFIT PROGRAM

Although not shown in the graphic, the net annual energy savings associated with this program is about 8,300 MWh (i.e. 8.3 GWh).

6.2.1.2 saveONenergy AUDIT FUNDING

Figure 6-2 below shows the annual results (in terms of number of participants as well as net annual demand reduction) of the saveONenergy RETROFIT PROGRAM within London Hydro's franchise service territory.

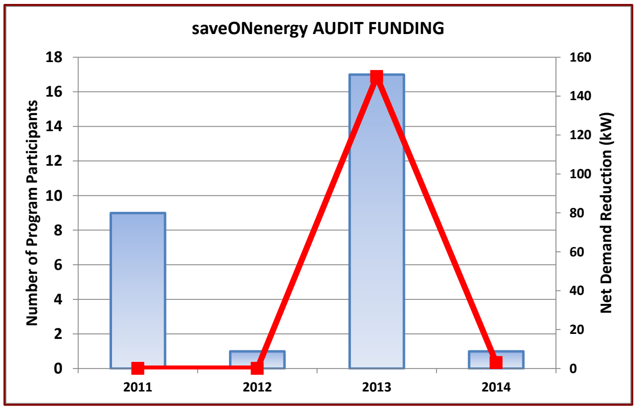


Figure 6-2, Participation in saveONenergy AUDIT FUNDING PROGRAM

Although not shown in the graphic, the average net annual energy savings associated with this program is about 210 MWh (i.e. 0.2 GWh).

It seems counter-intuitive that an energy audit could generate demand reductions or energy savings. However, the program EM&V assessors found a tendency for participants to undertake one or more operational efficiency recommendations (for which there probably isn't an incentive) that were identified as a result of the energy audit process.

6.3 Identification of Potential Energy-Efficiency Opportunities

6.3.1 Synopsis of Achievable Potential Report

The Ontario Power Authority (OPA) commissioned the consulting firm ICF Marbek to prepare an estimate of electricity and energy efficiency potential in Ontario. This study was intended to inform both the development of Ontario's updated *Long-Term Energy Plan, Achieving Balance*, and energy conservation programs for the 2015 to 2020 CDM delivery framework.

Achievable potential is the proportion of feasible gains in energy efficiency that can realistically be achieved within the study period. The overall study includes details on the achievable potential in each of the residential, commercial and industrial sectors.

The ICF Marbek report that deals specifically with the commercial sector [Ref 3] was reviewed with the following observations:

- Exhibit 17 (on page 37) is a forecast of technical potential electricity savings, by milestone year and facility type. The underlying data has been replicated in Table 6-1 below for convenience of reference.

Table 6-1, Technical Potential Electricity Savings, by Sub-Sector

Sub-Sector	Technical Potential Savings, GWh		
	2012	2017	2022
Large_Office	1,268	2,299	2,633
Other_Office	962	1,862	2,091
Other_Commercial_Building	748	1,463	1,813
Schools	568	1,059	1,220
Warehouse_Wholesale	477	1,040	1,277
Food_Retail	481	967	1,209
Large_Non-Food_Retail	457	965	1,185
University_Colleges	313	675	831
Nursing_Home	241	576	722
Restaurant	224	540	698
Hospital	192	389	431
Other_Non-Food_Retail	152	327	402
Large_Hotel	160	299	345
Other_Hotel_Motel	63	115	141
Other			
Grand Total:	6,306	12,577	14,997

- Offices account for 33% of the electricity consumption in the commercial sector. In addition, retail facilities account for 19% of commercial electricity consumption and the other commercial buildings sub sector accounts for 11% of the total commercial electricity consumption. [Ref 3; page 25]

- Exhibit 18 (on page 38) is a forecast of technical potential electricity savings, by milestone year and end use. The underlying data has been replicated in Table 6-2 below for convenience of reference.

Table 6-2, Technical Potential Electricity Savings, by End Use

Sub-Sector	Technical Potential Savings, GWh		
	2012	2017	2022
HVAC_Fans_Pumps	1,671	3,554	3,493
Lighting_Interior_General	1,068	1,936	2,424
Computer_Equipment	904	1,345	1,539
Lighting_Interior_Architectural	729	1,064	1,359
Lighting_Exterior	273	743	1,064
Cooling_DX	292	808	1,076
Refrigeration	439	777	896
Domestic Hot Water	187	486	672

Sub-Sector	Technical Potential Savings, GWh		
	2012	2017	2022
Other_Plug_Loads	222	507	650
Miscellaneous_Equipment	129	416	613
Cooking	141	350	422
Lighting_Interior_High_Bay	101	239	334
Cooling_Chillers	55	155	222
Elevators	20	69	104
Forced_Air_Central_Heating	50	106	106
Baseboard_Heating	24	23	24
Other			
Grand Total:	6,306	12,577	14,997

- General interior lighting and HVAC fans and pumps make up the largest portion of consumption in each zone. [Ref 3; pg 25]
- Lighting CDM has been the workhorse of conservation so far in Ontario and in North America in general. This is, in part, because lighting technologies have advanced at a very fast pace over the course of the last two decades. They still are and therefore there is still a significant potential that can be achieved through, for example, state-of-the-art lighting design and controls, and new LED lamps and fixtures. Far from being saturated, this segment could still yield impacts for many years to come if the CDM portfolio evolves with the state of the industry. [Ref 3; pg 74]
- Contractors tend to be the "*weak*" link in most markets regarding energy efficiency information dissemination because they focus on minimizing cost and maximizing speed. Most contractors mentioned that information on energy efficiency hardly flows through them to the end-users. Many of them do not see that as their role. Nevertheless, they have a lot of face time with the end-users, and they do end up making many design decisions. [Ref 3; pg 87]
- The penetration of conventional Building Automation Systems (BAS) and building Retro-commissioning (RCx) are both on the rise in Ontario. Both RCx and the more advanced BAS techniques have penetrated only amongst innovators and early adopters, however. The market research showed large potential for both.
- In general, it was found that building owners are typically not aware of retro-commissioning, and if they are, then they are often not aware of the benefits to their operation. [Ref 3; pg 99]
- Refrigeration is a growing percentage of overall energy consumption, as more non-food retailers expand into the food market. The market research showed that the potential for programs targeting commercial refrigeration in Ontario was likely to be much larger than estimates based on other jurisdictions, particularly in the early years of the study period.

6.3.2 Results of OPA's Prediction Tool for London's Commercial Sector

The Ontario Power Authority's *Conservation First Framework LDC Tool Kit - Regional Potential Calculator* (V3) defines the following upper achievable potential for London Hydro's commercial sector:

Table 6-3, Upper Achievable Potential for London's Commercial Sector

Upper Achievable Potential for Commercial Sector, GWh					
2015	**2016**	**2017**	**2018**	**2019**	**2020**
29	51	88	99	103	119

The achievable potential study doesn't distinguish between small business sector, the commercial sector, the agribusiness sector or the institutional sector. Rather, these are all categorized as "*commercial*" customers.

Table 6-3 is a great example of the achievable potential studies not passing the basic credibility "*sniff test*" within the LDC community. London Hydro is no laggard when it comes to operating energy-efficiency programs, but recognizes that it could do better by, for example, developing mobile sales tools to better support channel partners (refer to discussion in Section 13.5 herein) as opposed to focusing on the incentive application. The workhorse CDM program for this sector is certainly the provincial saveONenergy RETROFIT PROGRAM. As described in Section 6.2.1.1 (starting on page 49 herein), for London Hydro the net annual energy savings associated with this program is 8.3 GWh. Even if this achievement was increased to 10 GWh per year to account for the other CDM programs that apply to this sector (e.g. DIRECT INSTALL LIGHTING, AUDIT FUNDING, HIGH-PERFORMANCE NEW CONSTRUCTION, EXISTING BUILDING COMMISSIONING, etc.) and then doubled to 20 GWh per year to reflect the availability of mobile sales tools and more effective strategies for increasing program uptake, this 20 GWh is still a long way from the audacious predictions presented in Table 6-3 above (that significantly increase year over year).

Note: It is hoped that the updated achievable potential study (that will be carried out pursuant to Clause 6.2 of the Ministry's March 31st, 2014 directive) will provide more credible and realistic forecasts by both adopting a "*bottom-up*" approach and calibrating the fantasy of this and previous achievable potential studies with marketplace reality.

6.4 Situation Analysis

For the saveONenergy RETROFIT PROGRAM, it is known that a working group is both updating and adding a number of energy-efficiency measures on the various worksheets within the prescriptive track reflect new and evolving technologies.

It is clear that as time progresses and the "*low hanging fruit*" disappears, the magnitude of each project is smaller (i.e. whereas years ago, it was common for a London Hydro project to encompass lighting upgrades in a complete apartment building or portfolio of buildings, now many projects encompass a few VFD's or roof-top HVAC units.

Nonetheless, provided the program can be refreshed to encompass emerging technologies (which is an activity underway), it is believed that the past performance will be a good predictor of the future.

6.5 Assessment

The saveONenergy RETROFIT PROGRAM has and will continue to be a "*workhorse*" program on account of its breadth (i.e. a multitude of energy-efficiency measures are covered) and relative simplicity.

It is believed that with the adoption (by staff) of sales management techniques coupled with the availability of sales tools (as described in Section 13.5 herein), it should be possible to increase customer uptake by 25%, thereby increasing the predicted net energy savings to 10.375 GWh per annum. As such, the projected overall energy savings is calculated to be:

Projected net energy savings = 8.3 GWh/yr x 1.25 x 6 years
= 62.3 GWh

6.5.1 Opportunities for New Commercial Sector CDM Offerings

Opportunities for new local or regional CDM programs are outline in Section 11.2 (starting on page 88 herein).

7 AGRICULTURAL SECTOR SITUATION ANALYSIS

This section profiles the agricultural sector within London Hydro's franchise service territory, describes the outcome of energy conservation programs that have been operated in recent years, and provides insight into the remaining opportunities for new or continued energy conservation programs in the forthcoming years.

7.1 Characterization of London's Agricultural Sector

Other than the London Dairies operation, which was entirely retrofitted a few years ago under the saveONenergy RETROFIT PROGRAM, there are no major agribusiness operations (e.g. large greenhouse operations or factory farms) within London Hydro's franchise service territory.[38]

Note: The term "*factory farm*" refers to a large, industrial operation that raises large numbers of animals for food.

7.2 Assessment

Although, London is surrounded by agribusiness operations, there are no known opportunities to develop a CDM program that focuses on the agricultural sector.

[38] Middlesex County brochure: Agri-business Sector Profile. See URL:: http://www.investinmiddlesex.ca/sites/default/files/Agribusiness.pdf

8 INSTITUTIONAL SECTOR SITUATION ANALYSIS

This section profiles the institutional sector within London Hydro's franchise service territory, describes the outcome of energy conservation programs that have been operated in recent years, and provides insight into the remaining opportunities for new or continued energy conservation programs in the forthcoming years.

8.1 Characterization of London's Institutional Sector

London's institutional sector includes:

- Western University
- Fanshawe College
- Two (2) school boards, namely the Thames Valley District School Board (with 68 elementary and 13 secondary schools within London Hydro's service territory) and London Catholic School Board (with 29 elementary and 6 secondary schools within London Hydro's service territory);
- The Corporation of the City of London, including police, fire, water pumping, water treatment, recreation facilities, etc.
- Two (2) hospital organizations, namely London Health Sciences Centre (that is responsible for the Victoria Hospital campus and University Hospital campus) and St. Joseph's Health Care London (that is responsible for St. Joseph's Hospital, Mount Hope Centre for Long-Term Care and Parkwood Institute).
- Ontario Infrastructure and Lands Corporation (which operates as Infrastructure Ontario), an Ontario crown agency responsible for facilities management and real estate for all buildings and lands occupied by the provincial government and their agencies, e.g. London Court House, London Middlesex Detention Centre, etc.
- Public Works Canada, a Canadian crown agency responsible for facilities management and real estate for all buildings and lands occupied by the federal government and their agencies.

In total, the institutional sector has a very significant presence in London.

8.2 Review of Energy-Efficiency Achievements to Date

Institutional customers can and have participated in a number of provincial CDM programs within the saveONenergy FOR BUSINESS portfolio (e.g. RETROFIT PROGRAM, PROCESS & SYSTEMS initiative, SMALL BUSINESS FUNDING, AUDIT FUNDING, etc.).

As with most LDC's customers are categorized by their tariff classification (e.g. General Service Less than 50 kW, General Service Greater than 50 kW, Large User, etc.) and not by other identifiers (e.g. small business, institutional, municipal, industrial, etc.) so it is not practical to query existing databases and determine the contributions from the institutional sector to the achievements of each provincial CDM program.

However, three (3) institutional customers, namely the City of London, Fanshawe College, and London Health Sciences Centre, have funded Embedded Energy Managers (under the saveONenergy PROCESS & SYSTEMS program) to achieve defined energy savings and demand reduction savings within their respective organizations year over year.

8.3 Identification of Potential Energy-Efficiency Opportunities

8.3.1 Backgrounder on Ontario Regulation 397/11

Ontario Regulation 397/11, *Energy Conservation and Demand Management Plans*,[39] specifically applies to 722 broader public sector organizations throughout the Province with approximately 32,000 facilities. These include municipalities, municipal service boards, universities, colleges, school boards and hospitals.

Organizations are required to report on designated operations for all buildings that are owned or leased by the organization where they receive an energy invoice and are responsible for paying it. This includes electricity, natural gas, propane, fuel oil, and district energy use.

There are two (2) critical deadlines in the regulation, namely:

- All affected organizations were required to report and post 2011 energy consumption data by July 1, 2013.
- The next significant deadline was July 1, 2014, when all organizations were mandated to post a five-year energy conservation and demand management plan.

Subsequent CDM plans are to be submitted every five years. If energy conservation work was initiated prior to 2014, public agencies can include information on the results of those measures in the first plan. The second plan (due in 2019) will require a report of the results achieved through the first plan.

It is noteworthy that no targets for reductions in energy consumption or demand are mandated at this time.

Note: During the consultation with stakeholders, the Ministry of Energy was told that the Broader Public Sector (BPS) was not ready for provincially set targets. As a result of this feedback, and due to insufficient data on energy consumption within BPS operations, the ministry chose

[39] Ontario Regulation 397/11, *Energy Conservation and Demand Management Plans*, made under the Green Energy Act, 2009 is posted electronically at URL: http://www.e-laws.gov.on.ca/html/source/regs/english/2011/elaws_src_regs_r11397_e.htm

not to set energy conservation targets at this time. Instead, it has required agencies to set goals and objectives within their energy conservation and demand management plans.[40]

Ironically, Infrastructure Ontario which is responsible for asset management of all provincial buildings is not specifically named in Ontario Regulation 397/11 (for reasons unknown). According to London Hydro's records, the facilities within London Hydro's service territory under the management of Infrastructure Ontario are listed in Table 8-1 below.

Table 8-1, Provincial Facilities in London

Provincial Facility	Municipal Address	Activity
Employment Ontario	1200 Commissioners Road East	
Ministry of Community Safety and Correctional Services - Probation and Parole	561 Southdale Road East	
London Court House	80 Dundas Street	
Ontario. Ministry of Community Safety and Correctional Services - Probation and Parole	1165 Oxford Street East	
	859 Exeter Road	
London Psychiatric Hospital	850 Highbury Avenue North	
Ontario Ministry of Agriculture and Food, Ministry of Rural Affairs - London Resource Centre	667 Exeter Road	
Genest Detention Centre for Youth	1670 Oxford Street East	
Elgin-Middlesex Detention Centre	711 Exeter Road	
Central Ambulance Communications Centre	1510 Woodcock Street	
	900 Highbury Avenue North	
Ontario Provincial Police	823 Exeter Road	
Ontario Provincial Police	6355 Westminster Drive	
London Normal School	165 Elmwood Avenue East	
	233 Wharncliffe Road South	

Note: Of the foregoing list, the historic London Psychiatric Hospital staff and patients will be relocated to new facilities at Parkwood Institute and the facility will ultimately be closed. Similarly the historic London Normal School will be re-purposed in future.

Public Works and Government Services Canada is responsible for asset management of all federal

[40] Environmental Commissioner of Ontario report: *Restoring Balance - A Review of the First Three Years of the Green Energy Act - Annual Energy Conservation Progress Report – 2011 (Volume One)*; June 2012; *Benchmarking and Target Setting*, pg 37.

buildings and as a federal Crown entity would be exempt from provincial regulations, and specifically Ontario Regulation 387/11.

According to London Hydro's records, the facilities within London Hydro's service territory under the management of Public Works Canada are listed in Appendix C herein..

8.3.2 Synopsis of the City of London's CDM Plan

The Corporation of the City of London has over 200 facilities distributed throughout its municipal boundaries.

The City of London's CDM Plan[41] has a specific overall objective (i.e. The City of London's proposed goal is to achieve an additional 10 percent reduction in total annual energy use from 2014 levels by 2020), but correctly considers energy to be electricity, natural gas, district energy, and vehicle fuels without a specific breakdown of anticipated gains by fuel type. This approach gives the City considerable flexibility with respect to the unpredictable future. If, one option stalls due to unforeseen circumstances then other options can be explored to meet the stated overall goal.

On the electricity side, the Plan envisions continued deployment of renewal energy generation (e.g. solar photovoltaic energy systems, biogas generation projects, and waste heat recovery generation projects). Two of these embedded load displacement generation projects are known to London Hydro and included in *Table 10-3, Active Embedded Load-Displacement Generation Projects* (on page 78 herein).

The CDM Plan also makes specific reference to seventeen (17) energy audits performed with financial assistance from the saveONenergy AUDIT FUNDING program. If all projects proceed (likely under the RETROFIT PROGRAM), then the projected savings will be 1,502,335 kWh and 395 kW. The City of London has been a regular participant in the RETROFIT program, so these projects will simply be considered in the future projections associated with the RETOFIT program.

Interestingly the City's CDM Plan is devoid of any reference to an project now being contemplated, namely the conversion of some 9,000 cobra-head roadway lighting fixtures from high-pressure sodium (HPS) technology to energy-efficient LED technology. The anticipated annual savings with this endeavor is 5,691 MWh (or 5.6 GWh).

---

[41] City of London report: *Corporate Energy Conservation and Demand Management (CDM) Plan;* July 2014. Document available online at URL:: http://www.london.ca/residents/Environment/Energy/Documents/2014%20CDM%20Plan%20final.pdf

Note: Reported gross energy savings are usually discounted (subsequent to the program EM&V phase) to account for "*free ridership*" and similar phenomena. Many LDC's are concerned that the discount rate for these types of municipal roadway lighting projects may be significant since their respective municipality identified such projects in their submitted CDM Plan, i.e. the municipality likely would have done this whether or not there was an incentive program available. For the purposes of this CDM Plan, London Hydro will not be discounting the predicted energy savings associated with the described roadway lighting upgrade project on the basis that it wasn't something that was included in the City's CDM Plan submission.

It is perhaps noteworthy that Ontario Regulation 397/11 does not encompass a municipality's Boards and Commissions. As such the following entities are excluded from London's CDM Plan:

- London Fire Department
- London Police Services
- London Transit Commission
- London & Middlesex Housing Corporation

Nonetheless, the entities identified above have participated in various provincial CDM programs, and it is likely they will also continue to participate in future, irrespective of whether they are include in London's CDM Plan.

8.3.3 Synopsis of Fanshawe College's CDM Plan

Fanshawe College has facilities in London, Simcoe, St. Thomas, Woodstock and Tillsonburg.

FANSHAWE COLLEGE

Within London, the main campus is located at 1001 Fanshawe College Boulevard and consists of 11 modern buildings set on 100 acres. Also within London are the following satellite facilities:

- Centre for Applied Transportation Technologies (located at 1764 Oxford Street East;
- Centre for Digital and Performance Arts (located at 137 Dundas Street);
- Cuddy Court warehouse (located at 2 Cuddy Court); and
- The downtown Citi Plaza Mall facilities (located at 355 Wellington Street).

Ontario Regulation 397/11 allows a Broader Public Sector's CDM Plan to include renewable energy generation, behavioral changes, and perhaps other energy-conservation measures that wouldn't be eligible for incentives within the saveONenergy FOR BUSINESS portfolio of energy-efficiency programs

Salient features of Fanshawe College's CDM Plan[42] are identified below:

[42] Fanshawe College publication: *Energy Conservation & Demand Management Plan; 2014 – 2019*; July 2014.

- The College has completed a comprehensive audit (under the saveONenergy AUDIT FUNDING program) of all college-owned facilities at 24 buildings located in London, St. Thomas, Simcoe and Woodstock [page 1 within CDM Plan].
- The Energy Management Opportunities (EMO's) are projected to reduce overall electrical and natural gas usage by 11% and 9% respectively [page 8 of CDM Plan].
- Tables D-2 through to D-6 within the CDM Plan set forth anticipated capital expenditures and anticipated electricity and natural gas savings, year by year, over the 2015 to 2019 timeframe.
- The major elements of Fanshawe College's CDM Plan are as follows:
  - Capital projects - Capital Projects are EMOs which include lighting, electrical, mechanical upgrades (controls, and hydronic equipment such as boilers and pumps), HVAC upgrades (motors, variable frequency drives, building automation controls, etc.), and building envelope upgrades (new roofing, and cladding, weather-stripping of doors and windows) as well as major renovations and new construction. The Plan identifies Capital Projects which when fully implemented are expected to provide annual electrical and natural gas usage avoidances of 1,748 MWh, and 140,986 m^3 respectively, as well as reduce electrical peak demand by 287 kW.
  - Retro-Commissioning (RCx) - Retro-Commissioning (RCx) of existing buildings involves a process of optimizing a building's operations and maintenance. The goal of RCx is to return the building to either its original designed purpose or to an improved energy efficient state. RCx may result in Capital Projects being identified, but the main purpose is the optimization of the facility. The Plan anticipates that RCx of select facilities will provide annual electrical and natural gas usage avoidances of 876 MWh and 33,984 m^3 respectively, as well as reduce electrical peak demand by 42 kW.
  - Implementation of an Energy Management Information System (EMIS) - This system will provide the necessary information and analysis required to monitor energy usage in real time so that action can be taken in a timely manner, ensuring system efficiency is maintained. The Plan anticipates that the EMIS will provide annual electrical and natural gas usage avoidances of 358 MWh and 28,500 m^3 respectively, as well as reduce electrical peak demand by 113 kW.
  - College Community Awareness & Training - In partnership with the Sustainability Committee, employee incentive and reward programs will be developed to bring about an awareness of energy usage and foster a culture inclined towards reducing waste and becoming more efficient. As these initiatives are difficult to quantify, it is estimated that a conservative reduction of ½% will be realized annually. This Plan estimates that providing College Community Awareness & Training will result in annual electrical and natural gas usage avoidances of 130 MWh and 9,500 m^3 respectively, as well as reduce electrical peak demand by 29 kW.

- Energy Team - During the first year of the Plan an Energy Team will be formed consisting of key energy champions. This team will meet on a tri-annual basis to review progress of the Plan's implementation, identify additional measures, oversee the implementation of the College Community Awareness and Training programs as well as provide recommendations for additional content and improvements.

Fanshawe College has a dominant presence in London, and therefore it is reasonable to assume that the lion's share of the projected energy savings will occur with London Hydro's service territory.

8.3.4 Synopsis of Western University's CDM Plan

Western University's main campus consists of 63 buildings of various vintages located on lands to the west of Richmond Street, on both sides of Windermere Road, on both sides of Western Road, and on both sides of Sarnia Road.

Other satellite operations include Western's Advanced Manufacturing Park, located in Innovation Park (east of Veterans Memorial Parkway and north of Bradley Avenue) that presently has three (3) new facilities, namely: the Wind Engineering, Energy and Environment (WindEEE) Dome, the Fraunhofer Project Centre for Composites Research, and the Advanced Manufacturing Centre. All three facilities were designed and constructed for LEED® Silver certification so no opportunities for further energy-efficiency programs are foreseen within the Advanced Manufacturing Park.

Western University previously developed and published a ten-year energy and water management master plan[43] that covers the existing sixty-three (63) buildings on the main campus over the period from June 2013 to June 2013. The 10-year roadmap is divided into three (3) distinct phases, namely:

- Year 1 (June 2013 – June 2014) priority actions;
- Years 2 – 4 (June 2014 – June 2017) medium-term actions; and
- Years 5 – 10 (June 2017 – June 2023) longer-term actions.

Since the CDM delivery framework for the LDC community covers the time period from January 2015 to December 2020, the year 1 priority actions are irrelevant to this resource planning endeavor, and some judgment will be required to excerpt energy-efficiency projects from the latter part of Western University's medium-term actions and the earlier part of Western University's longer-term actions.

[43] Western University report B2761, *Western University Energy and Water Management Master Plan; 2013 – 2023*; prepared for Western University by Finn Projects and IndEco Strategic Consulting Inc; May 22, 2013.

Western University has not participated in the provincial saveONenergy FOR BUSINESS energy-efficiency programs due to an unwillingness to surrender environmental attributes (which don't exist at present) to the province. In fairness, the Ontario Power Authority approach is inequitable. Rather than divide the environmental attributes in accordance with each party's contribution, the various incentive agreements are worded such that all environmental attributes accrue to the Ontario Power Authority regardless of the incentive amount in comparison to the customer's overall investment in energy-efficiency measures.

According to Western University's master plan, the medium-term will focus on technological energy-efficiency actions within six (6) buildings with the poorest energy performance. These buildings and the anticipated energy savings are identified in Table 8-2 below.

Table 8-2, Estimated Medium-Term Annual Electricity Savings for Western University

Facility	Reference to Tabulation within Western University's Master Plan	Anticipated Annual Electricity Savings, kWh
(Col 1)	(Col 2)	(Col 3)
Dental Sciences Building	Table 9	749,100
Medical Sciences Building	Table 10	192,309
Social Science Centre	Table 11	1,660,250
Spenser Engineering Centre	Table 12	515,500
Student Recreation Centre	Table 13	194,700
3M Centre	Table 14	42,650
	Total:	**3,354,509**

The energy-efficiency measures based on technology are primarily the deployment of variable frequency drive technology for exhaust fans, air handling units, domestic water pressure booster pumps, and chilled water recirculation pumps, and the deployment of high-efficiency motors in high duty cycle applications.

Note: In cases where the deployment of solar photovoltaic energy systems is listed in the Master Plan as one of the energy actions, this has been removed from Column 3 in Table 8-2 above.

Western University's master plan specifically notes the need for more building-level flow meters to measure the consumption of domestic water and thermal power (e.g. steam or chilled water) to properly benchmark the overall energy performance and water consumption of various buildings. The installation of such permanent flow meters is anticipated to occur in year 1 and years 2 – 4 of the 10-year roadmap.

Specific efficiency measures are planned for years 5 – 10 for the buildings identified in Table 8-3 below. It is anticipated that this list will be expanded once more flow meters are installed and performance benchmarking is carried out, and specific opportunities are identified.

Table 8-3, Estimated Longer-Term Annual Electricity Savings for Western University

Facility	**Reference to Tabulation within Western University's Master Plan**	**Anticipated Annual Electricity Savings, kWh**
(Col 1)	(Col 2)	(Col 3)
University Community Centre	Table 16	133,000
Law Building	Table 17	135,495
Siebens-Drake Research Centre	Table 18	207,450
	Total:	**475,945**

Again, the energy-efficiency measures based on technology are primarily the deployment of variable frequency drive technology for exhaust fans, air handling units, domestic water pressure booster pumps, and chilled water recirculation pumps, and the deployment of high-efficiency motors in high duty cycle applications.

Note: In cases where the deployment of solar photovoltaic energy systems is listed in the Master Plan as one of the energy actions, this has been removed from Column 3 in Table 8-3 above.

Page 39 of Western's CDM Plan is discusses the virtue of a tri-generation facility (i.e. district energy plant) located on the main Western campus. A feasibility study is recommended in the CDM Plan, and in fact London Hydro is initiating discussions with Western and their consultants to finalize such a study. Preliminary findings suggest the campus thermal load will support a district energy plant with an electrical output greater than 10 MW_e, but Clause 7.1 of the Ministry directive of March 31st, 2014[44] limits the output rating of eligible embedded load displacement generators to 10 MW.

Historically, Western University has chosen not to participate in the provincial CDM programs on account of provisions in the various agreements concerning non-existent environmental attributes.[45] This matter is now been addressed via another Ministry directive[46] instructing the OPA to remove all terms related to environmental attributes and their ownership. This is a long-overdue but welcome notice, as it means that Western's energy-efficiency and embedded load-displacement generation projects will contribute to London Hydro's CDM targets.

[44] Directive, dated March 31st, 2014, to Ontario Power Authority from Ministry of Energy; re*: 2015 – 2010 Conservation First Framework*.

[45] London Hydro Report EM-12-04, *Energy Conservation and Demand Management – Annual Report of London Hydro's 2011 Activities and Achievements*; September 2012; Section 3.6.9, *The Environmental Attributes Inequity*; pg 55 – 57.

[46] Directive, dated December 5, 2014, to the Ontario Power Authority from the Ministry of Energy; re: *Treatment of Environmental Attributes under the 2015 – 2020 Conservation First Framework*.

8.3.5 Synopsis of Thames Valley District School Board's CDM Plan

The Thames Valley District School Board encompasses 134 elementary schools, 28 secondary schools, plus administrative and maintenance buildings.[47] Of this population of facilities, 68 elementary schools and 13 secondary schools are located within London Hydro's franchise service territory. While much of the Plan deals with past achievements (with respect to electricity and natural gas), Section 6, *Energy Management Projects and Programs*, of the Plan mentions a few specific planned energy-efficiency upgrades (some of which are in London, but others that are in Tillsonburg, Strathroy and Woodstock), but the strategic direction is to consider energy-efficiency in conjunction with end-of-life asset renewal projects.

Section 6 of the Plan also notes: "*A 6.5% reduction in energy intensity in the next 5 years is achievable if current renewal budgets are maintained.*"

8.3.6 Synopsis of London District Catholic School Board's CDM Plan

The London District Catholic School Board encompasses 51 elementary schools, 9 secondary schools, 1 adult learning centre, plus administrative and maintenance buildings.[48] Of this population of facilities, 29 elementary schools, 6 secondary schools, and 7 French immersion / adult education facilities are located within London Hydro's franchise service territory. While much of the Plan deals with past achievements (with respect to electricity and natural gas), page 27 shows a graphic of the 2012 energy intensity for each facility in the portfolio along with a notation that 42% of the facilities meet or exceed the industry average – implying of course that more than half the facilities are below the industry average for energy intensity.

On a go-forward basis, it appears that the LDCSB's strategy is two-fold, namely:

- Undertake building re-commissioning (also referred to as retro-commissioning) – As noted on page 37 of the LDCSB CDM Plan: "*Building re-commissioning, or retro-commissioning, refers to the optimization of the current automation, controls and energy consuming systems. As buildings age, both the functionality of the equipment and the functions that they serve can undergo significant changes. A re-commissioning program generally focuses on ensuring that the equipment operations are modified to include any new or deleted duties. The*

[47] Thames Valley District School Board publication: *2014 – 2019 Conservation and Demand Management Plan*; Section 1, *Facility and Utility Consumption Background*.

[48] London District Catholic School Board publication: *Five Year Conservation and Demand Management Plan – September 2013 – August 2018*; Prepared by VIP Energy; June 2014; pages 17 & 18.

following is a list of common problems found in re-commissioning projects that result in increased energy costs: …".

- Adjust purchasing practices to consider life-cycle costs -

  As noted on page 36 (of the LDCSB CDM Plan): "*The practice of 'low bidder wins' purchasing limits the Staff when trying to make the right environmental decision. Making a specific amount of money available to include the conservation upgrades allows the School Board to take advantage of necessary investments in order to reduce their impact on the bottom line after the cost of purchase. For example, when purchasing a motor, all suppliers will specify standard efficiency motors. An energy smart buyer will know that 90%+ of the motor's lifecycle cost is in its energy use. Therefore, buying a premium efficiency motor at a small incremental cost has a payback of less than three years. Missing this opportunity translates into a long term financial increase. In fact, the incremental cost between a less efficient and a more efficient alternative is often less than 5% of the capital cost. That 5% capital cost difference is often recuperated in less than three years. This allows Staff to make the right environmental decision based on industry best financial practices.*"

There is nothing in the LDCSB CDM Plan that provides a definitive breakdown on the anticipated electrical savings within London Hydro's service territory within the five-year plan.

8.3.7 Synopsis of London Health Science Centre's CDM Plan

London Health Science Centre (LHSC) is comprised of four (4) separate campuses / facilities, all located in London.

The campuses / facilities are identified following:

- Victoria Hospital & Children's Hospital, 800 Commissioners Road East, London
- University Hospital, 339 Windermere Road, London
- Byron Family Medical Centre, 1228 Commissioners Road West, London
- Victoria Family Medical Centre, 60 Chesley Avenue, London

LHSC has been active on the energy conservation front for many years now. The larger energy savings opportunities identified in their CDM Plan[49] are:

- Upgrading of the existing high-pressure sodium (HPS) lighting fixtures in the various parking garages to induction lighting systems for an expected annual energy savings of 350,000 kWh;

[49] LHSC publication: *Conservation Demand Management Plan – London Health Sciences Centre – Made for Ontario Regulation 397/11 under the Green Energy Act, 2009*.

- Replace the existing absorption chillers (now at end of life) with steam-driven centrifugal chillers, thereby harnessing waste heat from the cogeneration facilities. Such a plan would allow increased generation in the summer months, with an associated anticipated savings of 2,464,000 kWh per year.

LHSC is a show-case for The Chester Network behavioral change program, but none of the (un-incented) savings have ever been claimed by London Hydro.

8.3.8 Synopsis of St Joseph's Health Care – London's CDM Plan

St Joseph's Health Care – London is comprised of six (6) separate facilities, five (5) located in London and one (1) located in St Thomas.

The facilities are identified following:

- St. Joseph's Hospital, 268 Grosvenor Street, London
- Mount Hope Centre for Long-Term Care, 21 Grosvenor Street, London
- Parkwood Hospital, 801 Commissioners Road East, London
- Regional Mental Health Care London. 850 Highbury Avenue, London
- Southwest Centre for Forensic Mental Health Care, 401 Sunset Drive, St Thomas
- St. Joseph's Family Medical and Dental Centre, 346 Platts Lane, London

Many of these facilities are fairly new, so St. Joseph's CDM Plan[50] really only identifies three areas for energy-efficiency improvements, namely:

- A continuation of *The Chester Network* behavioral change program;
- Installation of VFD's to improve cooling tower operation; and
- Upgrading exterior parking lot and security lighting systems to LED technology.

These latter two classes of energy-efficiency projects would be handled under the saveONenergy RETROFIT PROGRAM.

8.4 Situation Analysis

While Ontario Regulation 397/11 was likely well-intended, there are some shortcomings that influence London Hydro's CDM plan, namely:

- The CDM Plans created by the Broader Public Sector and filed with the Ministry are aspirational only – there are no firm targets and no real requirement for the entity to achieve anything (i.e. no consequences for underachievement).
- The regulation doesn't encompass boards, commissions, etc.

[50] St. Joseph's Health Care London document: *Energy Conservation and Demand Management Plan; Made for Ontario Regulation 397/11 Green Energy Act, 2009*; June 18, 2014.

As such, even though this CDM Plan is counting on the energy savings opportunities documented within each institution's CDM Plan to be realized, there is some risk that some of these projects won't proceed for a variety of reasons (e.g. technology perceived to be immature, the cost-benefit ratio isn't favourable, etc.) that may not be revealed to London Hydro.

8.5 Assessment

The institutional sector in London has been engaged (to various degrees) with energy conservation for many years now, and it is likely that this interest and participation will continue into the future. Under the 2011 – 2014 CDM delivery framework, three-quarters of the embedded energy managers (EEM's) in London were employees of institutional organizations, and specifically:

- The Corporation of the City of London
- Fanshawe College
- London Health Sciences Centre

A prerequisite for ongoing funding is continuing to deliver (both incented and un-incented) annual energy savings. Although the Embedded Energy Manager program is being re-designed, there are still sufficient energy-efficiency opportunities within these organizations to continue funding Embedded Energy Managers in the forthcoming years.

Ontario Regulation 397/11 raises the profile within the various institutions, thereby increasing the likelihood that energy-efficiency projects identified in the various CDM Plans will be funded and carried out. Usually, the institutional sector can accept much longer paybacks on energy-efficiency projects than would be deemed acceptable in other sectors (e.g. manufacturing, small business, etc.).

8.5.1 Opportunities for New Institutional Sector CDM Offerings

With respect to Section 8.3.6, *Synopsis of London District Catholic School Board's CDM Plan* herein, the LDCSB already undertakes energy performance benchmarking and has identified building retro-commissioning as an opportunity for improving energy efficiency. Fanshawe College arrived at the same conclusion within their CDM Plan as outlined in Section 8.3.3, *Synopsis of Fanshawe College's CDM Plan* herein. The literature[51] suggests that energy benchmarking can be an effective strategy for improving the participation rate in energy audits and the implementation rate for re-commissioning projects.

The LDCSB CDM Plan notes the following examples of common problems found in re-commissioning projects that result in increased energy costs (if left uncorrected):

[51] Minnesota Department of Commerce report COMM-03192012-55323/71145, *Integrating Benchmarking into Utility Conservation Improvement Programs to Capture Greater Energy Savings*; prepared by The Weidt Group, Inc.; August 2014; page 36.

- Inefficient scheduling of HVAC equipment,
- Simultaneous heating and cooling,
- Economizer sequences not optimized,
- Incorrect airflow and water balance,
- Malfunctioning sensors or incorrect calibration,
- Fan VFD control overridden,
- Supply air static pressure set-points not optimized,
- Boiler controls not operating efficiently,
- Balancing dampers and valves not installed or installed in poor or unusable locations,
- Incorrectly piped water coils,
- Process or space classification changes (lab space to office, etc.),
- Incomplete or incorrect control component installation,
- Control sequence incorrectly implemented,
- Substituted control components,
- Incomplete installations (missing control valve, actuators, etc.), and
- Testing, adjusting, and balancing (TAB) not completed or only partially completed.

Within the provincial saveONenergy FOR BUSINESS portfolio, is an incentive program identified as saveONenergy EXISTING BUILDING COMMISSIONING. However, Table 4A within the IESO publication *Conservation & Demand Management Status Report - Q4 2014 Preliminary Results Update* indicates that the provincial uptake, over the 2011 to 2014 time period, has been zero (i.e. an abysmal failure).

The opportunity here for London Hydro is either to initiate re-design of the provincial EXISTING BUILDING COMMISSIONING program (to eliminate the participation barriers), or to create a local or regional custom CDM program (in conjunction with the Business Sector Benchmarking effort described in Section 13.1.3 - starting on page 99 herein).

9 INDUSTRIAL SECTOR SITUATION ANALYSIS

London's industrial sector (also known as its "*manufacturing*" sector) is simply a subset of overall "*commercial, industrial and institutional*" category of customers. This section describes the outcome of energy conservation programs that have been operated in recent years, and provides insight into the remaining opportunities for new or continued energy conservation programs in the forthcoming years.

9.1 Characterization of London's Industrial Sector

The North American Industry Classification System (NAICS) is used by business and government to classify business establishments according to type of economic activity (process of production). Each establishment is classified to an industry according to the primary business activity taking place there. For example, the 31-, 32- and 33-series of codes identify "*Manufacturing*", the 44- and 45-series of codes identify "*Retail Trade*" businesses, the 52-series of codes identify "*Finance and Insurance*" businesses, the 72-series of codes identify "*Accommodation and Food Services*" businesses, etc.

Like most LDC's, London Hydro doesn't have any business reasons for obtaining and maintaining the NAICS code for each industrial, institutional and commercial customer as an attribute within its *Customer Information System* (CIS) database. Rather the closest attribute that is maintained is each customer's electricity tariff classification, e.g. residential, general service less than 50 kW, general service greater than 50 kW, large user, etc.

Note: As part of a customer engagement project, an electronic data file was previously created that identifies every "*manufacturing*" sector customer within London Hydro's service territory complete with contact information and an indication of whether or not that customer has previously undertaken energy-efficiency upgrades via one of the incentive programs.

9.2 Review of Energy-Efficiency Achievements to Date

9.2.1 Effect of Provincial Incentive Programs

Depending upon the magnitude of the energy efficiency project and proposed technology, the two (2) provincial programs that are most applicable to the manufacturing sector are:

- saveONenergy RETROFIT PROGRAM, for lighting retrofits and smaller energy-efficiency upgrades; and
- saveONenergy PROCESS & SYSTEMS for non-lighting large energy-efficiency upgrade projects.

9.2.1.1 saveONenergy PROCESS & SYSTEMS Program

Under the 2011 – 2014 CDM delivery framework, the saveONenergy PROCESS & SYSTEMS initiative had a number of elements, namely:

- Incentives for large non-lighting energy-efficiency projects (with potential energy savings above a defined threshold value);
- Incentives for the installation and utilization of a Monitoring & Targeting System within the customer's plant;
- Funding, up to a defined threshold amount, to carry out two (2) levels of engineering feasibility studies (referred to as "*preliminary*" engineering studies and "*detailed*" engineering studies) via the consultant of the customer's choosing;
- Significant funding for customers (above a certain size) to hire an "*embedded energy manager*" and for LDC's to engage "*roving energy managers*" and "*key account managers*" provided certain minimum energy savings and demand reduction targets were attained.

The plethora of a participation barriers limited London Hydro's success with the incentive funding component of the initiative to two (2) relatively small energy efficiency projects, representing (432 MWh/y + 267 MWh/y =) 699 MWh in net annual energy savings, and two (2) M&T systems for which the saving have yet to be reported.

The Embedded Energy Manager sub-program within the saveONenergy PROCESS & SYSTEMS initiative provides funding for embedded energy managers provided they meet or exceed their target and at least 30% of the energy savings is unincented.

Figure 9-1 below shows the annual results (in terms of number of participants as well as net annual demand reduction) of the saveONenergy PROCESS & SYSTEMS initiative (and specifically the Embedded Energy Manager funding sub-program) within London Hydro's franchise service territory.

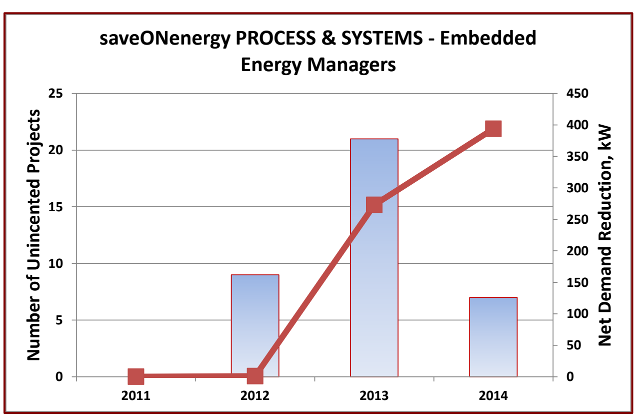


Figure 9-1, Participation in Embedded Energy Manager Sub-program

Although not shown in the graphic, the average net <u>annual</u> energy savings associated with this program is about 1,085 MWh (i.e. 1 GWh).

Note: Three of the four (4) embedded energy managers presently under contract with London Hydro, are also responsible for facilities outside of London Hydro's franchise service territory. As such, some achieved energy savings may be credited to other LDC's.

9.3 Identification of Potential Energy-Efficiency Opportunities

Perhaps the best source of identifying previously untapped energy-efficiency opportunities is via a study of the Achievable Potential report that applies to the industrial sector [Ref 4].

9.3.1 Synopsis of Achievable Potential Report

The Ontario Power Authority (OPA) commissioned the consulting firm ICF Marbek to prepare an estimate of electricity and energy efficiency potential in Ontario. This study was intended to inform both the development of Ontario's updated *Long-Term Energy Plan, Achieving Balance*, and energy conservation programs for the 2015 to 2020 CDM delivery framework.

Achievable potential is the proportion of feasible gains in energy efficiency that can realistically be achieved within the study period. The overall study includes details on the achievable potential in each of the residential, commercial and industrial sectors.

The ICF Marbek report that deals specifically with the industrial sector [Ref 4] was reviewed with the following observations:

- The report introduces the term "*technical potential*" as the level of electricity consumption that would occur if all equipment was upgraded with the most energy efficient, commercially available technologies and behavioral practices, regardless of cost. [Ref 4, pg 33]
- By contrast, the term "*achievable potential*" is considered the proportion of the savings identified in the technical potential forecasts that could realistically be achieved within the study period. Achievable potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the technical potential forecast. The results are presented as a range, defined as "*Lower*" and "*Upper*". [Ref 4, pg 42].
- The lower achievable potential was based on a target customer payback period of two years for each measure, and the upper achievable potential was based on a target payback of one year. [Ref 4, pg 105]
- Exhibit 23 (on page 44) shows relationship between technical potential and achieved savings via OPA CDM programs to 2012, by end use. Of the 1,896 GWh/yr in technical potential savings, provincial CDM programs delivered 253.2 GWh/yr, or about 13%.

- Exhibit 18 (on page 38) is a forecast of technical potential electricity savings, by milestone year and end use. The underlying data has been replicated in Table 9-1 below for convenience of reference.

Table 9-1, Technical Potential Electricity Savings, by End Use

End Use	Technical Potential Savings, GWh/yr		
	2012	2017	2022
Motors_Pumps	346	1,288	1,949
Compressed Air	335	1,209	1,814
HVAC	301	653	997
Process_Specific	333	578	852
Motors_Other	153	568	889
Motors_Fans_Blowers	152	554	818
Process_Heating	132	477	691
Lighting	96	328	493
Process_Cooling	35	134	215
Other	8	24	39
ElectroChemical	4	21	33
Grand Total:	**1,896**	**5,834**	**8,790**

As noted on page 41, "*The top end uses in terms of savings potential for each zone were compressed air and pump motors …*".

More comprehensive descriptions of the various "*end use*" systems are included in the relevant Achievable Potential study [Ref 4].

9.3.2 Results of OPA's Prediction Tool for London's Industrial Sector

The Ontario Power Authority's *Conservation First Framework LDC Tool Kit - Regional Potential Calculator* (V3) defines the following upper achievable potential for London Hydro's industrial sector:

Table 9-2, Upper Achievable Potential for London's Industrial Sector

Accumulated Upper Achievable Potential for Industrial Sector, GWh					
2015	2016	2017	2018	2019	2020
14	17	21	32	43	54

Note: Recall that the Achievable Potential studies did not include embedded load-displacement generation as a CDM measure, so the entries in Table 9-2 above reflect only opportunities associated with energy-efficiency projects.

Note: Given the lack of traction over the 2011 – 2014 timeframe with the saveONenegy PROCESS & SYSTEMS initiative, it is difficult to gauge how much of a "*stretch goal*" Table 9-2 actually represents.

9.4 Situation Analysis

Certainly, one of the significant challenges getting much traction in this sector (throughout the 2011 – 2014 CDM delivery framework) has been the plethora of participation barriers inherent in the design of the saveONenergy PROCESS & SYSTEMS initiative. This program is being re-designed from the ground up, primarily to eliminate such barriers, so the expectation is for much greater participation (and delivered energy savings) going forward than has been historically recorded (both province-wide and within London Hydro's franchise service territory).

Note: The OPA's *Industrial Accelerator* program (IAP) for transmission-connected customers, upon which the PROCESS & SYSTEMS program was apparently modeled, has fared no better (in spite of having richer incentives). Although launched in 2010 (i.e. 1 year earlier than the saveONenergy FOR BUSINESS programs), by 2013 it had only garnered 8 GWh in accumulated net energy savings and 700 kW in net demand savings province-wide.[52]

Note: The lack of traction with both industrial programs represents a squandered opportunity. In addition to rich incentives, such energy efficiency investments would certainly be eligible for favourable tax treatment under the government's temporary accelerated *capital cost allowance* (CCA) provisions for new investment in machinery and equipment in the manufacturing and processing sector, an element of the federal *Economic Action Plan* which comes to an end in December 2015.

Given the lack of historical perspective, if one assumes that at least two (2) energy-efficiency projects (i.e. non embedded load displacement generation projects) come to fruition each year, and the average net energy savings associated with each project is 1,282 MWh/year,[53] then the projected energy savings will be

Projected net energy savings = *1,282 MWh/yr x 2 projects x 5 years*
= *12,820 MWh*
= *12.8 GWh*

Note: The foregoing projection uses 5-years as opposed to the 6-year timeframe of the new CDM framework. The reason is two-fold, namely: (i) the re-designed PROCESS & SYSTEMS program isn't expected to be in-market until mid-2015, and the manner in which savings are attributed is different than with other CDM programs such as RETROFIT PROGRAM.

London Hydro is presently working with one (1) industrial customer on an embedded load displacement generation project. The generator has a 1,550 kW electrical output rating and is expected to produce 11.353 GWh in annual energy savings.[54]

[52] Environmental Commissioner of Ontario annual energy conservation progress report for 2014, *Planning to Conserve*; January 2015; Section 3.3.6, *Results of OPA-Only Programs*; page 108.

[53] *saveONenergy PROCESS & SYSTEMS: Program Design Technical Reference Manual*; Section A.2, *Observations*; unpublished as yet.

[54] CLEAResult *Project Incentive Application Review* document for Project ID: 600,682; February 9, 2015 (Rev 1); Exhibit 10, *Estimated Electricity Savings Summary*.

9.5 Assessment

9.5.1 Opportunities for New Industrial Sector CDM Offerings

Although the saveONenergy RETROFIT PROGRAM and PROCESS & SYSTEMS incentive programs are sufficient broad to encompass energy-efficiency upgrades for all end use technologies previously identified in Table 9-1 (on page 73 herein) there are no sub-programs specifically targeted at enticing industrial customers to consider energy efficiency improvements to compressed air systems or pump motors (the top two end uses with respect to energy savings potential).

To this end, there are opportunities for two (2) sub-programs, which may more aptly be described as “market focus” initiatives as described in the subsections that follow.

9.5.1.1 Compressed Air System Optimization

Most manufacturing operations have some type of fluid power system, whether it is a pneumatic (i.e. compressed air) or hydraulic system. The literature suggests that compressed air systems are inherently expensive to operate, tend to have many air leaks, and such leaks carry an associated significant operating cost.

The proposed compressed air system leak detection & tagging program, described in Section 11.2.3 (starting on page 90 herein) represents a first step in a customer engagement process that is expected to lead to deeper energy savings via the implementation of more persistent energy-efficiency measures.

Addressing air leaks in a compressed air system only has a measure persistence of one year, but it both positions the customer as being concerned about the efficient operation of their compressed air system, and becomes a “*foot in the door*” for subsequent optimization measures (e.g. zero loss drains, VFD trim compressors, sequence controllers for multi-compressor systems, etc.).

9.5.1.2 Optimization of Pump Motors

The three (3) energy-efficiency measures defined on page F-3 of Ref [4] that pertain to pump motors are replicated below for convenience of reference:

- Impeller Trimming – Since pumps are often conservatively designed, the impellers are larger than they need to be, and require more power than if they were properly sized. Although replacing the impeller is always an option, impeller trimming offers the opportunity to customize the size without having to buy expensive parts. This is an appropriate measure for pumps that have many open system bypass valves indicating that excess flow is available, excessive throttling for flow control, have high levels of noise or vibration, and/or are operating far from their design points. The measure is associated with lower O&M costs.
- Super Premium Efficiency Motor for Pumps – Electric motors convert approximately 85% of industrial plant electricity use to torque to drive industrial end uses such as fans, pumps, material handling and a large portion of process

loads. These motors range in size from 75 watts to more than 25,000 kW, with corresponding efficiencies of 40%-98%. While inherently efficient in converting electricity to shaft or motive power, on average 5%-8% of this power is lost in motor inefficiencies that occur before the driven equipment losses.

For a size range from 0.75 kW to 375 kW:

- Standard efficiency motors range from 77.4% to 95%
- High efficiency motors range from 80.7% to 95.8%
- Energy savings vary from 0.8% for larger motors to 3.3% for smaller motors.

Further savings are possible for smaller motors (0.55 kW to 22 kW) with permanent magnet motors (PM motors). The efficiency of PM motors is 2% to 8% higher than that of standard motors

- Motor Control with Adjustable Speed Drive - Pumps used for variable flow in industrial applications may be candidates for adjustable speed drives (ASD). Most pump installations are single speed and operate continuously, independent of the actual load. Installing an ASD will result in significant energy savings in variable load applications where full operation may be required for less than 30% of the operating time. In these applications, 20 to 60% energy savings can be achieved. This measure is also representative of the potential to achieve energy savings through new equipment purchases, which is particularly applicable to new construction projects, plant expansions, and/or early replacement of equipment.

In reflecting on the various provincial CDM programs that were operated throughout the 2011 – 2014 timeframe, London Hydro has come to realize that the incentive application has mistakenly become the heart of the program. A proper CDM program should evolve about the sales process. The channel partners find it both challenging and time consuming to create a value proposition for energy-efficient alternatives to existing motors.

London Hydro expects to significantly increase the number of energy-efficient pump motor project and better support our channel partners by developing a number of mobile sales tools (as described in Section 13.5 herein).

10 DISCUSSION

This section assesses the energy savings likely to accrue from aggressive continuation of provincial saveONenergy CDM programs and identifies the possible short-fall between such energy savings and the target assigned to London Hydro.

10.1 Summary of Savings Resulting from Provincial CDM Programs

It is known that the various provincial CDM programs (within the saveONenergy portfolio) are undergoing design changes, which may affect program uptake, gross energy savings, net-to-gross ratios, etc. Nonetheless, unless otherwise indicated, the projections in this section are based on aggressive continuation of the existing programs and historic performance in each program.

10.1.1 Energy Savings Projection from saveONenergy FOR HOME Programs

The anticipated net energy savings for the various provincial residential CDM programs, marketed under the brands, saveONenergy FOR HOME and saveONenergy HOME ASSISTANCE, are tabulated in Table 10-1 following.

Table 10-1, Energy Savings Projections - FOR HOME Programs

Section	Section Title	Energy Savings, MWh
3.2.2.1	saveONenergy FRIDGE & FREEZER PICKUP Program It is understood that the OPA intends to suspend the saveONenergy FRIDGE & FREEZER PICKUP program in early 2015 on the basis that it is no longer cost-effective as a provincial CDM program. saveONenergy HEATING & COOLING INCENTIVE Program	--
3.2.2.2	saveONenergy HEATING & COOLING INCENTIVE Program	6,000
3.2.2.3	saveONenergy COUPON EVENT Program	4,200
3.2.2.4	saveONenergy *peaksaver* PLUS Program	--
3.2.2.5	saveONenergy EXCHANGE EVENT Program It is understood that the OPA intends to suspend the saveONenergy FRIDGE & FREEZER PICKUP program in early 2015 on the basis that it is no longer cost-effective as a provincial CDM program. saveONenergy HEATING & COOLING INCENTIVE Program.	--
3.2.2.6	saveONenergy NEW HOME CONSTRUCTION Program	1,200
4.5	saveONenergy HOME ASSISTANCE Program	2,700
	Total:	**14,100**

Overall, the anticipated energy savings (without the introduction of new CDM programs for this sector) will be on the order of 14,100 MWh, or 14 GWh.

10.1.2 Energy Savings Projection from saveONenergy FOR BUSINESS Programs

The anticipated net energy savings for the various provincial business CDM programs, marketed under the overarching brand saveONenergy FOR BUSINESS is tabulated in Table 10-2 following.

Table 10-2, Energy Savings Projections - FOR BUSINESS Programs

Section Reference herein	Section Title	Energy Savings, GWh
6.2.1.1	saveONenergy RETROFIT PROGRAM	62.3
6.2.1.2	saveONenergy AUDIT FUNDING	1.2
9.2.1.1	saveONenergy PROCESS & SYSTEMS Program	12.8
9.2.1.1	“, (Embedded Energy Manager subprogram)	6
	Total:	**82.3**

Overall, the anticipated energy savings (without the introduction of new CDM programs for this sector) will be on the order of 82.3 GWh.

10.1.3 Energy Savings Projections from Embedded Load Displacement Projects

London Hydro is presently working with four (4) customers on embedded load displacement projects. The anticipated annual energy savings of each are indicated in Table 10-3 below.

Table 10-3, Active Embedded Load-Displacement Generation Projects

Customer Reference	Generator Output Rating	Estimated Annual Energy Savings, GWh	Section Reference herein
Industrial Customer #1	1.55 MW	11.853	9.4
Institutional Customer #2	≈ 10 MW	≈ 70	8.3.4
Municipal Customer #3	3 x 19 kW_e	0.465	8.3.2
Municipal Customer #4	≈ 660 kW	≈ 5	8.3.2

The fourth project involves an organic Rankin cycle (ORC) waste heat recovery generator that is unfortunately in a grey area of the prevailing TSSA regulations. It is unclear at this point whether or not the project will proceed, i.e. if designated stationary engineers are deemed to be required, then the project is uneconomic and will not proceed. Given the uncertainty associated with this fourth generation project, it is not included in the projections of this CDM Plan.

10.2 Projected Target Shortfall

London Hydro's target, as given in Section 2.2.2 (starting on page 13 herein) is 196.66 GWh.

The information in Table 10-4 below indicates London Hydro's energy savings projections based on aggressive pursuit of existing provincial saveONenergy programs.

Table 10-4, Projected Savings from Existing Programs

Section Reference herein	Portfolio	Energy Savings Expectation, GWh
10.1.1	FOR HOME	14.1
10.1.2	FOR BUSINESS	82.3
8.3.2	" (City Roadway Lighting)	5.6
10.1.3	Embedded Generation	82
	Total:	184

Comparing London Hydro's assigned CDM target to the projected energy savings shown in Table 10-4 above shows a projected shortfall of 12.66 GWh. This is the amount that needs to be made up via regional or local CDM programs and the manner in which this will be achieved is discussed in Section 11 herein.

11 ADDRESSING THE GAP – VISION FOR NEW CDM PROGRAMS

A CDM Plan should show not only what is possible via the continuation of existing provincial CDM programs, but also how the LDC proposes to bridge the gap to meet its respective CDM target. This section presents a vision of the CDM programs that London Hydro plans to introduce, along with some rough estimates of the expected energy savings associated with each CDM program.

11.1 Opportunities for New Residential CDM Offerings

There are a number of opportunities for new or re-formulated energy-efficiency programs targeted to the residential marketplace. Each is outlined in the sub-sections that follow along with a projection of energy savings.

11.1.1 Whole-Home CDM Program – The Holy Grail

Residential CDM programs currently in the Ontario marketplace (e.g. FRIDGE & FREEZER PICKUP, COUPONS, HEATING & COOLING INCENTIVE program, etc.) encourage the homeowner to undertake a single energy-efficiency measure, e.g. replacing a few incandescent bulbs with CFL's, upgrading their central air conditioner to an ENERGY STAR qualified unit, etc.

By contrast, whole-home CDM programs (such as Pacific Gas & Electric's *California®* *Home Upgrade* offering that will serve as a model for London Hydro) take a holistic, comprehensive approach to energy-efficiency rather than focusing on individual improvements.

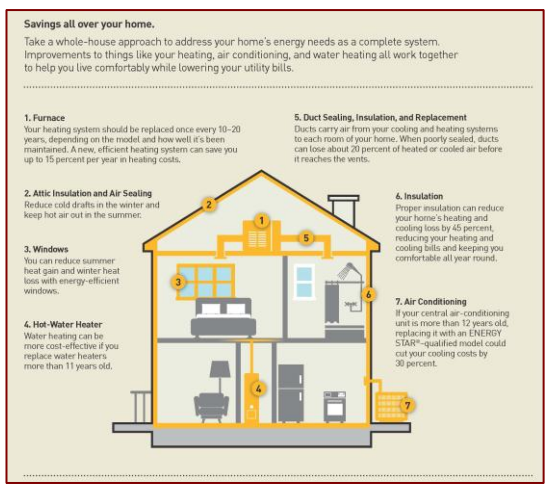


Figure 11-1, Promotional Brochure for *California Home Upgrade* Program

These programs generally consider the home as a system and consider the home's thermal envelope (outside walls, attic, foundation, insulation, and air leakage), mechanical systems (heating/cooling, hot water, kitchen and bathroom ventilation), appliances, lighting, water usage, occupant behavior, site conditions, and local climate.

Upgrades are often arranged as bundles, the greater the number of upgrade bundles implemented, the greater the energy savings and usually the greater the incentive amounts (i.e. there is a greater incentive amount associated with implementing multiple bundles than in doing a single bundle in isolation). Examples upgrade bundles are as follows:

- Home thermal envelope upgrades -
  - Attic and basement insulation
  - High-efficiency windows
  - Weatherization (sealing leaks)
- Mechanical system upgrades -
  - Furnace, air conditioner, duct insulation, and duct sealing and/or replacement
- Appliance upgrades –
  - Fridge, freezer, dishwasher
- Home automation – WiFi-enabled thermostat, etc.
- Home lighting upgrades –
- Other upgrades –
  - Swimming pool energy efficiency
  - Drain water heat recovery unit

Successful whole-home programs will strive to attain electricity savings, natural gas savings, and have a financing option available to participants (e.g. Local Improvement Charges) thereby requiring close collaboration between London Hydro, Union Gas and the City of London to design an effective program.

It will be a culmination of many sub measures/programs, yet operated as a single program. The needs of each resident and dwelling will vary and the program will be flexible enough to accommodate. It is best described as menu driven, in that a customer can choose from a single offering or a multiple of offerings.

With respect to enticing residential customers to participate in this potential CDM program offering, there are three (3) avenues, namely:

- Social benchmarking, as described in Section 11.1.3 herein.
- On-line household energy benchmarking tool, as described in Section 13.1.2 herein.
- Use of infrared thermography,[55] as illustrated in Figure 11-2, to

Figure 11-2, Application of Infrared Imagery to Highlight Household Leaks

[55] Image from website: http://www.digitaltrends.com/home/use-infrared-thermometer-easily-spot-heat-leaks-house/

make household heat loss very visual (in contrast to non-visual information that is usually included in energy audit or similar assessment reports.

Note: Before this program can be designed and launched, a number of sub-programs and other elements (e.g. financing, benchmarking tools, etc.) have to be available. As such, it is unlikely that this proposed CDM program will be in-market before 2017.

Note: It is understood that the EDA/IESO Residential CDM Working Group is considering another provincial CDM program, but it is believed that the focus of this potential offering is more of an "*interconnected home*" initiative than a "*whole home*" initiative. As such, rather than have London Hydro's whole home program considered duplicative, it may be that the provincial "interconnected home" initiative can be considered as a sub-program within London Hydro's comprehensive CDM program.

The projected annual energy savings and expected participation levels will be defined as an integral part of the program design effort, and future editions of this CDM Plan will provide energy savings projections and other updated information.

11.1.2 Regional Fridge & Freezer Program

In late 2014, the OPA announced to the LDC community that the saveONenergy FRIDGE & FREEZER PICKUP program no longer met the cost-effectiveness criteria and as such the program would come to an end in early 2015.

London Hydro (and other LDC's) currently leverages this program as an element of their saveONenergy HOME ASSISTANCE program, so this OPA decision negatively impacts two consumer programs.

As such, London Hydro has spearheaded an effort to re-formulate the FRIDGE & FREEZER PICKUP as a cost-effective regional program (likely with participation from LDC's in southwestern Ontario and the Greater Toronto area).

Assuming that this regional fridge & freezer pickup program is extended for at least another three (3) years, and the annual net energy savings is projected based on historic performance trends as depicted in Figure 3-3 (on page 22 herein), then the projected energy savings is:

Projected net energy savings = *700 MWh/yr x 3 years*
= *2,100 MWh*
= *2.1 GWh*

There may be merit in extending the regional FRIDGE & FREEZER PICKUP program past the 3-year mark, but this will be assessed later.

11.1.3 Behaviour-Based Residential Energy Efficiency Program

Behaviour-based residential energy efficiency programs (also referred to as "*social benchmarking programs*" in the literature) rely on motivations other than financial incentives to influence people's energy consumption. These non-financial influences can be powerful motivators that encourage people to reduce their energy consumption. For example, some programs send their customers home energy reports, which present that customer's energy use relative to a similar home.

On average, when informed that they use more energy than a similar home, people will take steps to reduce their consumption and across a population households can save 1-3 percent (with a mean of 2.1%).[56]

Note: The underlying theory of such programs is behavioral science that indicates "… *individuals are motivated much more by their perceptions of what other people do and find acceptable than they are by other factors such as the opportunity to save money or conserve resources, contrary to even their own perceptions of motivation*." [57] Interestingly, studies show that "… *respondents do not rate normative information (i.e. reports showing how much energy other people were consuming) as an important influence to their behavior. These results illustrate the potential power of normative messages for reshaping behavior despite the fact that their influence is often under-detected by individuals themselves.*" [58]

Usually, to demonstrate energy savings, the overall population is divided into two (2) groups; a *treatment* group (that receives the feedback about their respective energy performance), and a *control* group (that receives no feedback). In broad terms, the energy savings are determined by comparing the energy performance of each group. Usually, behaviour-based residential energy efficiency programs require the availability of at least one year of energy consumption information for participants.

Of the 134,982 active residential accounts within London Hydro's franchise service territory (in December 2014), Table 11-1 below provides an indication of the expected turn-over in residential dwellings and apartment units.[59]

Table 11-1, Normal Turn-Over of Residential Accounts

Number of Accounts Continuously Occupied by the Same Account Holder for:				
≥ 6 months	**≥ 12 months**	**≥ 18 months**	**≥ 24 months**	**≥ 30 months**
(Col 1)	(Col 2)	(Col 3)	(Col 4)	(Col 5)
122,786	115,710	108,385	103,542	97,769

If one considers (from Table 11-1 above) that there are 115,710 residential customers with at least 12 months of continuous occupancy (i.e. 12 months of revenue metering data available), then the size of the "*treatment*" group would be 57,855 customers.

Note: For the purposes of discussion, the treatment and control groups are equal sizes. A control group in the range of 25,000 is usually deemed adequate, meaning that in London Hydro's case, the treatment group can probably be increased by 50%.

---

[56] "*Are Savings from Behavior Programs Ready for TRM Prime Time?*" Scott Dimetrosky, Apex Analytics 2013, http://www.iepec.org/wp-content/uploads/2013/03/Presentations/Dimetrosky.pdf

[57] Minnesota Department of Commerce - Office of Energy Security Research Study: *Residential Energy Use Behavior Change Pilot*; by Ed Carroll – Franklin Energy, Eric Hatton – Franklin Energy, and Mark Brown – Greenway Insights; April 2009; page 5.

[58] *Understanding the Residential Customer Perspective to Emerging Electricity Technologies: Informing the CSIRO Future Grid Forum*; Naomi Broughen, Zaida Contreras Castro and Pete Ashworth; July 2013; pg 15.

[59] E-mail dated December 16, 2014 to Gary Rains from Thara Toms; re: *Request for Data….*

Given the average annual energy consumption for a London Hydro residential customer is 7,953 billed kWh per residential customer (as per page 89 in the OEB publication: *2013 Yearbook of Electricity Distributors*), then the projected energy savings is calculated to be:

Projected Energy Savings = 57,855 participants x 7,953 kWh/yr x 2.1%
= 9,662,537 kWh
= 9.6 GWh

Often such programs simply accelerate energy-efficiency measures that the customer might have undertaken anyway, e.g. replacement of a CRT-based television with a modern television that uses LED display technology. As such, even if the projected energy savings was discounted by 30%, the resulting net energy savings is still very significant.

Note: The literature shows that to maintain sustained energy savings, the behaviour-based residential energy efficiency program needs to be continued throughout the framework period (i.e. until at least 2020).

Since there are a multitude of services providers that offer behaviour-based residential energy efficiency analysis products, in the summer of 2015, London Hydro intends to issue a formal *Request for Information* (RFI) to select a service offering that yields the most cost-effective solution given the information that is available about our customers (basically revenue metering data combined with MPAC property assessment information) and the service provider's track record in other jurisdictions.

Note: The concept of behavior-based residential demand response (i.e. measurable peak reduction based on highly personalized communication to individual customers in contrast to a price signal or devices, such as thermostats or load control switches to cycle air conditioning on hot days, in the home) is gaining traction in other jurisdictions. Even though the marketplace for residential demand response is in a state of evolution (i.e. the market value hasn't been established), London Hydro will likely explore the potential of this strategy (in addition to more traditional legacy demand-response programs based on WiFi-enabled thermostats) to maximize the overall value of the investment.

11.1.4 Energy-Efficiency Program for Swimming Pools

London Hydro has previously carried out comprehensive measurements of baseline electricity consumption patterns[60] which are foundational to development of an energy-efficiency program for swimming pools. A companion study looked at the prevailing penetrations of technologies (e.g. ENERGY STAR qualified pool pumps, VFD pool pumps, etc.) in the marketplace.

Note: The predominant swimming pool heater is natural gas fired. As such, and to maximize overall value to participating customer, it is worthwhile to collaborate with the regional natural gas distributor so see if there are natural gas efficiency elements (e.g. higher efficiency

[60] London Hydro Report London Hydro Report EM-13-05, *Energy Consumption Characteristics of Residential Swimming Pools*; Issued: November 2013.

heaters, solar blankets, etc.) that can be included to offer a more-comprehensive energy-efficiency program for residential swimming pools.

For the purposes of this CDM plan, it is assumed that a comprehensive CDM program will commence in 2017, the annual program uptake will be on the order of 150 residential swimming pools, and the annual electrical energy savings will be about 950 kWh per swimming pool. As such, the projected overall energy savings is calculated to be:

Projected Energy Savings = *150 participants x 950 kWh/yr x 4 years*
= *570,000 kWh*
= *0.5 GWh*

The projected annual energy savings and expected participation levels will be refined as program design work progresses, and future revisions of this CDM Plan will provide updated information.

11.1.5 Cold-Climate Air-Source Heat Pumps

The term "*energy poverty*" is generally understood to be households that spend more than 10 percent of their income on home energy. In Ontario, the lowest income quintile – one in every five households – spend on average 12 percent of their income on utilities while the average Ontarian spends only 4 percent.[61] As energy prices rise and disposable incomes stagnated, the problem becomes more acute.

There are a number of vintage townhouse developments within London Hydro's franchise service territory that are operated as housing co-operatives or by the local social housing authority. These townhouse units (believed to number in excess of 1,000 units) are heated via electric baseboard heaters and the tenants have previously qualified for the saveONenergy HOME ASSISTANCE program.

For townhouse units heated by electric baseboard heaters, those heaters probably account for the largest chunk of the total annual electricity bill.

[61] Research Profile: Energy Poverty; Guelph & Wellington Task Force for Poverty Elimination; May 2011. Publication available electronically at URL:: http://gwpoverty.ca/wp-content/uploads/2011/06/Energy-Poverty.pdf

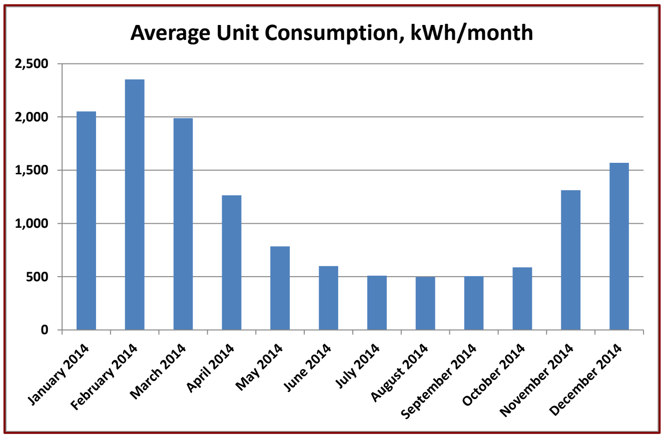


Figure 11-3, Typical Load Profile for Electrically-Heated Townhouse Unit

Note: Given the average annual energy consumption for a London Hydro residential customer is 7,953 billed kWh per residential customer (as per page 89 in the OEB publication: *2013 Yearbook of Electricity Distributors*), the average annual electricity consumption for an electrically-heated townhouse unit is on the order of 14,000 kWh.

London Hydro is presently in the analysis phase for a new CDM program to convert electric baseboard heating systems to cold-climate air-source heat pump systems. The opportunity is being assessed from a technology, practicality, and cost-effectiveness perspective.[62] Once this phase is completed, the parameters (i.e. incentive levels, qualification parameters, etc.) of this new CDM program will be developed.

Note: Part of the overall analysis will be a collaborative element with the local natural gas distributor to ascertain the merit in conversion to natural gas heating systems. As a general principle, fuel substitution programs can only provide monetary incentives if there are projected net energy savings (as opposed to monetary savings based only on differences in electricity and natural gas prices).

Note: With respect to program roll-out, the intention is to retrofit a few units (i.e. two end units with 3 exterior walls and two or three internal units with 2 exterior walls) in 2016 in a willing townhouse development, and then validate the energy savings and program cost effectiveness. Assuming a favourable outcome, the program can be ramped up.

Note: There are thousands of similar electrically-heated townhouses located throughout the province, so the progress of this project will likely be closely observed by many LDC's throughout southwestern Ontario.

For the purposes of this CDM plan, it is assumed that the program uptake will be on the order of 150 townhouse units and the annual energy savings will be about 2,000 kWh per townhouse unit. As such, the projected overall energy savings is calculated to be:

Projected Energy Savings = *150 participants x 2,000 kWh/yr*
= *300,000 kWh*
= *0.3 GWh*

[62] London Hydro report EM-14-04, *Conversion of Electric Resistance Baseboard Heating Systems to Ductless Mini-Split Heat Pump Systems in Residential Co-operative Homes*.

As noted earlier, the projected annual energy savings and expected participation levels will be refined as program design work progresses, and future revisions of this CDM Plan will provide updated information.

11.1.6 Regional Clothes Washing Machine & Dryer Program

The average American family washes about 300 loads of laundry each year. ENERGY STAR certified clothes washers use about 25% less energy and 40% less water than regular washers. They are available in front-load and top-load models.[63]

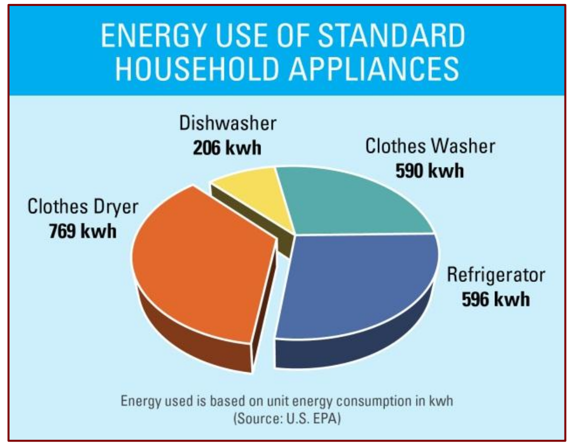


Figure 11-4, Energy Use of Standard Household Appliances

ENERGY STAR certified dryers use 20 percent less energy than conventional models without sacrificing features or performance. They do this using innovative energy saving technologies, such as moisture sensors that detect when clothes are dry and automatically shut the dryer off.[64]

For the purposes of this CDM plan, it is assumed that the program uptake will be on the order of 150 appliance pairs and the annual energy savings will be about (25% x 590 kWh + 20% x 769 kWh =) 300 kWh per participant. As such, the projected overall energy savings is calculated to be:

Projected Energy Savings	=	150 participants x 300 kWh/yr
	=	45,000 kWh
	=	0.045 GWh

The projected annual energy savings and expected participation levels will be refined as program design work progresses, and future revisions of this CDM Plan will provide updated information.

Note: It is recognized that the projected overall net energy savings aren't large, so it will be challenging to introduce a stand-alone program to the marketplace that meets the "*cost effectiveness*" criteria. Nonetheless, this initiative is seen to be a component of a larger "*whole home*" offering (as described earlier in Section 11.1.1 herein).

[63] Source: ENERGY STAR website – page: *Clothes Washers for Consumers*; see URL:: https://www.energystar.gov/products/certified-products/detail/clothes-washers

[64] Source: ENERGY STAR website – page: Clothes Dryers for Consumers; see URL:: https://www.energystar.gov/products/certified-products/detail/clothes_dryers

11.2 Opportunities for New Business CDM Offerings

There are a number of opportunities for new or re-formulated energy-efficiency programs targeted to the business marketplace. Each is outlined in the sub-sections that follow along with a projection of energy savings for each program.

Note: The provincial saveONenergy RETROFIT PROGRAM and saveONenergy PROCESS & SYSTEMS initiatives are sufficiently broad incentive programs as to encompass most eventualities. What is really needed is enabling programs to funnel customers into these two initiatives.

11.2.1 Regional Sector-Specific Roving Energy Managers

11.2.1.1 Role of Roving Energy Manager

Roving energy managers (REM's) are individuals with technical expertise that are made available to businesses on a short-term basis to perform energy assessments at the business premise, assist in building a business case to invest in energy-efficiency projects (i.e. define the expected energy savings and payback period of a business process improvement), and otherwise assist every step of the way from applying for incentives to establishing monitoring and verification protocols to verify the savings resulting from the installation of energy-efficiency measures. The ability of companies to get this expertise in place, even for only a specified period of time, can be the critical resource to keep an organization moving forward.

11.2.1.2 Sectors Covered

Sector-specific roving energy managers are individual that possess expertise in a specific sector, for example:

- Healthcare sector
- Hospitality (hotel, motel & restaurants) sector
- Manufacturing sector
- Cross-market refrigeration – for industrial, ice rinks, refrigerated warehouses and similar application
- Commercial real estate (includes REITS such as strip malls/large malls, leased commercial space)

Conceptually, the roving energy managers will be made available as "*regional resources*" since certain customers (such as schools, manufacturers, hospitals) often have facilities within the service territories of neighbouring LDC's. Although London Hydro will be the contracting agency for a pool of sector-specific roving energy managers, each year the costs of these resources will be allocated to neighbouring LDC's in proportion to the energy savings achieved by that resource for a neighbouring LDC. For example, if a roving energy manager with special expertise in healthcare, obtained 60% of the electricity savings in St Thomas, 20% in Tillsonburg and the remaining 20% in London, that resource's costs will be divided accordingly amongst participating LDC's.

London Hydro has expressed interest in participating in a pilot project involving the Canadian Coalition for Green Health Care for what will essentially be a regional sector-specific roving energy manager. London Hydro's letter expressing interest in participating in this project is included in Appendix B herein.

11.2.1.3 Projected Energy Savings

Whereas under the 2011 – 2014 CDM delivery framework, it was possible to for LDC's obtain funding from the Ontario Power Authority for Roving Energy Managers (as an element of the saveONenergy PROCESS & SYSTEMS initiative), this element has disappeared under the new framework, and the onus is on LDC's to fund such resources from their budget allocation.

While there isn't yet consensus within the LDC sector of the requirements for Roving Energy Managers, if one assumed the parameters from the past framework wherein each REM was responsible for capturing 300 kW in demand savings on an annual basis, with one-third unincented, and further assume a 70% load factor and that 50% of the savings will be within London Hydro's service territory, 4 REMS are retained for a 5-year period, then the projected unincented savings will be:

Projected net energy savings = 100 kWh x 70% x 8760 x 50% x 4 REMs x 5 yr
= 6,132 MWh
= 6.1 GWh

Note: Certainly one of the program design challenges for energy managers, whether they be Embedded Energy Manager or Roving Energy Managers, has been obtaining the 100 kW of unincented savings year after year. For many facilities, it is an achievable target for a couple of years, but then such opportunities become exhausted. Given the Energy Manager program is still being re-designed, perhaps it would be better to adopt a more conservative expectation of 4 GWh in unincented energy savings.

Note: Another challenge that arose in the 2011 – 2014 CDM delivery framework was finding qualified individuals to take on the role as a Roving Energy Manager or Embedded Energy Manager. Individuals with the desired skill set are inevitable already gainfully employed elsewhere. As a result, some LDC's were unsuccessful finding suitable REM's and some companies had open vacancies for a suitable EEM for a considerable period of time (i.e. almost 2 years for one London institution).

11.2.2 Conversion of Electric Chillers to District Energy

Like many other LDC's in southern Ontario, London Hydro is a summer peaking LDC, i.e. the maximum strain on the electricity distribution system usually occurs during prolonged summer heat waves.

The core area of London has a number of commercial buildings with vintage electric chillers.

A few years ago, London Hydro examined the feasibility of converting vintage electric chillers to the district energy system (at a time when the electric chiller was at or near the end of its expected lifetime and the building's HVAC system was top-ofmind to the building owner or operator).[65] This report examined the potential of four different building in the core area of the City.

In the meantime, the OPA has revised the "*Avoided Supply Costs*" tabulation (which has had a negative impact on a number of provincial CDM programs). The cost effectiveness calculations in this referenced report will have to be updated.

For the purposes of this CDM Plan, it is assumed that a comprehensive CDM will commence in late 2015, an opportunity will arise ever year for electric chillers within a core area building to be converted to district energy, and the average annual electrical savings associated with each project will be 241,000 kWh/yr. As such, the projected energy savings will be

Projected net energy savings = *241 MWh/yr x 5 projects*
= *1,205 MWh*
= *1.2 GWh*

Note: Within the referenced study, four (4) very different buildings were selected for analysis essentially to demonstrate that the findings are applicable to any building in the core area. The actual energy savings will be very dependent upon which opportunities present themselves over the next six years.

11.2.3 Compressed Air System Leak Detection & Tagging Program

Most manufacturers have significant in-plant fluid power systems as the foundation of their drive and automation technology to deliver the necessary force and torque wherever linear, rotary or combination movements are required. A major advantage of fluid power is the compact design of its components, giving the high power-to-weight ratio which distinguishes it from all other forms of propulsion. Fluid power includes both hydraulics and pneumatics (i.e. compressed air). Fluid power systems use a considerable amount of electricity and represent a significant opportunity for energy-efficiency.

One of the significant differences between hydraulic and pneumatic fluid power systems is the response to leaks in fittings, hoses, etc. Leaks in hydraulic systems result in hydraulic fluid making a mess in the workspace. Leaks in pneumatic systems however simply result in compressed air migrating into the ambient air environment. As a consequence, there is little urgency to repair compressed air leaks and the number of leaks simply increases over time. Unfortunately, there is an incorrect perspective that air is free so why bother with a diligent preventive and corrective maintenance program.

According to an authoritative reference on the subject matter[66] [pg 27]:

[65] London Hydro Report EM-12-02, *Proposal to Expand the OPA's saveONenergy RETROFIT PROGRAM to Encompass "Conversions of Electric Chillers to Thermal Supply from a District Energy Plant"*.

[66] U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) Best Practices and the Compressed Air Challenge® joint publication: *Improving Compressed Air System Performance: A Sourcebook for Industry*

> *Leaks can be a significant source of wasted energy in an industrial compressed air system, sometimes wasting 20 to 30 percent of a compressor's output. A typical plant that has not been well maintained will likely have a leak rate equal to 20 percent of total compressed air production capacity. …*

Furthermore [pg 28 of this same reference]:

> *Leaks occur most often at joints and connections. Stopping leaks can be as simple as tightening a connection or as complex as replacing faulty equipment, such as couplings, fittings, pipe sections, hoses, joints, drains, and traps. In many cases, leaks are caused by failing to clean the threads or by bad or improperly applied thread sealant.*

A good compressed air system leak repair program is very important to maintaining the efficiency, reliability, stability, and cost effectiveness of any compressed air system.

London Hydro previously developed an idea for leak detection and tagging program for compressed air systems[67] with the intention of launching the program in 2014, but this plan was delayed and will now be re-established for introduction in the Fall of 2015. Essentially (to mitigate risk), the customer arranges for a selected local contractor (that has the expertise, training, and equipment) to conduct a non-intrusive leak survey on behalf of London Hydro. Then, in those very few cases (and likely none) whereby the cost of the survey exceeds the recurring cost associated wih identified leaks, the customer can send London Hydro the contractor's invoice for payment.

Leak repairs on a compressed air system are considered to have a persistence of one year, so the resulting energy savings wouldn't count towards London Hydro's six-year CDM target. None-the-less, this is a "*foot-in-the-door*" strategy for drawing customer attention to the efficiency of its compressed air system that can lead to conversations about energy-efficiency and the adoption of energy-efficiency measures with greater persistence (e.g. zero-loss drains, VFD's for trim compressors, etc.).

No persistent savings are associated with this program as it is essentially an innovating marketing strategy to expose opportunities for other energy-efficiency measures with greater persistence.

11.3 Summarized Opportunity

Table 11-2 below summarizes the predicted energy savings associated with each the proposed new / reformulated residential CDM programs described in Section 11.1 above.

[67] London Hydro Report EM-13-03, *Marketing & Execution Plan for a Leak Detection & Tagging Program for Industrial Compressed Air Systems*

Table 11-2, Energy Savings Predictions for New Residential CDM Programs

Section and Title herein	Anticipated Savings, GWh
11.1.1, Whole-Home CDM Program – The Holy Grail	--
11.1.2, Regional Fridge & Freezer Program	2.1
11.1.3, Behaviour-Based Residential Energy Efficiency Program	9.6
11.1.4, Energy-Efficiency Program for Swimming Pools	0.5
11.1.5, Cold-Climate Air-Source Heat Pumps	0.3
11.1.6, Regional Clothes Washing Machine & Dryer Program	0.045
Total:	12+

Table 11-3 below summarizes the predicted energy savings associated with each the proposed new / reformulated residential CDM programs described in Section 11.2 above.

Table 11-3, Energy Savings Predictions for New Business CDM Programs

Section and Title herein	Anticipated Savings, GWh
11.2.1, Regional Sector-Specific Roving Energy Managers	4
11.2.2, Conversion of Electric Chillers to District Energy	1.2
11.2.3, Compressed Air System Leak Detection & Tagging Program	--
5.3.1, Retrofitting Outdoor Illuminated Retail Signage	0.131
Total:	5.3+

As was previously noted in Section 10.2, *Projected Target Shortfall*, regional and local CDM programs are needed to address the 12.66 GWh shortfall in the overall CDM target. The predicted energy savings associated with such regional and local CDM programs (and the means of addressing this shortfall) are set forth in Table 11-2 and Table 11-3 above.

12 PREDICTING THE MONTHLY PEAK DEMAND REDUCTIONS

Whereas the 2015 – 2020 CDM delivery framework establishes net energy reduction targets (in Megawatt-hours), the regional supply planning exercise is based on predictions of monthly peak loads (in Megawatts). This section presents a methodology for ascertaining reasonable estimates of the peak demand reductions (in kW or MW) based on achieved net energy reductions (in kWh or MWh)

12.1 Outline of Approach

London Hydro distributes both electricity that is received from the provincial transmission grid and exported electricity from a number of embedded generators (e.g. London District Energy, various photovoltaic energy systems, Fanshawe Dam, etc.). Some embedded generators don't in fact export electricity but rather primarily offset customer load (e.g. London Health Science's Victoria Hospital Campus, Ingredion – formerly Casco, Labatt, etc.).

One way of looking at London Hydro's CDM target over the 2015 – 2020 delivery framework is that it doesn't matter whether the target (previously defined in Section 2.2 – starting on page 12 herein) is achieved via energy-efficiency measures or embedded load displacement generation projects. Both will have the same effect of reducing London Hydro's energy procurements from the provincial transmission grid by the same amount. The challenge is converting diminished energy procurements into an estimate of seasonal demand reductions that will be observed at the delivery points (i.e. transformer stations).

12.2 Review of Interconnections to Provincial Transmission Grid

London Hydro's medium-voltage electrical distribution system receives supply from the provincial transmission system via six (6) transformer stations distributed throughout the service territory as shown in Figure 12-1 to the right.

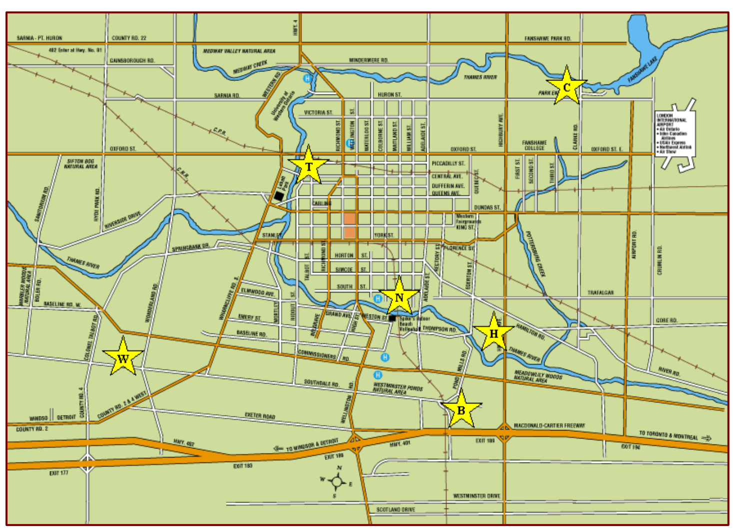


Figure 12-1, Locations of Transformer Stations

Some transformer station supply only London Hydro's load, while others are "*shared*" meaning the transformer station also supplies Hydro One Networks' load in the rural areas outside of London Hydro's franchise service territory. The identification of each transformer station is given in Table 12-1 below along with a descriptor of whether the transformer is dedicated to London Hydro's load of shared amongst several LDC's.

Table 12-1, Identification of Each Transformer Station

Symbol on Figure 12-1	Transformer Station Name	Operating Designation	Notes
B	Buchanan TS	NAW19	Feeder 19M21 supplies Hydro One Networks' load
C	Clarke TS	NA70	Feeder 70M2 supplies Hydro One Networks' load
H	Highbury TS	NW4	Feeder 4M1 supplies Hydro One Networks' load
N	Nelson TS	NW13	Dedicated to London Hydro
T	Talbot TS	NAW26	Dedicated to London Hydro
W	Wonderland TS	NA32	Feeder 32M2 supplies Hydro One Networks' load

London Hydro's total system electricity procurements from the provincial transmission grid are the summation of London Hydro's electricity procurements from each transformer station identified in Table 12-1 above.

12.3 London Hydro's Load Profile

There are many ways of describing the profile of London Hydro's annual energy procurements from the provincial transmission grid. One such method that is often used to ascertain avoided upstream costs associated energy efficiency measures is an "*allocation*" method whereby the annual energy procurements are divided into a number of time periods (e.g. winter off-peak, winter mid-peak, winter on-peak, etc.).

Such an allocation for the three-year period 2012, 2013 and 2014 is shown in Table 12-2 below.

Table 12-2, Allocation of Annual Energy Procurements from Transmission Grid

Calendar Year	Percentage of Annual Energy Consumption in Each Defined Period (%)							
	Winter On-Peak	Winter Mid-Peak	Winter Off-Peak	Summer On-Peak	Summer Mid-Peak	Summer Off-Peak	Shoulder Mid-Peak	Shoulder Off-Peak
2014	7.50%	8.50%	18.71%	6.83%	9.49%	18.11%	14.90%	15.96%
2013	7.45%	8.41%	17.82%	7.28%	10.07%	17.58%	15.54%	15.84%
2012	7.30%	8.28%	17.38%	7.63%	10.51%	18.06%	15.32%	15.51%

Table 12-2 above shows that, for example, in 2014, 7.5% of the annual energy procurements from the provincial transmission grid occurred during the defined "*winter on-peak*" period and 9.49% occurred during the defined "*summer on-peak*" period.

Although the overall energy procurements from the provincial transmission grid can vary somewhat year over year (e.g. 3,346,753,076 kWh in 2012, 3,345,545,156 kWh in 2013, and 3,304.249,127 kWh in 2014), the allocation of the overall annual energy procurements into the various time-of-use periods doesn't vary substantially year over year.

For consistency with transmission system rate design, the seasons are as defined in Table 12-3 below.

Table 12-3, Seasons for Avoided Cost Assessments

Season	Months Included
Winter	December – March
Summer	June – September
Shoulder	April, May, October & November

Similarly, the time-of-use periods are defined in Table 12-4 below.

Table 12-4, Time-of-Use Periods for Avoided Cost Assessments

Time-of-Use Period	Season		
	Winter	Summer	Shoulder
On-Peak	07:00 – 11:00 and 17:00 – 20:00 weekdays (602 Hours)	11:00 – 17:00 weekdays (522 hours)	None
Mid-Peak	11:00 – 17:00 and 20:00 – 22:00 weekdays (688 hours)	07:00 – 11:00 and 17:00 – 22:00 weekdays (783 hours)	07:00 – 22:00 weekdays (1,305 hours)
Off-Peak	00:00 – 07:00 and 22:00 – 24:00 weekdays; All hours weekends and holidays (1,614 hours)	00:00 – 07:00 and 22:00 – 24:00 weekdays; All hours weekends and holidays (1,623 hours)	00:00 – 07:00 and 22:00 – 24:00 weekdays; All hours weekends and holidays (1,623 hours)

Note: Of the 8,760 hours in a year, the numbers in brackets show the number of hours in each TOU period.

12.4 Predicted Seasonal Peak Demand Reductions

The methodology assumes that:

- The annual energy savings will be achieved in a uniform manner throughout the six-year period (even though there is normally a participation lag at the beginning of any new programs or framework); and
- The energy savings are allocated into the same seasonal time-of-use periods as the load, e.g. if 7% of London Hydro's energy procurements from the transmission grid occur during the defined summer on-peak period, then it is assumed that 7% of the energy savings accrue during this same time period.

From Table 12-3 it can be seen that the 3-year average summer on-peak allocation is 7.2% and it can be seen from Table 12-4 that there are 522 hours in the summer on-peak period. This means that the predicted average hourly demand reduction during the summer peak period is:

$$\textit{Predicted } \underline{\textit{Summer}} \textit{ On-Peak Demand Reduction} = \frac{196.66\ GWh\ x\ 7.2\%}{522\ h} = 27\ MW$$

From Table 12-3 it can be seen that the 3-year average winter on-peak allocation is 7.6% and it can be seen from Table 12-4 that there are 602 hours in the winter on-peak period. This means that the predicted average hourly demand reduction during the winter peak period is:

$$\textit{Predicted } \underline{\textit{Winter}} \textit{ On-Peak Demand Reduction} = \frac{196.66\ GWh\ x\ 7.6\%}{602\ h} = 25\ MW$$

For electrical power transmission and distribution systems, the load typically isn't constant but rather fluctuates throughout the day, as illustrated in Figure 12-2, throughout the week, and throughout the season. For power system planning, it is common to use the term "*load factor*" which is simply the ratio of "*average*" load throughout a given time period to the "*peak*" load throughout that same time period. In Figure 12-2, the daily load factor can be calculated to be (14,096 MW / 15,980 MW =) 88%.

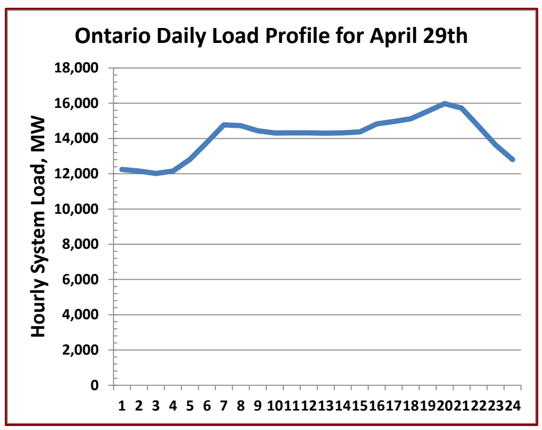


Figure 12-2, Example Fluctuating Load Pattern

It is assumed that London Hydro will progress in a uniform manner towards its assigned CDM target, and as such, the predicted demand reductions will progress from 0 MW at present to the predictions given above in year 2020.

Note: It will be recalled from Table 10-3 (on page 78 herein) that embedded load displacement generation projects are a significant contributor towards London Hydro's CDM targets. As such, progress is unlikely to be linear, but rather "*lumpy*" and dependent upon the "*in-service*" date of the various generation systems.

12.5 Limitations of Prediction Methodology

The methodology used above to convert a net energy savings target to a predicted demand reduction is straightforward, but has two (2) short-comings as described in the subsections below:

12.5.1 A System-Wide Versus Per-Delivery-Point Prediction

Whereas system planning is normally carried out on a "*per delivery point*" approach (e.g. additional capacity is required at Wonderland TS by year 2018), often based on zoning and future land-uses identified in various municipal planning documents (tempered with experience in interpreting these often overly-optimistic publications).

Herein are predictions of the energy savings that could be achieved by customer sector (e.g. residential, institutional, industrial, etc.) but in London Hydro's case, a particular sector isn't necessarily supplied by a single delivery point. For example the institutional sector would encompass facilities spread throughout the entire service territory and as such the predicted demand reduction is system-wide (as opposed to being specific to one or two delivery points).

12.5.2 Weather-Sensitivity of Predicted Demand Reduction

London Hydro's peak system load is highly influenced by weather conditions, i.e. the system load during a prolonged heat wave is significantly more than would be the case during more moderate summer weather conditions.

An energy savings target makes no distinction between energy-efficiency measures that are independent of ambient temperature (e.g. a lighting retrofit produces the same energy savings irrespective of ambient weather conditions and those that are influenced by ambient weather conditions (e.g. a new HVAC system using modern refrigerants will consume less energy during a heat wave than the HVAC system it replaced, thereby decreasing the weather-sensitivity of the load).

As such, the predicted system demand reductions are based on nominal weather patterns. Depending on the penetration of HVAC upgrades, the peak demand reduction during heat waves may be greater than the prediction given herein.

13 Synopsis of London Hydro's CDM Frontier Endeavours

This section describes a number of initiatives underway or planned at London Hydro intended to advance the state-of-the-art with respect to Energy Conservation and Demand Side Management. These initiatives aren't CDM programs in their own right, but rather enabling products intended to drive greater participation or deeper savings, or both.

13.1 Energy Performance Benchmarking

Energy benchmarking is a key energy management best practice that enables one to identify poorly performing buildings, invest strategically in energy efficient upgrades and track the effectiveness of the improvements undertaken. Through benchmarking, the key metrics for assessing the performance of a building or portfolio of buildings can be identified along with a facility's key drivers of energy use.[68]

13.1.1 General - Leveraging the Green Button Connect My Data Initiative

The Green Button initiative is sometimes misunderstood to be an energy-efficiency technology. Rather it is correctly simply a standardized and secure method of conveying revenue metering data (e.g. hourly consumption data for Smart-meters; 15-minute interval data for other interval meters) from a metering data repository to a third-party application with the explicit (electronic) authorization of the customer. Such third-party offerings (that analyze the revenue metering data) are the enabling technology that may motivate customers to undertake energy-efficiency actions.

In Ontario, London Hydro, in concert with the Ontario Ministry of Energy and MaRs, is spearheading a number of Green Button *Connect My Data* pilot projects.[69] [70]

Note: Although the Green Button Connect My Data is an umbrella initiative, there are a number of projects that leverage this secure information conduit that may be submitted for consideration for IESO participation via the IESO's Conservation Fund or Collaboration Fund.

[68] Source: Natural Resources Canada website page: *Why benchmark energy performance?*; URL:: https://www.nrcan.gc.ca/energy/efficiency/buildings/energy-benchmarking/3713

[69] News from the Green Button pilots; December 1, 2014. See URL:: http://greenbuttondata.ca/news/2014/11/28/news-from-the-green-button-pilots

[70] Ontario Newsroom article: *Ontario's Green Button Initiative*; February 27, 2014. See URL:: http://news.ontario.ca/mei/en/2014/02/ontarios-green-button-initiative-1.html

13.1.2 Residential Sector Benchmarking

It is said that throughout the decades, thousands of energy audits have been carried out (under various government programs) with very few or no subsequent energy actions undertaken subsequently. It is suspected that this is simply another case of "*information doesn't motivate*".[71]

Figure 13-1, ENERGY STAR Home Energy Yardstick

The organization *Resources for the Future* directly asked a number of home energy auditors for their perspective.[72] The response (on page 24 of the discussion paper) has been replicated below for convenience of reference:

> "*… customers cannot grasp how investing in retrofits will save them money in the long run, and that homeowners do not understand that their homes are inefficient in the first place.".*

The ENERGY STAR Home Energy Yardstick, a simple on-line self-assessment tool to provide customers with a simple assessment of their home's annual energy use compared to similar homes, developed by the US Environmental Protection Agency (EPA) and Department of Energy (DOE), is intended to address the second point.

To deploy this tool in Ontario, it would have to be "*Candianized*" from several perspectives:

- The current edition uses US ZIP codes to determine weather patterns (e.g. 25 or 30 year average heating and cooling degree days)
- The current edition uses units of measure for natural gas (Therms as opposed to cubic meters) that aren't commonly used in Ontario and there are also fuel types that are irrelevant (e.g. wood, propane, fuel oil)

Preliminary discussions have been carried out with Natural Resources Canada concerning some type of partnership arrangement. This discussion needs to be pursued.

13.1.3 Business Sector Benchmarking

Energy performance benchmarking of commercial and institutional buildings is a useful enabling strategy for energy-efficiency upgrades, i.e. owners or property

---

[71] *Motivating Home Energy Action - A handbook of what works*; Michelle Shipworth; April 2000 - for the Australian Greenhouse Office; *Information by itself rarely motivates action*; page 55.

[72] Resources for the Future discussion paper DP 11-42, *Assessing the Energy-Efficiency Information Gap: Results from a Survey of Home Energy Auditors*; Karen Palmer, Margaret Walls, Hal Gordon, and Todd Gerarden; October 2011.

managers that are shown some of their buildings underperforming from an energy perspective are more easily convinced to participate in energy efficiency upgrades.

One public-domain product that is gaining traction for this purpose is ENERGY STAR Portfolio Manager (that is supported by NRCan in Canada).

One of the stumbling blocks with Portfolio Manager is that the data interface historically wasn't Green Button compliant. Although such an interface is on the roadmap, the US-based Environmental Protection Agency (EPA) claims it is working on this feature but makes no commitment with respect to an availability date.[73]

Pursuing the Portfolio Manager product would not only advance London Hydro's interest in the Green Button *Connect My Data* initiative, but could be an effective tool for encouraging participation in energy-efficiency programs.

Note: The literature[74] indicates that many energy audit and building re-commissioning studies conducted are never implemented. However, a utility-run energy benchmarking program can improve the energy audit / re-commissioning implementation rate.

13.2 Residential Load Disaggregation

As an extension of the Green Button initiative, London Hydro has an ongoing arrangement with Bidgely Inc.[75] (of Sunnyvale, California) for their cloud-based load disaggregation software that utilizes and analyzes hourly consumption data from Smart-meters.

At this point in time, there are no independent EM&V studies to demonstrate the effectiveness of this product in motivating energy conservation actions. It is understood, however, that Bidgely is working with subject matter experts to design an EM&V study to assess energy savings, if any.

13.3 Residential Demand Response

The *peaksaver* residential demand response program was founded on technology that is edging closer to

[73] Refer to website: *Green Button - Federal Agency Frequently Asked Questions*. See URL:: http://www.greenbuttondata.org/fed-faq/

[74] Minnesota Department of Commerce report COMM-03192012-5532371145: *Integrating Benchmarking into Utility Conservation Improvement Programs to Capture Greater Energy Savings*; prepared by The Weidt Group, Inc.; August 2014; page 36.

[75] Business Wire article: *Bidgely and London Hydro launch customer engagement project for 150,000 homes*; November 20, 2014. Article available online at URL:: http://www.businesswire.com/news/home/20141120005264/en/CORRECTING-REPLACING-Bidgely-London-Hydro-Launch-Customer#.VQ9uhI5NqIQ

obsolescence. It is primarily based on paging signals dispatched to load control switches (for central air conditioner units) and thermostats.

A modern approach, referred to as "*Open Automated Demand Response*" or "OpenADR" uses the Internet as the communications medium and (OpenADR-compliant) WiFi-enabled thermostats as one type of residential end device.

As a part of its *Green Button Connect My Data* initiative, London Hydro has installed numerous Energate WiFi-enabled thermostats that are also enrolled in the provincial *peaksaver* PLUS program (to maximize perceived value for participants).

As a next phase (and to make the investments more valuable to the expected future demand response marketplace wherein demand response is bid as a resource into a capacity marketplace on the same footing as generation), London Hydro expects to undertake a very small scale demonstration project to transition some nominal number (e.g. 10) Energate or other thermostats to be OpenADR-compliant.

13.4 Intelligent Controller for Electric Storage Tank Water Heaters

Residential demand response has been traditionally considered as a means of short-term load reduction strategies for times of constrained power system operation (e.g. inadequate generation availability or transmission circuits exceeding their loadability limits).

There is a growing interest in "*load building*" technologies, i.e. the ability to absorb electricity in times of surplus generation as is often the case at night when windmills tend to aggravate this phenomenon. London Hydro has a cooperative arrangement with Western University's Engineering faculty[76] to explore intelligent controllers for electric storage tank water heaters. The basic concept is that the controller would:

- Confine recharging the water heater to the off-peak (lowest cost) period of the day to maximize benefit to the consumer; and
- Be dispatchable (perhaps via OpenADR) so that the water heater re-charge period coincides with times of surplus power thereby proving benefits to the grid operators.

Any funding (above in-kind contributions) for this endeavor would come from Smart-Grid accounts.

13.5 Development of Mobile Sales Tools for Contractors

The design of many of the provincial saveONenergy FOR HOME and FOR BUSINESS programs revolves around the "*incentive application*" as opposed to being integrated and providing value to the "*precursor*" sales process. It is assumed

[76] Letter dated September 27, 2014to Dr. Mohammad Dadash Zadeh P.Eng. (Western University – Engineering Faculty from Gary Rains, P.Eng. (London Hydro); re: *Intelligent Local Controller for Electric Storage-Tank Water Heaters; Expression of Support for Smart-Grid R&D Activities*.

(incorrectly) that the participating customer has a compelling value proposition in-hand and wants to procure a more energy-efficient technology.

Many HVAC contractors (for both the residential and commercial marketplaces) don't actively participate in the saveONenergy HEATING & COOLING INCENTIVE program or the portion of saveONenergy RETROFIT PROGRAM that pertains to roof-top HVAC units, primarily because is inconvenient and time-consuming to assemble a value proposition that compares alternative procurement choices – this is not their forte.

Building on the experiences and successes of the iPad-based software developed by London Hydro's long-time partner, Parachute Software, to support the saveONenergy HOME ASSISTANCE Program (internally code-named "*Dragon*") the vision is to enhance an existing product so that it:

- Dynamically creates value propositions associated with "*good*", "*better*", and "*best*" options for customer presentment based on the customer's circumstances;
- Automatically create and submit an incentive application reflecting the customer's choice; and
- Provides strategic sales management information to all parties.

It is expected that the initial thrust of these sales tools will cover:

- Commercial roof-top HVAC units (that are eligible for incentives under the saveONenergy RETROFIT PROGRAM);
- Residential central air conditioners (that are eligible for incentives under the saveONenergy HEATING & COOLING INCENTIVES program), and
- Additional energy-efficiency measures beyond the threshold amounts available to participants in the saveONenergy SMALL BUSINESS LIGHTING program.

The extent of the sales tools development and offerings for the future will depend on the successes realized with this initial vision.

14 Summary, Recommendations and Conclusions

14.1 Summary

Under the 2015 – 2020 CDM delivery framework, London Hydro's allocation of the provincial 7 TWh energy savings target is 196.66 GWh. Whereas under the previous 2011 – 2104 CDM delivery framework, energy savings were cumulative, this has changed under the new 2015 – 2020 CDM delivery framework (i.e. they aren't cumulative). As such, the new CDM targets (for the 2015 – 2020 CDM framework) are about double the targets under the previous 2011 – 2015 CDM delivery framework.

Establishment of the CDM targets was informed by three (3) Achievable Potential studies that were carried out [Ref 2, 3 and 4]; one for the "*residential*" sector, one for the "*commercial*" sector, and the final for the "*industrial*" sector. The CDM targets were seemingly based on the "*realistic*" achievable potential, a point midway between the upper economic achievable potential and the lower economic achievable potential. Specific commentary about these studies (that has been taken into account in developing this CDM Plan) follows:

- For the "*residential*" achievable potential assessment, the authors suggest "*home energy management systems*" (HEMS) as the emerging significant opportunity. There can be many components to a residential HEMS (e.g. Smart-meter, in-home display, WiFi-enabled thermostat, etc.) but unfortunately, in spite of initial promise, the emerging public-domain program EM&V studies are showing little or no electricity savings associated with these technologies. Refer to Section 3.2.1 (starting on page 19 herein) for the effect (or lack thereof) of time-of-use electricity pricing, Section 3.2.2.4 (starting on page 25 herein) for the effect (or lack thereof) of in-home displays and smart thermostats. A CDM initiative that has inherent costs (for the technology and for the promotion, installation and support of that technology) but little or no energy savings will not meet the cost-effectiveness thresholds.

  Note: The phenomenon described above is easily explained. Often "*proof of concept*" or "*small pilot*" projects involve self-selected highly-engaged participants that produce very encouraging energy savings. However, such participants are not reflective of the general population, and when the initiative is rolled out, the encouraging results from a pilot project can turn into disappointing results for program roll-out.

  While London Hydro will continue to "*dabble*" with advancing the state-of-the-art with Home Energy Management System (HEMS) technology, this CDM Plan is based on more-certain opportunities for energy savings in the residential sector.

- For the "*commercial*" achievable potential assessment, lighting retrofits have been the workhorse of conservation so far, and this trend is expected to continue as a result of significant advancements with solid-state lighting (i.e. LED technology) coupled with price decrease that reflect product maturity. Other significant opportunities are commercial HVAC and refrigeration systems. It is believed that an LDC-operated energy benchmarking program could be an effective tool for increasing uptake in various energy-efficiency upgrades (and retro-commissioning) amongst the institutional sector, retail shopping malls, apartment buildings, and office buildings [Ref 3, pg 99].

- For the "*industrial*" achievable potential assessment, while the provincial saveONenergy RETROFIT PROGRAM and saveONenergy PROCESS & SYSTEMS program are sufficiently generic to provide incentives for any energy-efficiency project where the energy savings are quantifiable and measurable, the largest opportunities are reportedly with industrial compressed air systems and industrial pump motors. However, currently there are no sub-programs in the marketplace targeted to increasing opportunity awareness and program participation levels for these two (2) end use technologies. This CDM Plan (and specifically Section 9.5.1 starting on page 75 herein) proposes a two-prong approach to addressing this matter.

Since past performance can often be uses as a proxy for future performance, this Plan firstly examines the various existing provincial CDM plans under the saveONenergy FOR HOME and saveONenergy FOR BUSINESS, and then makes projections about the resultant energy savings assuming that London Hydro continued with its aggressive approach to CDM.

Table 10-4 (on page 79 herein) indicates that the existing provincial CDM programs will have to be augmented with local or regional CDM program to fill the gap. Section 11 herein provides some indication of what these local or regional programs might be and their anticipated uptake and saving.

Interestingly embedded load-displacement generation is projected to produce 40% of London Hydro's energy savings, and is essential to London Hydro achieving its assigned CDM target.

Note: In the development of the Achievable Potential studies [Ref 2, 3 & 4] which formed the basis of establishing the provincial CDM target, embedded load displacement generation was not considered as a measure. And herein is the basis of a perplexing issue for LDC's – the Achievable Potential studies suggest that the LDC community could meet its CDM targets entirely via energy-efficiency programs, whereas London Hydro's analysis herein indicates that 40% of its target allocation will come from embedded load-displacement generation (in other words, London Hydro can only meet 60% of its allocated CDM target via energy-efficiency programs.

For the regional supply planning process, it is necessary to consider the expected outcome from CDM activities throughout the region. Unfortunately, CDM targets are expressed in terms of energy (in GWh), while system planners are only concerned with capacity (i.e. how much peak load, expressed in kW or MW, is being added to or removed from the overall electrical distribution system. Section 12 herein presents a method for converting London Hydro's CDM target into summer peak demand reductions and winter peak demand reductions in the final year 2020.

As the title of this CDM Plan implies, this document articulates a vision for London Hydro to meet its assigned CDM targets based on a set of assumptions. As the landscape changes on the energy front, London Hydro's continued success on the energy conservation front will be decided by the speed at which it can adapt its CDM Plan (i.e. the strategy) to these changing conditions, a desired outcome portrayed in the following inspirational quote:[77]

> *Only those who are able to adapt to changing scenarios will continue to survive and prosper. Success is directly proportional to the degree of positive adaptation to change.*

As noted earlier in Section 1.2.1 (starting on page 4 herein), clause 3.5 (ix) of the governing *Energy Conservation Agreement* (ECA) allows LDC's to modify and re-submit their CDM Plan on a regular basis.

14.2 Recommendations

1. To move forward with this plan, a number of engineering feasibility studies or program execution plans have to be developed or updated. Specifically:
   - Development of a feasibility study / execution plan for an energy-efficiency upgrade sub-program for illuminated retail signs. Refer to Section 5.3.1 herein.
   - Development of a feasibility study for a whole-home energy-efficiency program. Refer to Section 11.1.1 herein.
   - Development of an execution plan for a swimming pool energy-efficiency program. Refer to Section 11.1.4 herein.
   - Development of a feasibility study / execution plan for a cold-climate air-source heat pump CDM program. Refer to Section 11.1.5 herein.
   - Development of a feasibility study / execution plan for a regional clothes washing machine & dryer program (likely as an extension of the whole-home program). Refer to Section 11.1.6 herein.
   - Update the cost-effectiveness calculations for a proposed incentive program for electric chillers. Refer to Section 11.2.2 herein.
   - Finalize marketing plan for a compressed air leak detection & tagging sub-program. Refer to Section 11.2.3 herein.
2. There is reason to believe that energy benchmarking may be a catalyst for capturing greater energy savings in the latter part of the 2015 – 2020 CDM framework, but the provincial saveONenergy EXISTING BUILDING COMMISSIONING program will first need to be re-designed (likely initially as a local or regional program). Refer to Section 8.5.1 herein.

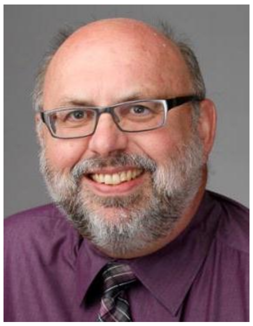
[77] Vishwas Chavan, Vishwasutras: *Universal Principles for Living: Inspired by Real-Life Experiences. See URL::* http://www.goodreads.com/quotes/tag/adaptation

3. In order to better leverage the channel partners, and provide greater value for mutual gain, London Hydro has to move beyond providing an applications processing function to providing channel partners with a suite of mobile sales tools that can provide immediate value propositions for various energy-efficiency options. Refer to Section 13.5 herein.

4. Within the context of defined CDM programs, continue to advance the state-of-the-art with respect to CDM via pursuit of the frontier endeavours identified in Section 13 herein.

♣ - ♣ - ♣

ABOUT THE AUTHOR



Gary Rains, P.Eng., Director of Energy Management Programs, has had a career in the electric distribution utility sector (Ontario Hydro, Scarborough PUC, Toronto Hydro, and now London Hydro) that now spans 35 years. His responsibilities over the years have included various SCADA and Distribution Automation systems, standards, revenue metering, and distribution system planning and Smart-metering. His present responsibilities include developing and overseeing implementation of London Hydro's CDM initiatives.

Appendices

Appendix A, Yearbook Data for London Hydro

The following data, excerpted from page 89 of the Ontario Energy Board publication *2012 Yearbook of Electricity Distributors*,[78] are inputs to the Ontario Power Authority's *Achievable Potential* spreadsheet tool, and are replicated below for convenience of reference.

Billed kWh:

- Residential: ....1,103,889,963 kWh
- General Service < 50 kW:..............................400,003,533 kWh
- General Service > 50 kW & Large User:.......1,717,827,442 kWh

As an input parameter, the achievable potential spreadsheet tool seeks a breakdown between annual energy sales to industrial customers and annual energy sales to commercial customers. Since such data is not readily available (and would take considerable time and effort to derive), it is simply assumed that 1/3 of the non-residential load is consumed by industrial customers and 2/3 of the non-residential load is consumed by commercial customers. Therefore:

Assumed industrial load	=	1/3 x (400,003,533 + 1,717,827,442)
	=	705,943,658.3 kWh
	=	705.8 GWh
Assumed commercial load	=	2/3 x (400,003,533 + 1,717,827,442)
	=	14,118,873,317 kWh
	=	1,412 GWh

✂ --

[78] Ontario Energy Board website; *Yearbook of Electricity Distributors and Yearbook of Natural Gas Distributors*; see URL:: http://www.ontarioenergyboard.ca/OEB/Industry/Rules+and+Requirements/Reporting+and+Record+Keeping+Requirements/Yearbook+of+Distributors

Appendix B, Correspondence

The following is London Hydro's letter of support for a Conservation Fund pilot project being proposed by the *Canadian Coalition for Green Health Care*.

London Hydro

Department: Energy Management
Attention: G. Rains
Telephone: 661-5800 Ext. 4870

111 Horton Street
P.O. Box 2700
London, Ont.
N6A 4H6

April 9, 2015

Canadian Coalition for Green Health Care
1724 Concession 6 West
RR #2
Branchton, Ontario
N0B 1L0

linda@greenhealthcare.ca

Attention: Ms. Linda Varangu, Executive Director

Re: Potential Participation in IESO Conservation Fund Pilot Project for Sector-Specific Roving Energy Managers

Pursuant to your e-mail of March 26th, regarding an application to the IESO's Conservation Fund to fund a pilot project for a "*enhanced*" energy manager program specific to the healthcare sector (with "*enhanced*" meaning that the program is intended to delivery electricity, natural gas and domestic water savings), I offer the following comments / feedback:

- London Hydro has yet to submit its CDM Plan, but when it does in the forthcoming weeks, you will see provisions for sector-specific roving energy managers (REMs). Identified sectors include the healthcare sector (that includes hospitals, long-term care facilities, etc.), the hospitality sector (i.e. hotels, motels and restaurants), and others.

  Note: London Hydro is presently working on the "*cost effectiveness*" elements to complete our CDM Plan submission. As an active participant in the EDA's Industrial CDM Working Group, I recall a presentation last Fall by CLEAResult (the OPA's Technical Reviewer) that showed the energy manager component of the saveONenergy PROCESS & SYSTEMS initiative to be cost effective, so I'm not concerned that London Hydro's intention to move forward with sector-specific roving energy managers may not prove to be "*cost effective*".

- London Hydro is already funding an embedded energy manager within London Health Sciences Centre and the City of London (which operates the Dearness Home for Senior Citizens), and would have little need for a REM specific to the healthcare sector, however the surrounding communities within south-western Ontario (e.g. St Thomas, Tillsonburg, Stratford, etc.) all have hospitals and nursing homes, but individually aren't large enough to fund their own REM. A proposal that was presented at a recent South-western Ontario group (SWOG) meeting was an arrangement wherein London Hydro would contract for a number of regional sector-specific REM's each with assigned minimum annual CDM targets. London Hydro will then allocate the REM's costs to the neighbouring LDC's based on achievements in that community. For example, in the first year, if 70% of the energy saving target was achieved in St Thomas, 20% was achieved in Tillsonburg,

Appendix B, Correspondence (Continued)

and the remaining 10% in London, then the REM costs would be allocated to St Thomas Energy, Tillsonburg Hydro, and London Hydro accordingly.

Note: Although there was general interest expressed by neighbouring LDC's in this "*resource sharing*" concept, no formal arrangements have been pursued pending approval of London Hydro's CDM Plan.

- You and I have conversed and exchanged information in the past and it seems that your Canadian Coalition for Green Health Care (CDGH) organization could be a good fit to provide REM services specific to the healthcare sector.

  Note: The specifics of the sector-specific roving energy managers (i.e. target setting, and pay-for-performance provisions) haven't yet been established but these will likely be similar to BC Hydro' program design parameters.

- We believe that this will be an effective arrangement that demonstrates continued collaboration amongst the SWOG LDC's, and one that will be free of the administrative burden that has plagued the Roving Energy Manager funding program that was part of saveONenergy PROCESS & SYSTEMS under the 2011 – 2014 CDM delivery framework.

- The Ministry's directive to the Ontario Power Authority dated October 23, 2014 and entitled: *Amending March 31, 2014 Direction Regarding 2015 – 2020 Conservation First Framework*, and specifically item #3 is replicated below for convenience of reference:

  3. *The OPA shall procure and coordinate the cost-effective services of energy managers to ensure their sufficient availability to target small business, commercial and institutional customers across the province. For certainty, this shall not restrict Distributors from developing complementary Province-Wide Distributor CDM Programs and Local Distributor CDM Programs to procure and coordinate the cost effective services of energy managers within their licensed service areas.*

  Like many LDC's, I am somewhat confused as to whether the LDC's should be funding these sector-specific REM's (within our CDM Plan) or the OPA will be separately funding these resources.

- Conceptually, it makes sense to have Embedded Energy Managers and Roving Energy Managers seeking both electricity and natural gas savings within facilities. However, I have had involvement in the re-design of the provincial saveONenergy PROCESS & SYSTEMS initiative (wherein funding of energy managers was a program element). In any conversation to date with the natural gas distributors about sharing the cost of energy managers, the response is invariably akin to "*A collaborative approach is certainly best for the customer and we are happy to have the energy managers identify and pursue natural gas savings opportunities (in addition to electricity savings) but we are unable to offer any partial funding for these energy managers*". And since funding for energy managers ultimately comes from the electricity marketplace (via Global Adjustments), it is not appropriate for the electricity marketplace to pay for natural gas or domestic water savings.

- London Hydro has a reputation as a "*no nonsense, Git-R-Done*" LDC, so I'm a bit concerned when I look at your *Conservation Fund – Project Overview Application*

- Page 2 of 3 -

Appendix B, Correspondence (Continued)

to see expenses for "*technical advisors*", "*program advisors*" and "*PhD students*" and other administrative overhead costs. But if IESO believes that this is an integral part of the pilot project (and is willing to pay for it), then London Hydro has no issue.

In summary, London Hydro is supportive of your request to the IESO's conservation fund for "*enhanced*" energy managers specific to the healthcare sector. The concept appears to fit well with London Hydro's vision and intentions (as expressed in our CDM Plan).

Hopefully, there will be an opportunity for IESO, Canadian Coalition for Green Health Care, and London Hydro to collaborate on this proposed pilot project for the success of all parties going forward.

Yours truly,

LONDON HYDRO INC.

Gary Rains, P.Eng.
Director of Energy Management Programs

GHR/ghr

cc: Ms. Victoria Gagnon IESO, Business Manager – EM Resources

Appendix C, Federal Buildings in London

According to public records,[79] the facilities within London Hydro's service territory under the management of Public Works & Government Services Canada are listed in Table C-1 below.

Table C-1, Federal Facilities in London

Federal Facility	Municipal Address	Activity
NRC London	800 Collip Circle	
PWGSC Office	78 Meg Drive	
PWGSC Office	197-199 Dundas Street	
PWGSC Office	1200 Commissioners Road East, #72	
PWGSC Office	417 Exeter Road	
Mount Pleasant Cemetery	303 Riverside Drive	
St. Peter's Cemetery	806 Victoria St	
RCMP - Air Services Section - London	163 Flight School St	
London Divisional Office Annex	955 Highbury Ave	
London Airport (MISC)	Huron Street	
London Middle Marker Site	Lot 1, Concession 3	
Military Facilities Site	Highbury Avenue	
Wolseley Barracks		
Military Facility Site		
Becher Street Armoury	19 Becher Street	
Lipton Building	120 Queens Avenue	
Dominion Public Building	457 Richmond Street	
The Richard Pierpoint Building	451 Talbot Street	
Talbot Centre	465 Richmond Street	
Research & Technological Development	73 Meg Drive	
The Royal Bank Building	383 Richmond Street, suite 1010	
Canada Post Corporation	555 Wellington Road	
"	387 Wellington Road S, Unit 387A	
"	555 Wellington Road South	
Business Development Bank of Canada	1000-148 Fullarton Street	
PWGSC Office	301 Oxford Street	
PWGSC Office	383 Richmond Street	
PWGSC Office	250 York Street	
Farm Credit Canada	835 Southdale Road West	
Agricultural Research and Management	1391 Sandford St.	
London Radio Facility	Part Lots 3 and 4, Concession 2	
PWGSC Office	130 Dufferin Avenue	
Farm Credit Canada	417 Exeter Road	
Export Development Canada	1512-148 Fullarton St.	

[79] Source: http://www.tbs-sct.gc.ca/dfrp-rbif/query_question/summary-sommaire-eng.aspx?qid=18087983

Federal Facility	Municipal Address	Activity
London Automotive Service Centre	225 Wharncliffe Rd. S.	
London Letter Carrier Depot 3	725 Notre Dame Dr.	
London Post Office	515 Richmond St.	
London Letter Carrier Depot 5	25 Waterman Ave.	
London Letter Carrier Depot 6	300 Wellington St.	
Lambeth Post Office	29 Main St. E.	
London Mechanized Processing Plant	951 Highbury Ave.	
London Divisional Office	955 Highbury Ave.	
London Letter Carrier Depot 4	720 Proudfoot Lane	
RCMP Offices	1950 Avro Rd	
Canada Post Corporation	951 Highbury Ave	

A notation in the third column in the tabulation above is to indicate that the records show there has been incentive applications filed at this site for energy-efficiency upgrades.

Appendix D, Green Button Primer

D.1 General - Leveraging the Green Button Connect My Data Initiative

The Green Button initiative provides a standardized and secure method for conveying time-series data, such as energy usage. This standard, initiated by a US White House call to action and developed through NIST, UCAIUG, NAESB and the Green Button Alliance, builds upon existing industry standards to provide a mechanism that addresses more structured industry data needs and allows for customer privacy management.

In Ontario, London Hydro, in concert with MaRS and the Ontario Ministry of Energy is spearheading the development of the Green Button standard as a model for Ontario LDCs to provide third party access to energy data. London Hydro's efforts have expanded the scope of Ontario's Green Button initiative to incorporate Commercial & Industrial data as well as non-metering sources of data such as thermostat measures and set points. Functionally, London Hydro has also demonstrated use of Green Button technology for business to business energy data exchange beyond the typical end consumer focused use cases.

Green Button is not inherently an energy-efficiency technology, rather it provides a standardized communication channel that can be leveraged by many technology solutions, including those focused on energy efficiency initiatives – effectively, Green Button is an enabling technology that allows greater focus on objectives rather than technology infrastructure. Through our participation as a founding member of the Green Button Alliance, we can see significant growth in adoption of the standard both in North America and globally. It is our belief that energy efficiency projects to the greatest extent possible should make use of Green Button interfaces for data access requirements and doing so can allow more cost effective deployment of initiatives across multiple utilities.

Note: As an enabling technology, Green Button provides an umbrella for a number of other projects that are participating in the provincial pilot. Some of these pilot participant projects may subsequently be submitted for consideration for IESO participation via the IESO's Conservation Fund or Collaboration Fund.

D.2 Background

London Hydro has been spearheading the Province's Green Button initiative by collaborating with 3rd Party application developers, in-home energy management device manufacturers, US-based Green Button organizations, NIST, NAESB and a number of our residential and C&I customers.

London Hydro has been recognized in its unique approach to extending Smart Meter / Grid Infrastructure to enable Customer Engagement by industry leaders.

In early 2014, our program was described by Dr. Martin J. Burns, President Hypertek, Inc. and Electronic Engineer at NIST (National Institute of Standards and Technology) as:

"... the first Green Button commercial deployment fully … in the Google Cloud."

Following an invitation to participate in the 2014 White House "Datapalooza" in Washington DC, Matt Theall a White House Presidential Innovation Fellow stated:

"London Hydro and MaRS innovation center have been at the forefront of the Green Button initiative since inception. Their leadership has resulted in over 60% (2.4 million) of Ontarians now having access to Green Button, as a result, consumers can now understand their energy use better, find ways to be more efficient and save money."

On February 26th, London Hydro was recognized by Bob Chiarelli, Ontario Minister of Energy, for our innovative approach:

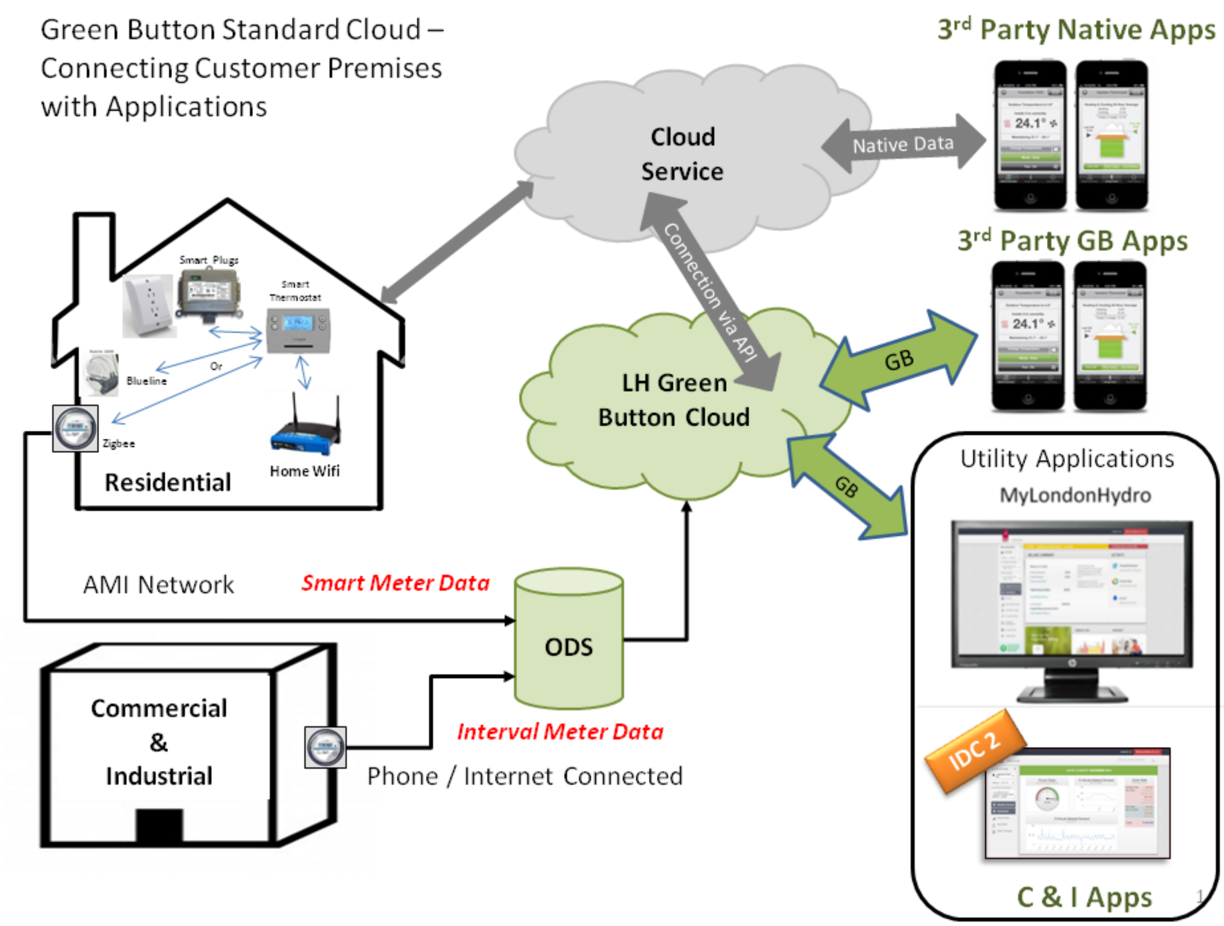
"London Hydro has been leading the way with innovative solutions to engage customers. One of the advantages of smart meters is that they can permit homeowners to download their home's electricity usage data using Green Button. This can help homeowners manage their electricity bill. Congratulations London Hydro and Festival Hydro on signing a collaboration agreement today to support London Hydro's customer and Green Button solutions.

In February 2015, London Hydro became a founding member of the Green Button Alliance. This underscores London Hydro's commitment to increase adoption of Green Button across Ontario based and Canadian utilities through collaboration with US utilities and vendors:

Green Button Alliance (GBA) is a nonprofit corporation formed in 2015 to foster the development, compliance, and wide-spread adoption of the Green Button standard. It is the single definitive go-to place for all things related to the Green Button initiative - from certification of implementations to marketing and education. Green Button Alliance members include; London Hydro , PG&E, San Diego Gas & Electric, US Department of Energy, UL, Southern California Edison, Schneider Electronic, NIST and Silver Springs Networks.

D.3 Innovative Green Button Solution

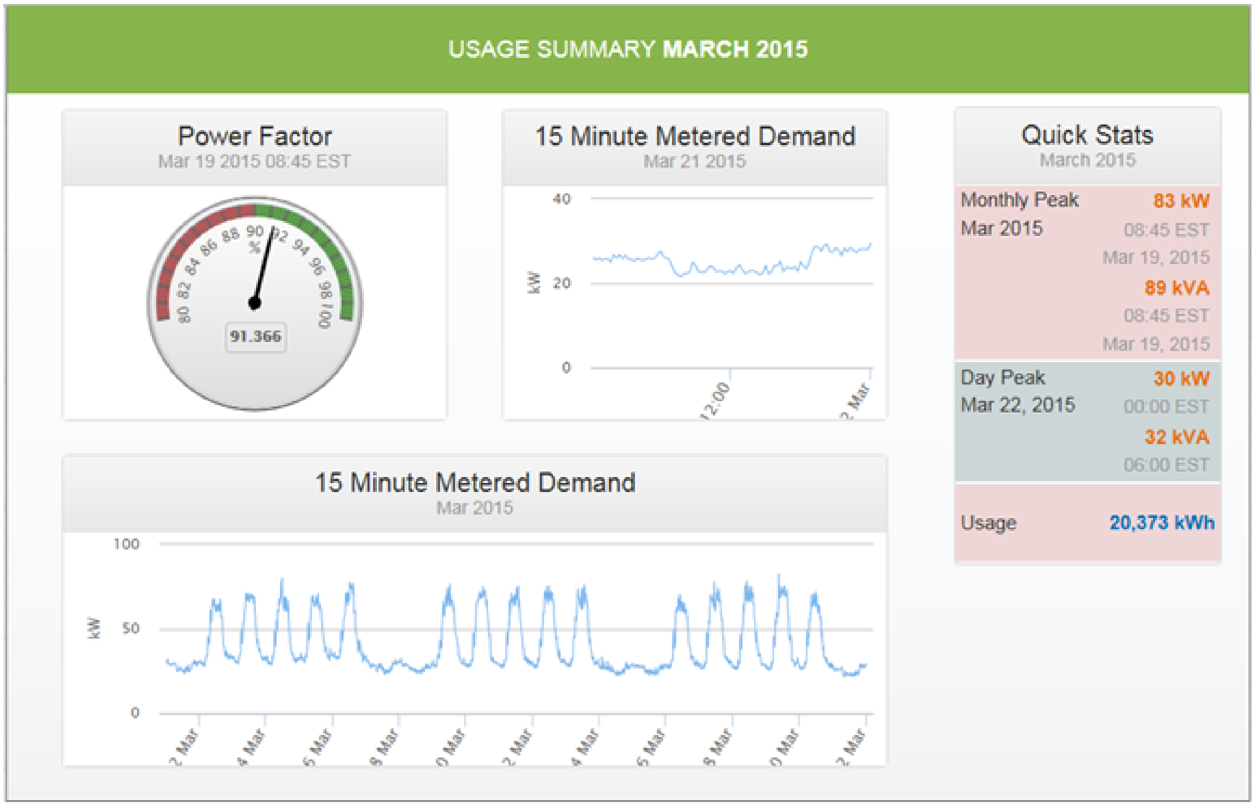
London Hydro took the innovative approach to deploy Green Button as part of the Smart Grid Infrastructure initiative. The following diagram highlights the "forward" thinking approach to implementing Green Button for utilities across North America using cloud, mobile computing and open source.



D.4 London Hydro Green Button Applications

D.4.1 Interval Data Centre 2

Interval Data Centre 2 is a cloud based Green Button enabled energy analysis application offering reports, trends and advice for commercial and industrial customers. It is best suited for users who have significant monthly energy consumption and costs. IDC2 offers advanced data reports such as power factor analysis, load factor, peak and multi facility comparisons. With IDC2 your smart operational changes turn into significant monetary savings.

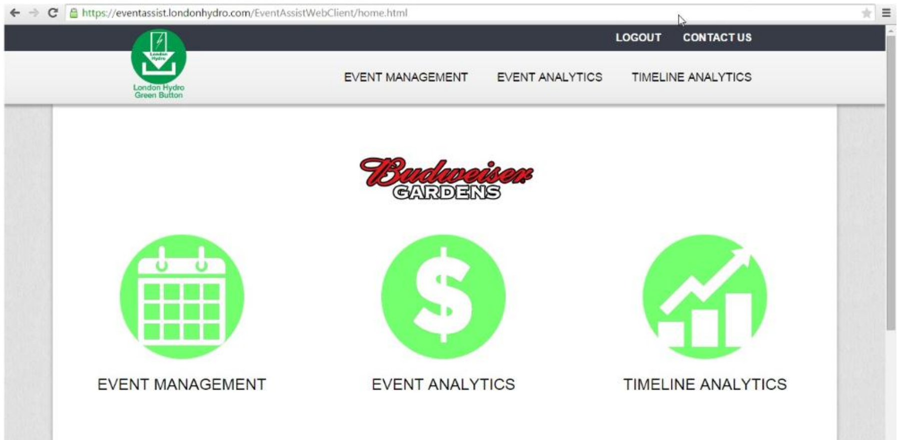


D.4.2 Event Assist

Event Assist is a web-based Green Button enabled energy data analysis and forecasting application for large commercial venues. Its key features include electricity bill breakdown at event level and prediction of cost for upcoming events.

Electricity cost for venues that rent facilities vary depending on: Event Type, Price Volatility, Event Duration, Venue Configuration, Setup Requirements and Number of Events.

The profit margins for a facility manager vary depending on the event type and timing. Our advanced algorithm helps you allocate your monthly peak and consumption cost specific to your event in order to ensure that your profit margins remain unaffected.



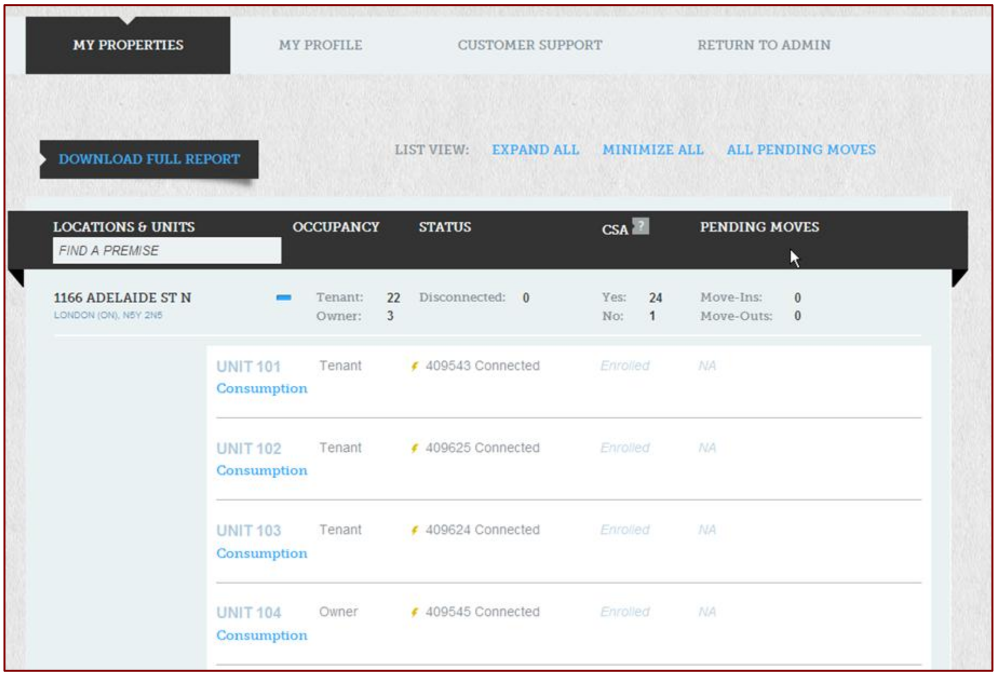
D.4.3 Green Home

"Greenhome", a Green Button-enabled web application is being developed in collaboration with Western University and London Hydro. The objective of Greenhome is to provide prospective home buyers and sellers with a web service to examine the utility costs of listed homes, including their own, using Green Button data and standards. This usage data is coupled with relevant demographic information to generate several cost metrics about the listed properties, giving the data context and providing an overview of a home's energy cost profile. The system is targeted at home buyers and sellers in general, as well as any third-party software developers that wish to use the aggregated Greenhome data in their own projects.

D.4.4 Property Manager

Designed and built for property owners, property management is a user-friendly Green Button enabled web based solution that combines utility data reports & analytics with day-to-day property management needs. With the property management tool you can view all of your properties, their occupancy status, connection, continuous service agreement and pending moves.

Property Management tool allows you to list all pending moves and disconnects with just one click. Property owners can now easily delegate system access on superintendent or user level, access tenant agreements, forms and utility invoices.



D.5 Innovation Timeline

D.6 Green Button 3rd Party Applications

The Ontario Green Button Pilot at London Hydro continues to expand consumer choice with more third-party applications.

D.6.1 Phase 1 Applications

Phase 1 of the Green Button pilot was initiated in 2014, where it offered residential and commercial customers a choice of 4 applications to access their electricity data and better manage their usage:

<u>Residential Applications</u>

MyEyedro by Eyedro

MyEyedro is a fun, fast and free way to manage electricity use. At home or on the go, customers can see how they measure up against family, friends, and find out how much they can save when they take control.

GOODcoins

GOODcoins rewards customers for tracking electricity and for achieving electricity reductions targets. Customers earn rewards for using less electricity.

<u>Commercial Applications</u>

BuiltSpace

BuiltSpace is designed to help property managers optimize electricity use across their portfolio of small and medium-sized buildings of diverse types.

Energent

Energent incorporates powerful statistical energy modeling capabilities to track monitor and assess customers' energy data and facility energy performance.

D.6.2 Phase 2 Applications

Phase 2 of the pilot will now offer 4 more applications to go live in the spring of 2015.

<u>Residential Applications</u>

HomeBeat by Bidgely

HomeBeat is a web and mobile application that provides customers with a trusted energy advisor to help them understand energy use by showing the impact of individual appliances on the bill and provide tips to reduce consumption.

Presence Pro Energy by People Power

Presence Pro Energy delivers real-time, whole-home energy monitoring and smart plug control giving residential and small business users the ability to manage electric use from a smartphone or tablet.

WATTSLY

Wattsly

Wattsly is your personalized energy butler that helps you monitor and lower your electricity usage, and helps you make great consumer choices for your wallet and the planet. Wattsly is the winner of the 2014 Energy Apps for Ontario Challenge.

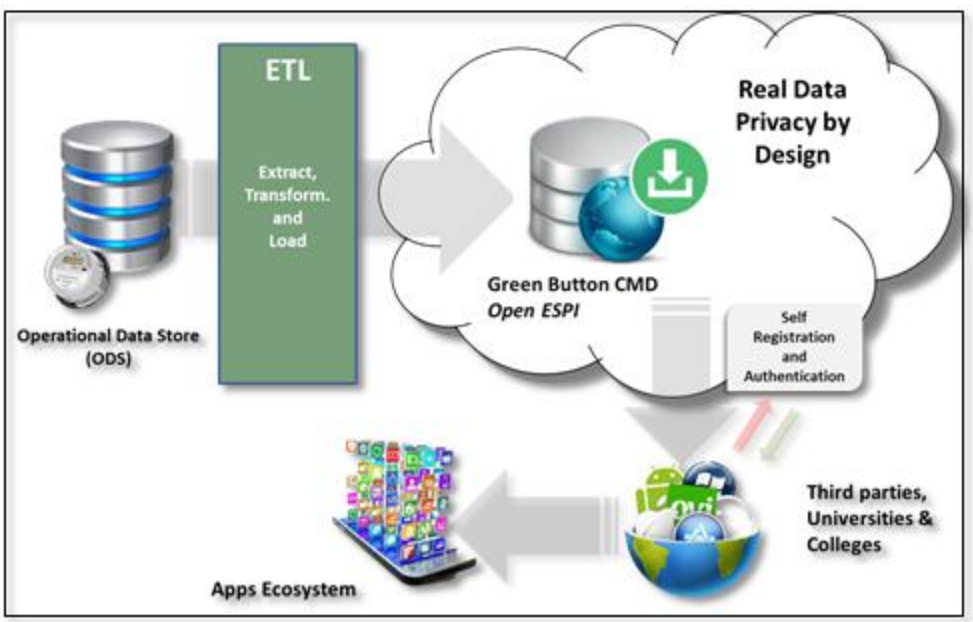
Commercial Applications

Stream by Energy Profiles Limited

Stream is a comprehensive utility data management system, which enables property owners and managers to understand their utility use and cost at both the portfolio and building level

D.7 London Hydro's Green Button Test Lab

London Hydro was requested by MaRs/Ministry of Energy to provide test lab for 3rd party labs as part of Green Button initiative. In January 2015, the lab was launched, To-date , eleven vendors have utilized the lab.



The test lab is the cloud-based sandbox where ideas and energy consumption data converge. It's here where the utility, or Data Custodian, makes available to registered app developers the interval usage data that their retail and commercial customers have permitted them to share by joining the Green Button program. All that is required is for interested app developers and solutions providers to complete the registration form below. Once registered you have access to the usage data APIs. Whether you're a developer working on an app targeted at consumers or a solutions provider working on a custom program for a large-scale commercial client, the data is all there. You can use it to test prototypes, work out bugs and run simulations before delivering the final product or taking it to market.

Solid reliable data that is continuously being updated in a risk free environment with no associated costs. It just does get any better than that. Because the design is totally open, all data from all participants conforms to the same consistent Green Button standard and is available and accessible all the time.

Whether you're working on a solution for a local client and only need access their specific data, or you're working on a residential app that has potential for use across Canada; you have access to the reliable and accurate data you need for testing purposes. The following testimonial is from current test lab client:

> *"Our end-to-end testing with the London Hydro Green Button Test Lab is on track to be far faster and easier than our previous OAuth 2.0 interfaces. We were able to obtain authorization tokens and initial resource downloads in under 4 hours of work, most of which were small tweaks required on our end."*
>
> David Krinkel, Energyai

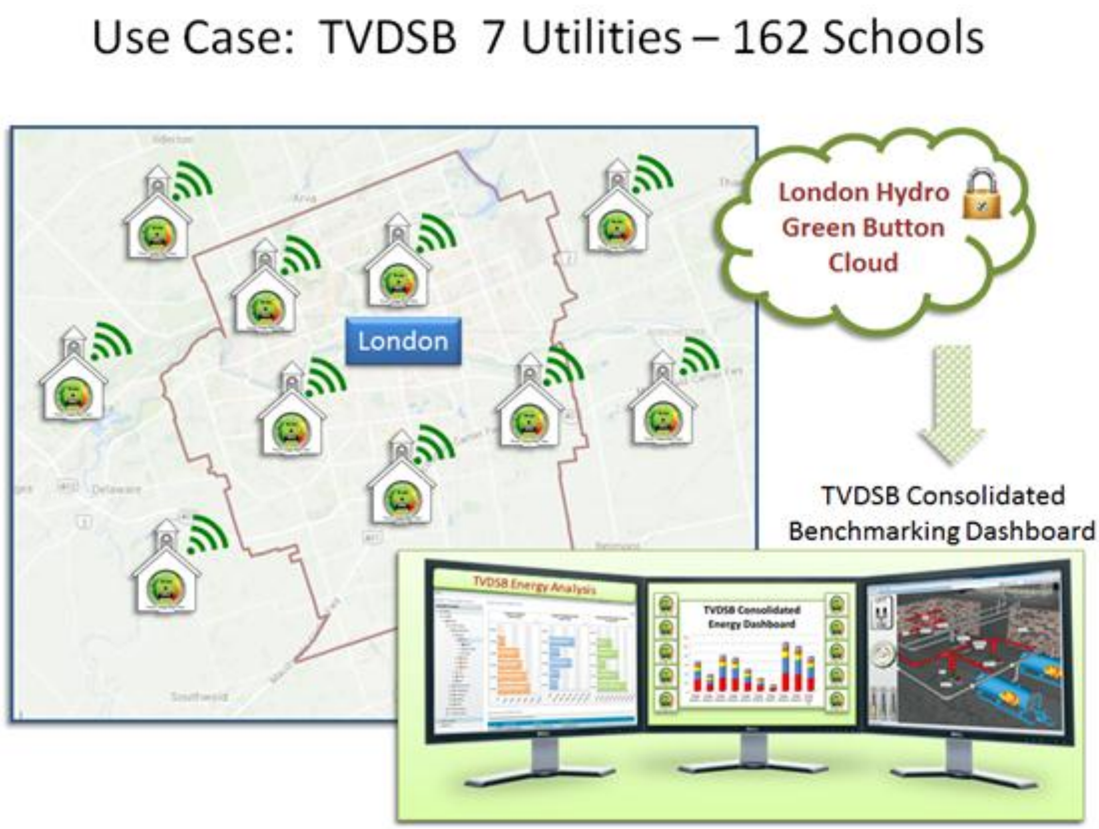
D.8 Green Button Use Case

The Thames Valley District School Board

The Thames Valley District School Board's (TVDSB) use case can be extended across Ontario's elementary and secondary schools as the board incurs significant energy costs of nearly half a billion dollars each year.

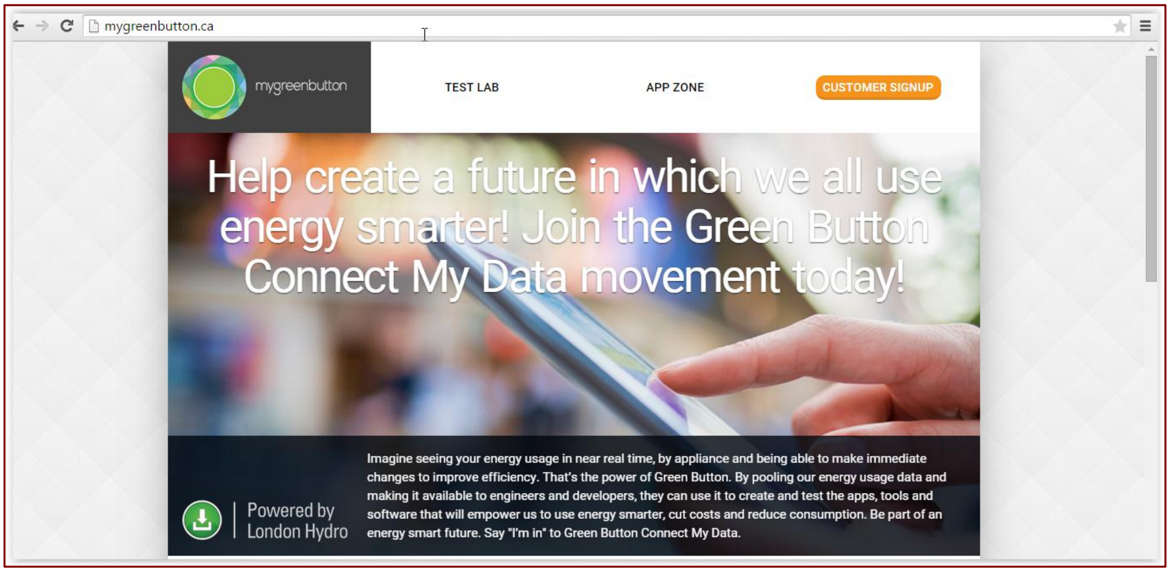
The TVDSB has 162 schools that extend past London Hydro's service territory across seven utilities in Ontario. The School Board wanted to access hourly interval data for all schools to analyze consumption and costs. The Green Button Program has now enabled London Hydro to provide TVDSB their usage data for all of their schools using an internally created web presentment tool called "Interval Data Centre 2. (IDC2)"

Essentially, London Hydro reads the meters, collects the data from all schools and pushes the data to the Green Button Cloud where the Interval Data Centre 2 accesses the data for presentment. This provides the school board with a no cost solution to access their interval data, enabling them to make more effective business decisions, including purchasing agreements.



D.9 Green Button Micro Site

mygeenbutton.ca provides London Hydro customers educational material on Green Button initiative and allows them to sign up to become a pilot participant.



♣ - ♣ - ♣

This Page Intentionally Left Blank....

London Hydro Report EM-14-03B, *Integrated Resource Planning: Forecasts of Energy Efficiency Program Outcomes as a Demand-Side Resource (Volume 2 – Budget & Resource Plan)*

Issued: April 2015

EXECUTIVE SUMMARY

The Minister of Energy's March 31st, 2014 directive to the Ontario Power Authority entitled: *2015 – 2020 Conservation First Framework*, defines the CDM delivery framework for the next six (6) years. Specific passages that relate to a Distributor CDM targets have been replicated following for convenience of reference:

> *Therefore, pursuant to my authority under section 25.32 of the Act, I hereby direct the OPA to coordinate, support and fund the delivery of CDM programs through Distributors to achieve a total of 7 TWh of reductions in electricity consumption between January 1, 2015 and December 31, 2020 in accordance with the following guiding principles and requirements.*

Based on its reported population of residential and non-residential customers, London Hydro's allocation of the provincial target is 196.66 GWh (to be achieved over the 6-year framework).

Clause 3.5 (v) of this same directive has been replicated below for convenience of reference:

> *v. The OPA shall ensure that there is a positive benefit-cost analysis of each CDM Plan and each Province-Wide CDM Program and Local Distributor CDM Program utilizing the OPA's Total Resource Cost Test and the Program Administrator Cost Test found in the OPA's Cost-Effectiveness Guide, dated October 15, 2010 (OPA Cost-Effectiveness Tests), which may be updated by the OPA from time to time. The OPA will establish hurdle rates to consider the cost of delivering Province-Wide Distributor CDM Programs and Local Distributor CDM Programs against the avoided cost of procuring supply.*

This Volume 2 (*Budget & Resource Plan*) of the overall report is intended to show the forecasted budget and resource requirements for London Hydro to meet or exceed these aggressive CDM targets (in a cost-effective manner) via:

- The continuation of provincial CDM programs (that are within the saveONenergy FOR HOMES and saveONenergy FOR BUSINESS portfolios); and
- The introduction of new CDM programs that are local to London Hydro, or perhaps created as regional CDM offerings.

Finally, this document highlights the ongoing collaboration activities with neighbouring LDC's and provides a "*change management*" strategy for the London Hydro organization to enter into the new 2015 – 2020 CDM framework.

♣ - ♣ - ♣

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction

1.1 Background

Energy conservation is considered an "*investment*" and therefore cost-effectiveness screening is a critical part of the energy efficiency program planning process. There are well-established methodologies for conducting cost-effectiveness analysis for demand-side resources (e.g. energy efficiency, demand response, and distributed generation). The Ontario Power Authority publication: *Conservation & Demand Management: Energy Efficiency Cost Effectiveness Guide* is used by Ontario electricity distributors and regulators. This publicly-available reference describes the primary approaches used for evaluating the cost-effectiveness of demand-side management activities.

Though there are several different tests that evaluate cost-effectiveness from a variety of perspectives, all of them compare the net present value of the benefits of the energy efficiency resource (lifetime savings) with the net present value of the cost of the energy efficiency resource. Results are typically expressed as a benefit-cost ratio or as the net present value of benefits (NPV benefits - NPV costs).

1.2 Purpose

This document serves two (2) distinct purposes, namely:

- As a supporting reference document for London Hydro's *CDM Plan* submission to the IESO in accordance with the governing *Energy Conservation Agreement* (ECA) between each LDC and the IESO (for the 2015 – 2020 CDM framework); and
- As an internal reference document to project future cash flows.

1.3 Scope

This document outlines the organizational structure that is recommended to fulfill the defined CDM targets of the 2015 – 2020 time period, describes the various cost-effectiveness tests that are used in Ontario for energy conservation programs and portfolios, provides transparency into the assumptions used for the various cost-effectiveness tests, and finally discusses the collaboration and change management activities that are to be carried out under the 2015 – 2020 CDM framework.

1.4 Document Structure

The overall CDM Plan spans three (3) documents as described following:

- Volume 1 – *Articulation of the Vision*, identifies London Hydro's assigned CDM targets for the 2015 – 2020 CDM framework; and indicates the manner in which these targets are anticipated to be achieved, both via the continuation of provincial

CDM programs complimented by the introduction of new local or regional CDM programs.

- This Volume 2 – *Budget & Resource Plan* – identifies the resources that London Hydro believes is necessary to deliver the various CDM programs, various management intentions (e.g. ongoing skills development plan, internal change management, etc.), a budget projection to fund CDM delivery, and finally the cost effectiveness of London Hydro's plan.
- Volume 3 – *Tillsonburg Hydro's CDM Plan*, indicates the CDM programs that London Hydro will deliver under a partnership arrangement with Tillsonburg Hydro within that franchise service territory in a cost-effective manner.

1.5 References

[1] Ontario Power Authority publication: *OPA Conservation and Demand Management - Cost Effectiveness Guide*; October 15, 2010.

[2] National Action Plan for Energy Efficiency (2008). *Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers*. Energy and Environmental Economics, Inc. and Regulatory Assistance Project. www.epa.gov/eeactionplan

1.6 Acronyms, Abbreviations and Symbols

1.6.1 Acronyms

Acronyms used in this report are presented following in alphabetic order:

CDM = Conservation and Demand Management

IESO = Independent Electricity System Operator

LUEC = Levelized Unit Electricity Cost

OPA = Ontario Power Authority (now amalgamated with IESO pursuant to Schedule 7 of Ontario Bill 194)

PAC = Program Administrators Cost

TRC = Total Resource Cost

1.6.2 Abbreviations

Abbreviations used in this report are presented following in alphabetic order:

GWh = Gigawatt-hour

kW = kilowatt

kWh = kilowatt-hour

MW = Megawatt

MWh = Megawatt-hour

TWh = Terawatt-hour

These abbreviations are consistent with CSA Standard Z85-1983, *Abbreviations for Scientific and Engineering Terms*.

2 RESOURCE PLAN

In comparison to the previous 2011 – 2014 CDM delivery framework, London Hydro's annual CDM targets under the new 2015 – 2020 CDM framework are double the very best year under the previous framework.[1] Clearly some staff augmentation within London Hydro's CDM department is likely needed to both achieve this objective and to provide CDM delivery services within the franchise service territories of other LDC's that have elected for a collaborative partnership with London Hydro.

Due to the unitized "*per kWh*" methodology used later for estimating the program administrator's cost (i.e the cost for London Hydro to delivery CDM programs), the cost of additional staff is already covered in the cost-effectiveness tests. For example, if it is determined that historically it has taken $X to capture Y kWh of energy savings, then if the requirement is to deliver 2 x Y kWh, then the associated budget is based on the delivery cost being 2 x $X. The analysis will show that London Hydro's CDM Plan remains cost-effective even with these additional staff resources.

[1] London Hydro report EM-14-03, *Integrated Resource Planning: Forecasts of Energy Efficiency Program Outcomes as a Demand-Side Resource (Volume 1 – Articulation of the Vision)*; Section 2.2.1, *CDM Target Expectation*; pg 12 – 13.

3 Cost Effectiveness

It is imperative that CDM Plans be "*cost effective*". This section provides an introduction to the requisite cost effectiveness metrics, the underlying assumptions used (including historical insight into incentives and program administration costs), and finally reports on the cost effectiveness of London Hydro's CDM Plan.

3.1 Primer on Cost Effectiveness Tests

Though there are several different tests that evaluate cost-effectiveness from a variety of perspectives, all of them compare the net present value of the benefits of the energy efficiency resource (lifetime savings) with the net present value of the cost of the energy efficiency resource. Results are typically expressed as a benefit-cost ratio or as the net present value of benefits (NPV benefits - NPV costs).[2]

Clause 3.5 (v) of the Minister's March 2014 directive[3] has been replicated below for convenience of reference:

> v. *The OPA shall ensure that there is a positive benefit-cost analysis of each CDM Plan and each Province-Wide CDM Program and Local Distributor CDM Program utilizing the OPA's Total Resource Cost Test and the Program Administrator Cost Test found in the OPA's Cost-Effectiveness Guide, dated October 15, 2010 (OPA Cost-Effectiveness Tests), which may be updated by the OPA from time to time. The OPA will establish hurdle rates to consider the cost of delivering Province-Wide Distributor CDM Programs and Local Distributor CDM Programs against the avoided cost of procuring supply.*

3.1.1 Total Resource Cost (TRC) Test

The TRC is an indicator of a measure, program or portfolio's attractiveness from a societal perspective.

The following equation summarizes the calculation of the TRC benefit/cost ratio:

$$\text{TRC} = \frac{NPV\ of\ Lifetime\ Generation\ Costs\ Avoided}{Measure\ Costs}$$

This test compares benefits to society as a whole (avoided supply-side cost benefits, additional resource savings benefits) with the participant's cost of installing the measure plus the cost of energy efficiency program administration (non-incentive

[2] *The Energy Efficiency Guidebook for Public Power Communities*; Energy Centre of Wisconsin; October 2009; Chapter 9, *Program Screening*.
[3] Directive, dated March 31, 2014 to Ontario Power Authority from Ministry of Energy; re: *2015 – 2020 Conservation First Framework*.

costs). Incentives are considered a transfer payment from program to participant and thus are not explicitly accounted for in the calculation.

Since the TRC test takes a societal perspective into account, it is the appropriate test for regulatory agencies and other policymakers to use in establishing energy conservation goals.

3.1.2 Program Administrators Cost (PAC) Test

The Program Administrator Cost (PAC), sometimes referred to as the utility cost test, compares the utility's avoided cost benefits with energy efficiency program expenditures (incentives plus administrative costs). Along with the TRC test, the PAC test is one of the most commonly-used tests for energy efficiency program planning purposes. It is also frequently used in a resource planning context to evaluate energy efficiency investments against supply-side alternatives.

To calculate PAC, the following equation is used:

$$\text{PAC} = \frac{NPV\ of\ Lifetime\ Generation\ Costs\ Avoided}{Incentive\ Costs + Other\ Program\ Costs}$$

The PAC has the same numerator as the TRC: the total benefits of the measures in the program. Again, typically this is the net present value of the lifetime stream of generation costs avoided due to the measure savings. The denominator is the program cost, which is the sum of the incentive costs (if any) and the other program costs as described above. As mentioned above, all costs and benefits are expressed in constant 2012 dollars. The real discount rate used in net present value calculations is 4%.

3.1.3 Levelized Unit Electricity Cost (LUEC) Test

Levelized Unit Electricity Cost (LUEC), also referred to in the literature as "*Levelized Delivery Cost (LC)*", is a measure of how much it costs for each kilowatt-hour of electricity conservation.

To calculate LUEC, the following equation is used:

$$\text{LUEC} = \frac{Incentive\ Costs + Other\ Program\ Costs}{NPV\ of\ energy\ savings}$$

The Levelized Delivery Cost Metric provides a basis for comparing energy-efficiency programs with other electricity supply resources. The metric expresses delivery costs (all costs associated with designing, delivering and evaluating a program) per unit of energy saved on an annualized basis in terms of $/MWh. It accounts for the energy savings that persist over the minimum expected useful life of all technologies and initiatives associated with the implementation of a conservation program.[4]

[4] Ontario Power Authority publication: *2011 Conservation Results*; December 2012; pg 7.

3.2 Program Assumptions

Assumptions concerning London Hydro's historic electricity savings acquisition costs (i.e. the program administration costs plus the incentive costs or contractor payment costs for direct-install initiatives) are provided in the subsections below on a program-by-program basis.

3.2.1 Annual London Hydro Program Administration Expenditures

Given that the past can often be a reasonable proxy for the future, the predicted program administration costs (e.g. direct labour costs, indirect program expenses, and customer incentives or contractor payments for the case of direct install programs) are based on historical patterns over the 2011 – 2014 CDM delivery framework.

Indirect program expenses are those necessary non-labour costs incurred by an organization to operate a special program. The indirect program expenses include (but aren't necessarily limited to) such items as facility lease costs, office equipment (e.g. photocopier paper, telephone charges, etc.), vehicles, registration and incidental costs at relevant events, membership in relevant organizations (e.g. London Property Management Association, London Home Builders Association), technology training, sample procurement, marketing, etc.

3.2.1.1 Program Administrator Costs Associated with RETROFIT PROGRAM

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy RETROFIT PROGRAM within London Hydro's franchise service territory is depicted in Figure 3-1 below.

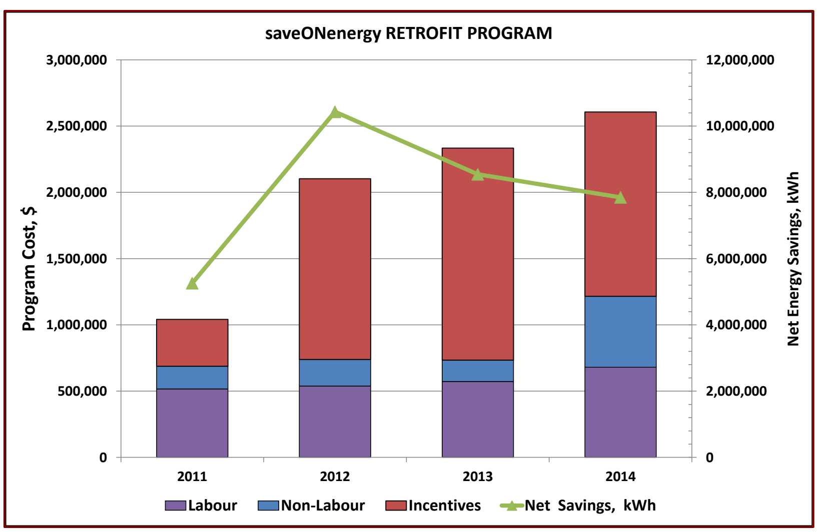


Figure 3-1, Historical Program Costs for RETROFIT PROGRAM

It will be seen from Figure 3-1 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy RETROFIT PROGRAM are provided in Table 3-1 below.

Table 3-1, Savings Acquisitions Costs for RETROFIT PROGRAM

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.11	$0.25
2014 only	$0.15	$0.33

For the purposes of this CDM Plan, the four-year average costs (i.e. $0.11 per net kWh program administrator's costs and $0.25 per net kWh all-in costs) will be used for establishing the budget. Although energy-efficiency projects are getting smaller (i.e. it takes similar administrative effort to sell and oversee a large scale energy-efficiency upgrade encompassing several apartment building involving hundreds or thousands of lighting fixtures as a single VFD pump or motor with much smaller associated energy savings), it is expected that London Hydro will compensate via various productivity improvement measures (e.g. mobile sales tools for contractors, etc.).

Note: Under the 2011 – 2014 CDM delivery framework, incentives were a "*pass-through*" expense, i.e. London Hydro paid incentive monies to participants and then recovered these monies from the Ontario Power Authority. Similarly, LDC's were allocated an annual Program Administration Budget (PAB) to cover the labour and other costs associated with operating the portfolio of provincial CDM programs within their respective service territory. Under the new 2015 – 2020 CDM framework, LDC's are provided with a budget threshold to cover all program expenditures (i.e. incentives plus program administration costs).

Note: Incentives are normally determined based on "*gross*" electricity savings (as opposed to "*net*" electricity savings. However, since CDM targets are based on net electricity savings, the "*all-in*" costs above are also based on historic administration costs and net annual energy savings.

3.2.1.2 Program Administrator Costs Associated with PROCESS & SYSTEMS

The saveONenergy PROCESS & SYSTEMS initiative included a number of sub-programs, namely:

- Funding for preliminary engineering studies (PES's) and detailed engineering studies (DES's);
- Funding for various types of energy managers (i.e. embedded energy managers – EEM's, roving energy managers – REM's, and key account managers – KAM's);
- Incentives for Monitoring & Targeting systems (M&T systems); and
- Incentives for energy efficiency projects and embedded load-displacement generation systems.

While, in principle, it was an attractive program, the plethora of participation barriers contributed to the resulting abysmal failure. The only element that seemed to work well and produce results was the "*energy manager*" funding component. As such, historical incurred program administration costs will not be reflective of the expectations for a re-designed PROCESS & SYSTEMS program.

For the purposes of this CDM Plan (and until better data is available), the following program administration costs will be assumed for projects carried out under this initiative:

- For energy-efficiency projects, the 2014 program administration costs associated with the RETROFIT PROGRAM will be used. As shown in Table 3-1, this is $0.15 per net kWh. PROCESS & SYSTEMS projects tend to be much more involved than RETROFIT projects, so a value at the high end of the RETROFIT spectrum of program administration costs is quite reasonable.
- For embedded load-displacement generation projects (which tend to produce on average ten times the savings per project), a program administration cost of $0.02 per net kWh is assumed.

3.2.1.3 Program Administrator Costs Associated with SMALL BUSINESS LIGHTING

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy SMALL BUSINESS LIGHTING program within London Hydro's franchise service territory is depicted in Figure 3-2 below.

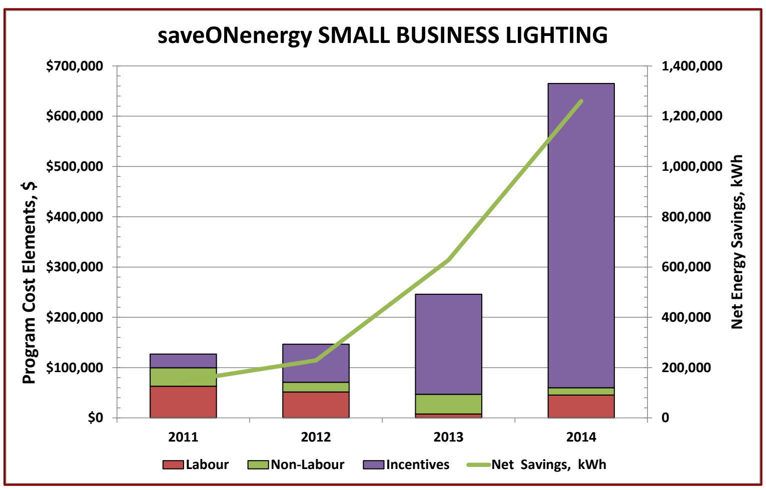


Figure 3-2, Historical Program Costs for SMALL BUSINESS LIGHTING

It will be seen from Figure 3-2 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy SMALL BUSINESS LIGHTING program are provided in Table 3-2 below.

Table 3-2, Savings Acquisitions Costs for SMALL BUSINESS LIGHTING

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.12	$0.52
2014 only	$0.05	$0.53

The achievements in 2014 were clearly an anomaly for London Hydro. As such, for the purposes of this CDM Plan, the 4-year average costs (i.e. $0.12 per net kWh program administrator's costs and $0.52 per net kWh all-in costs) will be used for establishing the budget.

3.2.1.4 Program Administrator Costs Associated with HOME ASSISTANCE

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy HOME ASSISTANCE program within London Hydro's franchise service territory is depicted in Figure 3-3 below.

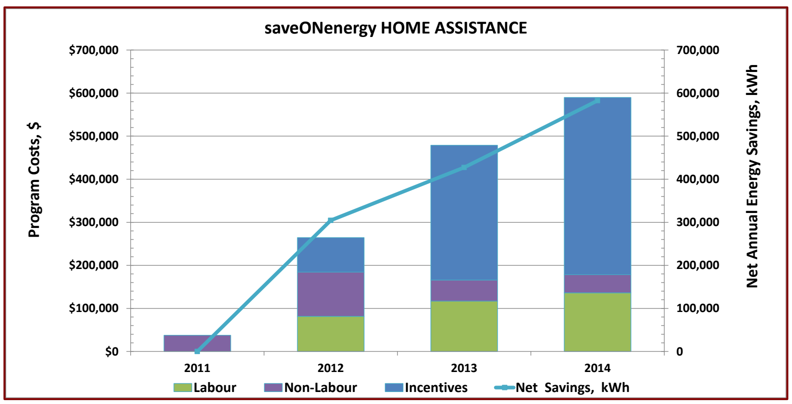


Figure 3-3, Historical Program Costs for HOME ASSISTANCE

Note: Since HOME ASSISTANCE is a "*direct install*" program, the chart bar segments identified as "*incentives*" are not monies paid to participating customers, but rather payments made to the contractors that are carrying out the energy-efficiency retrofits on behalf of the owner or tenant in qualifying dwelling units.

It will be seen from Figure 3-3 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy HOME ASSISTANCE program are provided in Table 3-3 below.

Table 3-3, Savings Acquisitions Costs for HOME ASSISTANCE

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.43	$1.04
2014 only	$0.31	$1.01

With reference to Figure 3-3, the years 2011 and 2012 were "*ramp-up*" years with higher than normal administration overhead costs and small than expected energy savings. Therefore, for the purposes of this CDM Plan, the 2014 costs (i.e. $0.31 per net kWh program administrator's costs and $1.01 per net kWh all-in costs) will be used for establishing the budget going forward.

3.2.1.5 Program Administrator Costs Associated with AUDIT FUNDING

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy AUDIT FUNDING program within London Hydro's franchise service territory is depicted in Figure 3-4 below.

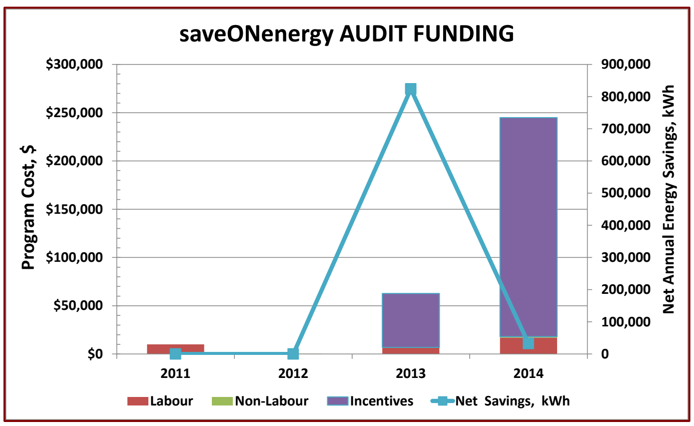


Figure 3-4, Historical Program Costs for AUDIT FUNDING

It will be seen from Figure 3-4 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy AUDIT FUNDING program are provided in Table 3-4 below.

Table 3-4, Savings Acquisitions Costs for AUDIT FUNDING

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.04	$0.37
2014 only	$0.56	$7.62

One of the anomalies of the AUDIT FUNDING program is that audit reports carried out in a given year often don't start accruing savings until the following year. As such, for the purposes of this CDM Plan, the four-year average costs (i.e. $0.04 per net kWh program administrator's costs and $0.37 per net kWh all-in costs) will be used for establishing the budget.

3.2.1.6 Program Administrator Costs Associated with NEW HOME CONSTRUCTION

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy NEW HOME CONSTRUCTION program within London Hydro's franchise service territory is depicted in Figure 3-5 below.

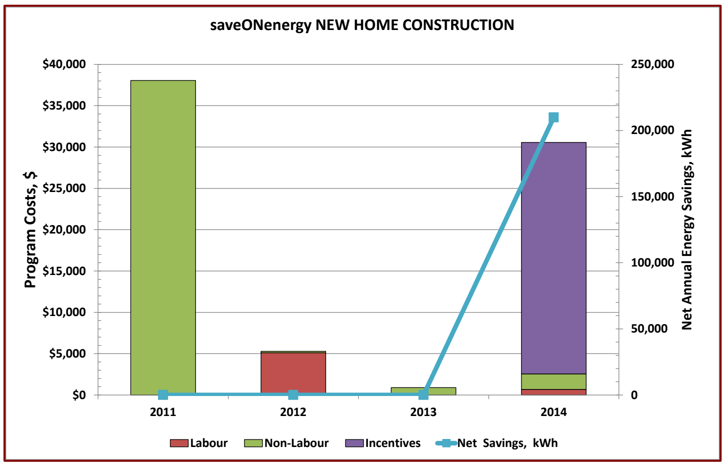


Figure 3-5, Historical Program Costs for NEW HOME CONSTRUCTION

It will be seen from Figure 3-5 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy NEW HOME CONSTRUCTION program are provided in Table 3-5 below.

Table 3-5, Savings Acquisitions Costs for NEW HOME CONSTRUCTION

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.22	$0.36
2014 only	$0.01	$0.15

There were numerous serious program design flaws with the saveONenergy NEW HOME CONSTRUCTION program that weren't corrected until Spring 2013.[5] As

[5] London Hydro Report EM-14-02, *Energy Conservation and Demand Management – Annual Report of London Hydro's Activities and Achievements*; September 2014; Section 3.3.2.8, *saveONenergy NEW HOME CONSTRUCTION Participation Insight*; pg 38 – 39.

such there was no real program uptake (even at the provincial level) until 2014. As such, the 2014 costs (i.e. $0.01 per net kWh program administrator's costs and $0.15 per net kWh all-in costs) are considered better proxies for the future and will be used for establishing the budget on a go-forward basis.

3.2.1.7 Program Administrator Costs for HEATING & COOLING INCENTIVE

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy HEATING & COOLING INCENTIVE program within London Hydro's franchise service territory is depicted in Table 3-8 below.

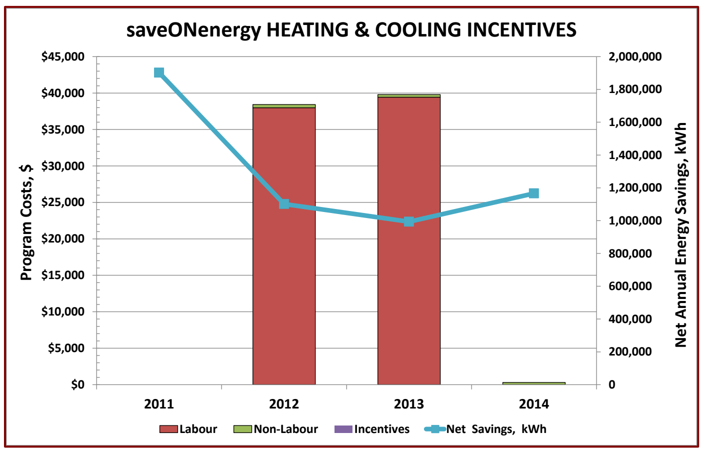


Figure 3-6, Historical Program Costs for HEATING & COOLING INCENTIVE

Note: The provincial saveONenergy HEATING & COOLING INCENTIVE program has an arrangement with HRAI for the administration of this program. These authorized HVAC contractor is responsible for filing incentive applications and incentive payments are made by the Ontario Power Authority directly to the participant (and not routed though the LDC's). As such, since London Hydro didn't make any incentive or contractor payments, no incentives / contractor payments are indicated in the chart above.

It will be seen from Figure 3-6 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy HEATING & COOLING INCENTIVE program are provided in Table 3-3 below.

Table 3-6, Savings Acquisitions Costs for HEATING & COOLING INCENTIVE

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.02	--
2014 only	$0.00	--

To overcome the erratic nature of program expenses versus program savings achievements, for the purposes of this CDM Plan, the 4-year average costs (i.e. $0.02

per net kWh program administrator's costs) will be used for establishing the budget going forward.

3.2.1.8 Program Administrator Costs Associated with COUPONS Program

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy COUPONS program (coupled with the bi-annual retailer event) within London Hydro's franchise service territory is depicted in Figure 3-7 below.

Note: For the purposes of this CDM Plan and the Annual CDM reports, London Hydro combines the expenses and outcomes for the saveONenergy COUPONS program and the bi-annual retailer events.

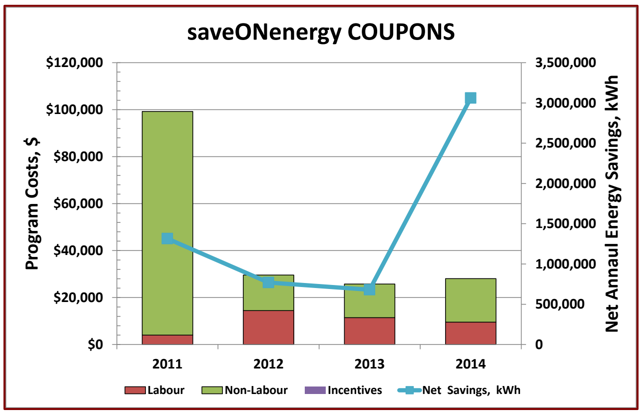


Figure 3-7, Historical Program Costs for COUPON Program

Note: The provincial saveONenergy COUPON program has an arrangement with redemption agency and as such London Hydro doesn't make any incentive or contractor payments directly to retailers or redemption agencies.

It will be seen from Figure 3-7 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy COUPON program are provided in Figure 3-7 below.

Table 3-7, Savings Acquisitions Costs for COUPON Program

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.03	--
2014 only	$0.01	--

To overcome the erratic nature of program expenses versus program savings achievements, for the purposes of this CDM Plan, the 4-year average costs (i.e. $0.03 per net kWh program administrator's costs) will be used for establishing the budget going forward.

3.2.1.9 Program Administrator Costs Associated with FRIDGE & FREEZER PICKUP

The history (i.e. direct labour costs, indirect program expenses, and annual net energy savings in kWh) of the provincial saveONenergy FRIDGE & FREEZER PICKUP program within London Hydro's franchise service territory is depicted in Figure 3-3 below.

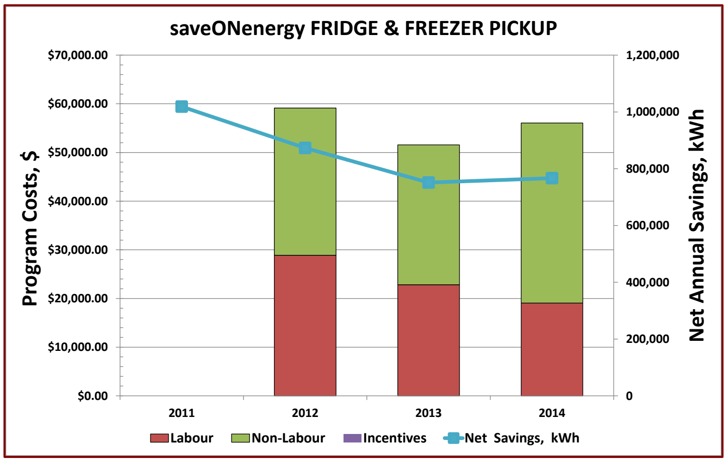


Figure 3-8, Historical Program Costs for FRIDGE & FREEZER PICKUP

Note: The provincial saveONenergy FRIDGE & FREEZER PICKUP program uses a provincial contractor to provide call centre, appliance pickup and appliance de-commissioning services. These contractor payments are made by the Ontario Power Authority directly to the provincial contractor (and not routed though the LDC's). As such, since London Hydro didn't make any contractor payments nor do we know the terms of the contract, no incentives / contractor payments are indicated in the chart above.

It will be seen from Figure 3-3 that the program administration costs (i.e. London Hydro's direct labour costs plus other indirect program expenses such as facilities costs, office equipment, vehicles, etc.) have varied over the four years as well as the annual net energy savings. London Hydro's historical electricity savings costs associated with the saveONenergy FRIDGE & FREEZER PICKUP program are provided in Table 3-3 below.

Table 3-8, Savings Acquisitions Costs for FRIDGE & FREEZER PICKUP

Savings Acquisition Cost Element	Program Administrator's Costs (PAC), $/kWh	All-In Costs (i.e. PAC plus Incentives), $/kWh
4-year average	$0.05	--
2014 only	$0.07	--

Although the saveONenergy FRIDGE & FREEZER PICKUP program will be suspended as a provincial program offering, it is planned to reformulate the program are offer it as a regional CDM program. As such, these savings acquisition costs will be useful for later reference.

3.2.2 Annual Customer Incentive Payments

For those provincial CDM programs whereby London Hydro makes an incentive payment to participating customers or pays contractors for direct-install CDM programs, the foregoing section provided both program administrator's costs plus the "*all-in*" costs (i.e. program administrator's costs plus incentive costs). Furthermore, the incentive are already built into the archetypes contained in the OPA's cost-effectiveness analysis spreadsheet (referred to in Section 3.4 below).

3.2.3 Energy Manager Funding

There are two (2) types of energy managers envisioned in the plan, namely (i) continued funding of embedded energy managers (as an element of the PROCESS & SYSTEMS initiative), and (ii) the introduction of sector-specific roving energy managers.

3.2.3.1 Embedded Energy Managers

Under the 2011 – 2014 CDM delivery framework, four (4) embedded energy managers (EEM's) received funding (from Ontario Power Authority) to satisfy energy savings / demand reduction targets at the facilities listed following:

- 3M Canada (Initial Contract: November 4, 2011)
- London Health Sciences Centre (Initial Contract: March 15, 2014)
- Fanshawe College (Initial Contract: July 1, 2012)
- The Corporation of the City of London (Initial Contract: July 9, 2012)

All embedded energy managers have been meeting or exceeding their CDM targets so it is likely that the customers and London Hydro will want to continue this arrangement, for mutual benefit, into the new 2015-2030 CDM framework.

The combined annual incentive (i.e. 80% of payroll burden to a maximum of $100K plus 80% of incurred expenses to a maximum of $8K) has been $406,218.

The Embedded Energy Manager program is currently being re-designed to provide greater flexibility. Until such time as the re-design is complete, this CDM Plan assumes the future will be a continuation of the past.

3.2.3.2 Sector-Specific Roving Energy Managers

The CDM Plan envisions London Hydro sponsoring several sector-specific roving energy managers. No costs or achievement expectations have or will be incorporated into the CDM Plan until there is greater clarity with respect to the provincial strategy for energy managers pursuant to Clause 3 of the Minister of Energy's directive of October 23, 2014. This clause has been replicated below for convenience of reference:

> 3. *The OPA shall procure and coordinate the cost-effective services of energy managers to ensure their sufficient availability to target small business, commercial and institutional customers across the province. For certainty, this shall not restrict Distributors from developing complimentary Province-Wide Distributor CDM Programs and Local Distributor CDM Programs to procure and coordinate the cost-effective services of energy managers within their licensed service areas.*

3.2.4 Ongoing Commitment to Creating a Culture of Conservation

Part of London Hydro's ongoing commitment to youth and creating a culture of conservation is taking on two (2) graduating students from the Engineering Technologist program at the local Fanshawe College for a one-year duration. During that period, the students receive extensive training, and specifically:

- Customer engagement training
- Workplace safety training
- Training for eligibility to attain Certified Energy Manager (CEM) designation.

This staffs are engaged in a variety of challenging projects related to the energy conservation programs (i.e. often M&V activities), so their labour and training costs are already included in the program administrator's costs previously presented.

3.3 London Hydro's Budget Allocation

In the same fashion that London Hydro has been assigned a CDM target, a threshold budget allocation of $51,192,690 is available to London Hydro to carry out delivery of CDM programs.[6]

3.4 Cost-Effectivenss Analysis of CDM Portfolio

The Ontario Power Authority developed an Excel spreadsheet (referred to as the "*IESO CDM EE Cost Effectiveness Tool*") for carrying out cost-effectiveness analysis.

For the portfolio of programs identified in the CDM Plan for London Hydro, the outcome is as tabulated below:

SUMMARY OF CDM PORTFOLIO COST EFFECTIVENESS									
	TRC			PACT			Levelized Cost		
Program Year	Benefits ($)	Costs ($)	Ratio	Benefits ($)	Costs ($)	Ratio	Benefits (Energy)	Costs ($)	($/kWh)
2015	10,103,119	6,290,205	1.6	8,374,234	3,987,789	2.1	161,409,695	3,987,789	0.025
2016	14,659,386	6,693,824	2.2	12,336,206	6,380,488	1.9	252,550,537	6,380,488	0.025
2017	11,317,851	6,546,045	1.7	9,430,524	4,333,052	2.2	155,141,960	4,333,052	0.028
2018	11,400,875	6,417,691	1.8	9,502,719	4,248,098	2.2	152,099,961	4,248,098	0.028
2019	11,544,775	6,291,854	1.8	9,627,849	4,164,810	2.3	149,117,608	4,164,810	0.028
2020	11,604,115	6,168,484	1.9	9,679,449	4,083,155	2.4	146,193,734	4,083,155	0.028
Plan Total	**70,630,122**	**38,408,103**	**1.8**	**58,950,981**	**27,197,393**	**2.2**	**1,016,513,494**	**27,197,393**	**0.027**

Figure 3-9, Cost Effectiveness of London Hydro's CDM Plan

[6] Ontario Power Authority document entitled: *LDC CDM Target and Budget Allocations - as of October 31, 2014*; a document included in the Conservation First Framework LDC Toolkit.

It can be seen from the foregoing chart that London Hydro's CDM Plan meets all three (3) criteria for a cost effective CDM Plan.

4 COLLABORATION

The new 2015 – 2020 CDM Framework has an emphasis on "*collaboration*" presumably in the belief that collaboration amongst LDC's and between the community of LDC's and natural gas distributors will lead to both greater cost effectiveness and a more seamless customer experience. This subsection outlines London Hydro's ongoing collaboration activities.

4.1 Collaboration Activities With Neighbouring Electricity Distributors

Collaboration with neighbouring LDC's in southwestern Ontario has been and will continue to be both a worthwhile and an ongoing activity as outlined in the subsections below.

4.1.1 Ongoing Participation in SWOG

The Southwestern Ontario group (SWOG) is an informal assembly of LDC's throughout south-western Ontario that meet on a monthly basis to identify marketplace issues, discuss common approaches to issues, receive updates from various members that are also participating members in various working groups and steering committees, provide feedback to working groups and steering committees, to share ideas and approaches (e.g. group purchases of SWAG, etc.), and to increase awareness from invited guests (which may be from OPA or third party vendors).

There is no formal charter or governance structure for SWOG, other than the simple rule that responsibility for chairing a meeting is rotated amongst the participating LDC's, and the LDC (or pair of LDC's for the smaller LDC's) has responsibility for covering the cost of the meeting facilities, A/V equipment (if needed) and lunch. Typically the all-in cost of each monthly meeting is about $800, for an annual expenditure of (12 x $800 =) $9,600.

4.1.2 Administering the Instrument Lending Library

One of the sub-programs within the umbrella saveONenergy PROCESS & SYSTEMS initiative was a "*meter lending library*". Unfortunately after the OPA procured more than twenty (20) Candura portable recording power measurement instruments, the OPA apparently determined that this endeavor exposed the organization to inordinate perceived risk, so the "*meter lending library*" was advertised on the OPA's website, but never launched.

After significant effort and elapsed time (i.e. more than a year), London Hydro successfully procured OPA's inventory of Candura portable recording power measurement instruments, provided training to neighbouring LDC's and has successfully operated an instrument lending library ever since.[7] The demand for such instruments has generally consistently exceeded the availability of instruments, so this CDM Plan includes procuring several more instruments to add to the library.

4.1.3 Sponsoring Regional Sector-Specific Roving Energy Managers

Section 11.2.1 of Volume 1 (*Articulation of the Vision*) of London Hydro's CDM Plan envisions sponsoring a number of sector-specific roving energy managers that are intended more as a regional resource than a resource specific to London Hydro.

4.1.4 Partnerships with Neighbouring LDC's

London Hydro has entered into a *CDM Delivery Services Agreement* with Tillsonburg Hydro. This partnership arrangement is expected to be beneficial to both London Hydro and Tillsonburg Hydro both for the delivery of CDM programs and utilization of internal resources.

4.2 Collaboration Activities with Natural Gas Distributors

There has been much talk of encouraging enhanced "*collaboration*" with the natural gas distribution utilities. In these discussions there seems to be many definitions of collaboration. Definitions include having the Gas Utilities operate LDC programs up to simple sharing of ideas and promotions. The difficulty arises when there is no clear definition and debates surround what it means versus what we could possibly accomplish with greater cooperation. In London, which in most cases different from other LDCs, all programs are managed internally by London Hydro staff and NOT farmed or contracted out for service providers to execute. It is the fundamental backbone of our philosophy that the LDC owns the relationship with the customers and this is the best way to engage and encourage a high level of participation for the CDM programs. London Hydro is always aware of program operation and can therefore adjust implementation strategies and operations in short order which we feel is more efficient.

In London there exists a solid relationship with the local natural gas distribution utility, Union Gas. This has existed for years and is an informal channel of communication between the Gas program managers and that of the LDC. This relationship typically includes sharing customers' projects for those who may benefit from the partner utility's programs. Although informal, this arrangement has worked well in the past and certainly will work in the future.

Relationships work best when the playing field is level, the relationships are voluntary in nature and not forced upon one or both parties. Natural efficiencies will occur and partnerships will thrive as the relationships progress.

[7] London Hydro Report EM-14-02, *Energy Conservation and Demand Management – Annual Report of London Hydro's 2013 Activities & Achievements*; September 2014; Section 3.6.6, *The Meter Lending Library – A Failure to Launch*; pg 55 -57.

London Hydro intends to share with Union Gas our CDM Plan and discuss where there might be opportunities to leverage the strengths we both have. We would hope, and expect that Union Gas would do the same.

5 CHANGE MANAGEMENT

The advent of the Conservation First Framework provides for an enhanced opportunity to further include the balance of the London Hydro organization and its employees in promoting and obtaining success in energy conservation and customer engagement. The longevity of the framework and consistency in the core programs allows for a greater depth of knowledge and familiarity for all levels of staff. Notwithstanding the current engagement from non-CDM staff, it is recognized that substantial interest and motivation exists to include all staff in varying degrees.

As the CDM plan is implemented, strategies and tools will be developed to leverage out other parts of the organization. These strategies and tools will include but are not limited to:

- Regular newsletters devoted to CDM issues

  The newsletters will include current projects and information on how the business took advantage of the programs. The technology and value to the customer will be presented in a fashion that a non-industry expert will be able to digest. This follows on our successful interaction at the internal *Passport to Innovation* event. Many staff was interested in how the CDM team operates and how we engage with our customers and showed genuine interest in learning more.

- Program Training Files

  These files will be hosted online internally and be available to all staff. These files will be high-level training files for some and in-depth training files for others. These will be available to interested parties who are interested in finding out more.

As is common with many if not all utility employees, off and on hours interaction with customers typically tend to be not super positive, given the environment of rising costs and mediocre press coverage. Although London Hydro may not have any influence with these issues, there is an opportunity to turn the conversations into something positive. Customers know virtually nothing about how electricity reaches their home or business. We have found that if an employee takes the time to introduce what London Hydro's responsibility is and how that is executed, the customer tends to respond positively, often commenting "*I didn't know that*". CDM would like to take the first steps in creating this new outreach opportunity to our customers. Our goal is to breed a high level of familiarity within our 300 plus employees. These employees can become energy-efficiency ambassadors. They do not need to be subject matter experts, but confidently point customers in the right direction. If we were to increase this scope of knowledge to include other departments and their responsibilities we believe it possible to have a better informed employee base and therefore have staff that are more likely to engage with customers. This can only enhance our image and improve customer satisfaction.

6 Summary, Conclusions & Recommendations

Energy conservation is considered an "*investment*" and like any other investment, it is prudent to predict whether the investment is a good one, i.e. the benefits outweigh the costs.

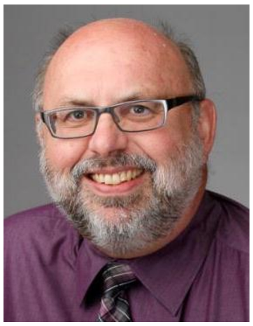
This document has introduced the reader to the three (3) cost effectiveness tests used in Ontario to screen energy conservation measures, programs and portfolios for cost effectiveness. Furthermore, in the interest of transparence, it has defined the basis for the various program administrator's costs used in the evaluation of cost-effectiveness and to predict cash flows over the time period 2015 – 2020.

Finally, it has replicated the output from the Ontario Power Authority's cost-effectiveness analysis tool to show that London Hydro's CDM Plan is cost-effective from the perspective of TRC, PAC and LUEC tests.

In time, as new provincial, regional and local programs emerge and are incorporated into London Hydro's CDM Plan, it is expected that the cost-effectiveness analysis will need to be updated to demonstrate that the portfolio of CDM programs remain cost effective.

♣ - ♣ - ♣

ABOUT THE AUTHORS



Gary Rains, P.Eng., Director of Energy Management Programs, has had a career in the electric distribution utility sector (Ontario Hydro, Scarborough PUC, Toronto Hydro, and now London Hydro) that now spans 35 years. His responsibilities over the years have included various SCADA and Distribution Automation systems, standards, revenue metering, and distribution system planning and Smart-metering. His present responsibilities include developing and overseeing implementation of London Hydro's CDM initiatives.

Hans Schreff, Program Manager – Conservation Activities, has held various positions in the utility for over 14 years. His responsibilities have included development of solar water heating systems, load controls for water heaters and air conditioners. Hans has also been involved in the marketing and communication divisions in London Hydro and has over the years been involved in many special projects. Hans presently manages the day-to-day operation of CDM projects in London Hydro and has been the driving force behind several initiatives for which London Hydro has been bestowed NRCan's ENERGY STAR Utility of the Year awards in 2007 and 2009.

This Page Intentionally Left Blank....

London Hydro Report EM-14-03C, *Integrated Resource Planning: Forecasts of Energy Efficiency Program Outcomes as a Demand-Side Resource (Volume 3 – Tillsonburg Hydro Element)*

Issued: April 2015

EXECUTIVE SUMMARY

The Minister of Energy's March 31st, 2014 directive to the Ontario Power Authority entitled: *2015 – 2020 Conservation First Framework*, defines the CDM delivery framework for the next six (6) years. Specific passages that relate to a Distributor CDM targets have been replicated following for convenience of reference:

> *Therefore, pursuant to my authority under section 25.32 of the Act, I hereby direct the OPA to coordinate, support and fund the delivery of CDM programs through Distributors to achieve a total of 7 TWh of reductions in electricity consumption between January 1, 2015 and December 31, 2020 in accordance with the following guiding principles and requirements.*

Note that the foregoing target is not a "*cumulative net*" energy reduction target, but rather a "*net*" energy reduction target, which is a subtle but significant change from the 2011 – 2014 CDM delivery framework. An analysis will show that the annual energy savings target is approximately double the target that was established under the previous framework – this "*approximate doubling of targets*" is consistent with informal feedback received from other LDC's.

Based on its reported population of residential and non-residential customers, Tillsonburg Hydro's allocation of the provincial target is 11.3 GWh (to be achieved over the 6-year framework).

This Volume 3 (*Tillsonburg Hydro Element*) of the overall report is intended to show how Tillsonburg Hydro intends to meet or exceed these aggressive CDM targets via:

- The continuation of provincial CDM programs (that are within the saveONenergy FOR HOMES and saveONenergy FOR BUSINESS portfolios); and
- The introduction of new CDM programs that are local to Tillsonburg Hydro, or perhaps created as regional CDM offerings.

The predicted outcomes of energy conservation and demand-side management programs are intended to be an input to the creation and update of regional supply plans (which in turn are intended to identify future needs to reinforce the provincial transmission grid, and increase the capacity of existing transformer stations or construct new ones). Unfortunately, CDM targets are defined in terms of energy savings (in kilowatt-hours or megawatt-hours or gigawatt-hours) whereas system planning professionals are more interested in predicted increases or decreases in load coincident with the summer or winter peak loading conditions. This report also presents a methodology for converting Tillsonburg Hydro's CDM targets into predictions of summer and winter peak demand reductions.

♣ - ♣ - ♣

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

List of Tables

1 INTRODUCTION

1.1 Background

For the 2015 – 2020 CDM Framework, London Hydro and Tillsonburg Hydro have elected to embrace a collaborative partnership for the mutual benefit of both organizations in the delivery of energy conservation programs in both franchise service territories.

1.2 Purpose

This document identifies Tillsonburg Hydro's assigned CDM targets for the 2015 – 2020 CDM framework; and indicates the manner in which these targets are anticipated to be achieved, both via the continuation of provincial CDM programs complimented by the introduction of new local or regional CDM programs.

1.3 Intent

To the extent possible, it is intended that the same CDM programs will be promoted and offered to customers in both Tillsonburg Hydro's and London Hydro's franchise service territories. Rather than duplicate substantial portions of London Hydro's CDM Plan (i.e. Volumes 1 and 2), this document focuses on the variances such as the different CDM target, the forecasts of program uptake specific to Tillsonburg Hydro, and the projected cost-effectiveness of the portfolio of CDM programs to be offered within Tillsonburg Hydro's service territory.

1.4 Document Structure

The overall CDM Plan spans three (3) documents as described following:

- Volume 1 – *Articulation of the Vision*, identifies London Hydro's assigned CDM targets for the 2015 – 2020 CDM framework; and indicates the manner in which these targets are anticipated to be achieved, both via the continuation of provincial CDM programs complimented by the introduction of new local or regional CDM programs.
- Volume 2 – *Budget & Resource Plan* – identifies the resources that London Hydro believes is necessary to deliver the various CDM programs, various management intentions (e.g. ongoing skills development plan, internal change management, etc.), a budget projection to fund CDM delivery, and finally the cost effectiveness of London Hydro's plan.
- This Volume 3 – *Tillsonburg Hydro's CDM Plan*, indicates the CDM programs that will be delivered under a partnership arrangement between London Hydro and Tillsonburg Hydro within the latter's franchise service territory in a cost-effective manner.

1.5 References

[1] Ontario Energy Board publication: *2013 Yearbook of Electricity Distributors*; published on August 14, 2014.

[2] ICF Marbek report: *Achievable Potential - Estimated Range of Electricity Savings Through Future Ontario Conservation Programs - Residential Sector - Final Report*; March 26, 2014.

[3] ICF Marbek report: *Achievable Potential - Estimated Range of Electricity Savings Through Future Ontario Conservation Programs - Commercial Sector - Final Report*; March 26, 2014.

[4] ICF Marbek report: *Achievable Potential - Estimated Range of Electricity Savings Through Future Ontario Conservation Programs - Industrial Sector - Final Report*; March 26, 2014

1.6 Terminology

The definitions below are not intended to embrace all legitimate meanings of the terms. They are applicable to the subject matter treated in this report.

Achievable Potential Forecast is a study or assessment of the estimated range of electrical energy savings attainable through programs that encourage the adoption of energy-efficient technologies, taking into consideration technical, economic, and market constraints. Such studies generally recognize that new technology does not replace existing equipment instantaneously or prematurely, but rather is "*phased-in*" over time as existing equipment reaches the end of its useful life.[1]

There are a variety of types of potential studies, as outlined below.

- ***Technical Potential*** represents the savings due to energy efficiency and demand response programs that would result if all homes and businesses adopted the most efficient, commercially available technologies and measures, regardless of cost. Technical Potential provides the broadest and largest definition of savings since it quantifies the savings that would result if all current equipment, processes, and practices in all sectors of the market were replaced at the end of their useful lives by the most efficient available options. Technical Potential does not take into account the cost-effectiveness of the measures.

- ***Economic potential*** represents the savings due to programs that would result if all homes and business adopted the most efficient, commercially available, cost-effective measures. It is a subset of the Technical Potential and is quantified only over those measures that pass a widely recognized economic cost-effectiveness screen. The cost-effectiveness screen often applied is a variation of the Participant Test, which compares the incremental cost to a consumer of an

[1] Electric Power Research Institute (EPRI) report 1018363, *Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010–2030) - Executive Summary*; January 2009. Document available at URL:: http://www.edisonfoundation.net/iee/Documents/EPRI_SummaryAssessmentAchievableEEPotential0109.pdf

efficient technology relative to its baseline option, and the bill savings expected from that technology over its useful life. Only those technologies for which the net present value of benefits exceeds its incremental cost to consumers pass the test.

In the Ontario context Economic Potential is subdivided into two categories by taking into account various barriers to customer adoption, namely:

- ***Upper Achievable Potential*** — takes into account market, societal, and attitudinal barriers that limit customer participation in utility- or government-administered voluntary programs. These barriers reflect, among other phenomena, customers' resistance to doing more than the absolute minimum required or a dislike of a given efficiency option. Upper achievable potential presumes no impediments to the effective implementation and delivery of programs, such as perfect information, and essentially extrapolates the impacts of the best run, most effective programs across the continent.
- ***Lower Achievable Potential*** — discounts the Upper Achievable Potential by taking into account impediments to program implementation, including financial, political, and regulatory barriers that are likely to limit the amount of savings that might be achieved through energy efficiency and demand response programs. Lower Achievable Potential considers recent utility experience and reported savings, and as such represents a forecast of likely customer response to programs.

Energy Conservation Agreement is a document that sets out the contractual relationship between the Ontario Power Authority and each Local Distribution Company under the new Conservation First Framework.

Interactive Effects means the energy impacts to one system resulting from changes made to another building system. Reduced lighting loads, for example, can reduce air conditioning energy consumption (a cooling bonus), but increase heating consumption (a heating penalty)

1.7 Acronyms, Abbreviations and Symbols

1.7.1 Acronyms

Acronyms used in this report are presented following in alphabetic order:

CDM	=	Conservation and Demand Management
ECA	=	Energy Conservation Agreement
EM&V	=	Evaluation, Measurement and Verification
GEGEA	=	Green Energy and Green Economy Act, 2009
IESO	=	Independent Electricity System Operator
IRP	=	Integrated Resource Plan
IRRP	=	Integrated Regional Resource Planning
LDC	=	Local Distribution Company

MURB	=	Multi-Unit Residential Building
MUSH	=	Municipalities, Universities/Colleges, Schools, and Hospitals
NAICS	=	North American Industry Classification System
OPA	=	Ontario Power Authority (now amalgamated with IESO pursuant to Schedule 7 of Ontario Bill 194)
RRFE	=	Renewed Regulatory Framework for Electricity
TOU	=	Time-of-Use

1.7.2 Abbreviations

Abbreviations used in this report are presented following in alphabetic order:

GWh	=	Gigawatt-hour
kW	=	kilowatt
kWh	=	kilowatt-hour
MW	=	Megawatt
MWh	=	Megawatt-hour
TWh	=	Terawatt-hour

These abbreviations are consistent with CSA Standard Z85-1983, *Abbreviations for Scientific and Engineering Terms*.

2 TILLSONBURG HYDRO'S CDM TARGET

This section identifies Tillsonburg Hydro's net energy reduction target within the 2015 – 2020 CDM delivery framework and provides a synopsis of the methodology used to develop this LDC-specific target.

2.1 Collective Target Set Forth in the Minister of Energy's Directive

The Minister of Energy's March 31, 2014 directive entitled: *2015 – 2020 Conservation First Framework*, defines the CDM delivery framework for the next six (6) years. Specific passages that relate to a Distributor CDM targets have been replicated following for convenience of reference:

> *Therefore, pursuant to my authority under section 25.32 of the Act, I hereby direct the OPA to coordinate, support and fund the delivery of CDM programs through Distributors to achieve a total of 7 TWh of reductions in electricity consumption between January 1, 2015 and December 31, 2020 in accordance with the following guiding principles and requirements.*

Note that the foregoing target is not a "*cumulative net*" energy reduction target, but rather a "*net*" energy reduction target, which is a change from the 2011 – 2014 CDM delivery framework. This basically means that the LDC community could achieve 7 TWh in the first year and nothing in the remaining 5 years, nothing in the first 5 years and all 7 TWh in the sixth year, or 1.16 TWh in each of the six years, and in all cases meet the collective CDM target.

Clause 2.1 of the Minister of Energy's directive has been replicated below for convenience of reference:

> *2.1 The OPA, in consultation with Distributors, shall develop an allocation methodology to allocate the full 7 TWh among Distributors. The allocation methodology may take into consideration Distributor CDM potential as a local and/or regional level as identified in the OPA's 2014 energy efficiency achievable potential study, and other factors as appropriate.*

2.2 Tillsonburg Hydro's Allocated CDM Target

The actual methodology for allocating CDM targets amongst the community of LDC's considers as the starting point the achievable potential studies [Ref 2, 3 and 4] wherein the province was divided into ten (10) zones (for compatibility with the *End-Use Forecast* model).

Note: For the purposes of regional supply planning, the province is divided into twenty-one (21) zones.

For the purposes of the "achievable potential" studies, Tillsonburg Hydro is in the "*west*" zone that also includes:

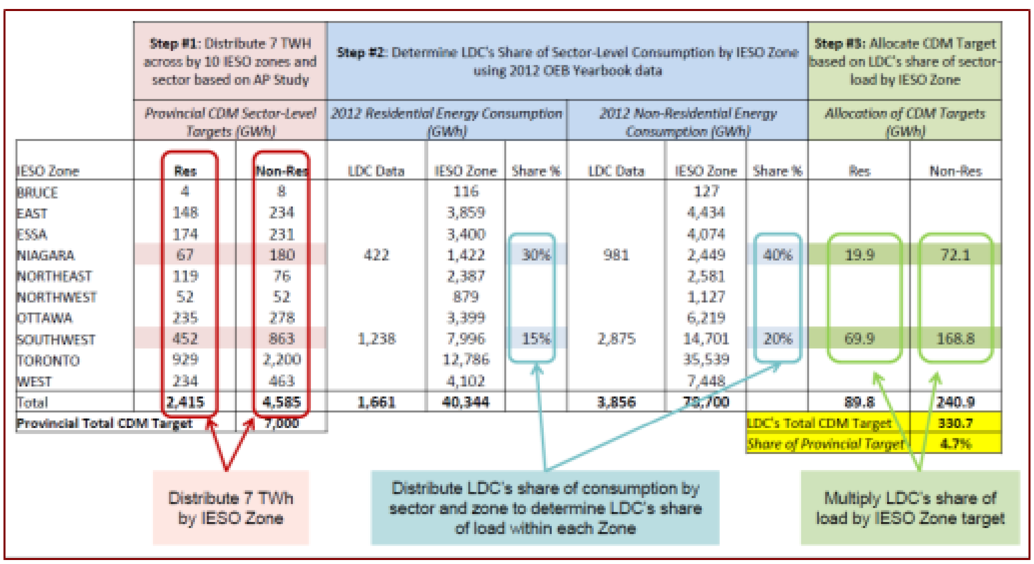
- Bluewater Power Distribution Corp.
- Hydro One Networks Inc.

- E.L.K. Energy
- Entegrus Power Lines Inc.
- EnWin Utilities Ltd.
- Essex Powerlines Corp.
- London Hydro Inc.
- St. Thomas Energy
- Woodstock Hydro Services Inc.

The "*west*" zone is illustrated in Figure 2-1 below.

Figure 2-1, IESO Zones Used in Achievable Potential Study

The 3-step "*target allocation*" methodology is illustrated in Figure 2-2 below:[2]



	Step #1: Distribute 7 TWH across by 10 IESO zones and sector based on AP Study		**Step #2**: Determine LDC's Share of Sector-Level Consumption by IESO Zone using 2012 OEB Yearbook data						**Step #3**: Allocate CDM Target based on LDC's share of sector-load by IESO Zone	
	Provincial CDM Sector-Level Targets (GWh)		*2012 Residential Energy Consumption (GWh)*			*2012 Non-Residential Energy Consumption (GWh)*			*Allocation of CDM Targets (GWh)*	
IESO Zone	Res	Non-Res	LDC Data	IESO Zone	Share %	LDC Data	IESO Zone	Share %	Res	Non-Res
BRUCE	4	8		116			127			
EAST	148	234		3,859			4,434			
ESSA	174	231		3,400			4,074			
NIAGARA	67	180	422	1,422	30%	981	2,449	40%	19.9	72.1
NORTHEAST	119	76		2,387			2,581			
NORTHWEST	52	52		879			1,127			
OTTAWA	235	278		3,399			6,219			
SOUTHWEST	452	863	1,238	7,996	15%	2,875	14,701	20%	69.9	168.8
TORONTO	929	2,200		12,786			35,539			
WEST	234	463		4,102			7,448			
Total	**2,415**	**4,585**	**1,661**	**40,344**		**3,856**	**78,700**		**89.8**	**240.9**
Provincial Total CDM Target		**7,000**								
								LDC's Total CDM Target		**330.7**
								Share of Provincial Target		**4.7%**

Figure 2-2, Illustration of Target Allocation Methodology

The steps are described below:

[2] Ontario Power Authority document: *Target and Budget Allocation Methodology*; Conservation First Framework – LDC Toolkit; Final V1; October 31, 2014.

- Step #1: The provincial 7 TWh CDM target is first distributed across the 10 IESO zones based on the "*residential*" and "*non-residential*" opportunities identified in the achievable potential study. It can be seen from Figure 2-2 above that the 234 GWh of residential electricity savings and 463 GWh of non-residential electricity savings have been allocated to the "*west*" zone.
- Step #2: Determine LDC's share of residential and non-residential electricity consumption by zone using statistics from the OEB publication: *2012 Yearbook of Electricity Distributors*. It can be seen from Figure 2-2 above that the composite electricity consumption throughout the "*west*" zone by residential customers was 4,102 GWh and by non-residential customers was 7,448 GWh.

  Note: For LDC's such as Hydro One Networks that cross multiple zones, their 2012 Yearbook data is allocated proportional to that LDC's 2012 consumption by transformer station within each zone.
- Step #3: Allocate CDM Target based on LDC's share of sector-load by zone. For Tillsonburg Hydro, the *2012 Yearbook of Electricity Distributors,*[3] shows:

Table 2-1, 2012 Electricity Sales Data for Tillsonburg Hydro

Customer Class	**Billed kWh**
Residential	49,401,384
Non-Residential:	
▪ General Service < 50 kW	21,887,576
▪ General Service > 50 kW & Large User	112,551,412
▪ Unmetered Scattered Load Connections	426,840
Non-Residential Total:	134,865,828

As such, Tillsonburg Hydro's CDM target allocation can be calculated as:

$$\text{CDM target} = 234\text{ GWh x } \frac{49.4\ GWh}{4{,}102\ GWh} + 463\text{ GWh x } \frac{134.8\ GWh}{7{,}448\ GWh}$$

$$= 11.2\text{ GWh}$$

Tillsonburg Hydro's CDM target for the 2015 – 2020 CDM delivery framework is 11.31 GWh.[4]

Note: The difference between the two numbers (i.e. the estimated and assigned CDM target) is small and likely attributable to rounding errors, i.e. the values given in Figure 2-2 are likely rounded (in the conversion from kWh to GWh).

Although CDM targets are allocated based on residential and non-residential consumption, LDC's are responsible for achieving only the total CDM target, i.e. the entire 11.31 GWh target could be achieved entirely in the residential sector, or entirely in the non-residential sector, or the more likely case being some combination thereof.

[3] Ontario Energy Board publication: *2012 Yearbook of Electricity Distributors*; August 22, 2013; page 93.
[4] Ontario Power Authority document: *Conservation First Framework LDC Tool Kit Final v1 - October 31, 2014*.

3 SITUATION ANALYSIS

For the 2011 – 2014 CDM delivery framework, Tillsonburg Hydro achieved great success with its assigned demand reduction target but was confronted with numerous challenges in achieving its assigned energy savings target. As such, Tillsonburg Hydro's energy savings achievements throughout the 2011 – 2014 CDM delivery framework are likely not a good proxy of the expectations for the 2015 – 2020 CDM framework with London Hydro on-board as a collaborative partner. Therefore, the simple methodology used herein is to simply scale London Hydro's forecasted electricity savings (within its service territory) to Tillsonburg Hydro's smaller population base and service territory. Only hindsight will show whether this approach yields a reasonably-correct forecast.

3.1 Number of Electricity Customers

According to the OEB publication *2012 Yearbook of Electricity Distributors*, the number of residential and non-residential customers within each organization's franchise service territory is tabulated following:

Table 3-1, Statistics by Customer Class

Customer Class	London Hydro	Tillsonburg Hydro
Residential Customers	136,032	6,047
Non-Residential Customers		
• General Service < 50 kW	12,058	646
• General Service > 50 kW	1,649	89
• Large User	3	--

Table 3-1 shows, for example, that the number of residential customers in Tillsonburg is only 4% of the number in London. As such, one would expect that the forecasted energy savings opportunities in Tillsonburg to be only about 4% of the savings opportunity in London.

3.2 Results of OPA's Prediction Tool for Tillsonburg Hydro

The Ontario Power Authority's *Conservation First Framework LDC Tool Kit – Regional Potential Calculator* (V3) defines the following upper achievable potential for Tillsonburg Hydro's residential, commercial and industrial sectors. These results have been transcribed into Table 3-2, Table 3-3 and Table 3-4 respectively:

Table 3-2, Upper Achievable Potential for Tillsonburg's Residential Sector

Upper Achievable Potential for Residential Sector, GWh					
2015	2016	2017	2018	2019	2020
1	1	2	2	3	3

The achievable potential study considers multi-unit residential buildings (MURBs) to be "*residential*", but from a tariff perspective LDC's classify "*tenant-metered*" apartments as "*residential*" customers and bulk-metered apartment buildings as "*General Service*" customers. As such, the "*residential energy sales*" field that is entered into the calculator is understated (since it doesn't included "*bulk-metered*" apartment buildings).

Table 3-3, Upper Achievable Potential for Tillsonburg's Commercial Sector

Upper Achievable Potential for Commercial Sector, GWh					
2015	**2016**	**2017**	**2018**	**2019**	**2020**
2	3	6	6	7	8

The achievable potential study doesn't distinguish between the small business sector, the commercial sector, the agribusiness sector, or the institutional sector. Rather these are all categorized as "*commercial*" customers.

Table 3-4, Upper Achievable Potential for Tillsonburg's Industrial Sector

Upper Achievable Potential for Industrial Sector, GWh					
2015	**2016**	**2017**	**2018**	**2019**	**2020**
1	1	1	2	3	3

The achievable potential studies did not include embedded load-displacement generation as a CDM measure, so the entries in Table 3-4 above reflect only opportunities associated with energy-efficiency opportunities.

3.3 Established Supply System Constraints

Clause 7.1, *Definition of CDM*, of the Ministry directive establishes embedded load-displacement generation as a CDM activity. Specifically:

> *7.1 The OPA shall consider CDM to be inclusive of activities aimed at reducing electricity consumption and reducing the draw from the electricity grid, such as geothermal heating and cooling, solar heating and small scale (i.e. < 10 MW) behind the meter customer generation. However, CDM should be considered to exclude those activities and programs related to a Distributor's investment in new infrastructure or replacement of existing infrastructure, any measures a Distributor uses to maximize the efficiency of its new or existing infrastructure, activities promoted through a different program or initiative undertaken by the Government of Ontario or the OPA, such as the OPA Feed-in Tariff (FIT) and micro-FIT Program and activities related to the price of electricity or general economic activity.*

The transformer station (i.e. Tillsonburg transformer station) that supplies Tillsonburg Hydro is understood to be "*capacity constrained*", meaning there is no inherent capacity to connect additional downstream sources of generation. Given that there are no known plans for the provincial transmitter (the Owner and Operator of this transformer station) to upgrade this transformer station within the 2015 – 2020 timeframe, Tillsonburg Hydro cannot consider embedded load-displacement generation as a contributor toward its CDM target.

4 DISCUSSION

The intention of this CDM Plan is to operate all available provincial CDM programs within Tillsonburg Hydro's franchise service territory and to augment these with local or regional CDM programs as may be necessary to achieve the established CDM target for Tillsonburg Hydro.

4.1 Savings Projections from Continued Provincial CDM Programs

The three (3) provincial CDM programs likely to produce the greatest results in Tillsonburg Hydro's service territory are RETROFIT PROGRAM, SMALL BUSINESS LIGHTING, and HOME ASSISTANCE. The electricity savings projections for each program are identified in the subsections that follow:

4.1.1 Savings Projections for saveONenergy RETROFIT PROGRAM

As indicated in Figure 6-1, *Participation in saveONenergy RETROFIT PROGRAM*, within Volume 1 – *Articulation of the Vision* of this CDM Plan, London Hydro is achieving a net annual energy savings of about 8,300 MWh.

If this electricity savings was scaled by the number of general service > 50 kW customers in Tillsonburg compared to London (as tabulated in Table 3-1 herein), then the projected annual energy savings would be:

$$\begin{aligned} \textit{Projected net energy savings} &= 8{,}300\ MWh \times \frac{89\ customers}{1{,}649\ customers} \times 6\ yr \\ &= 2{,}688\ MWh \\ &= 2.7\ GWh \end{aligned}$$

The saveONenergy RETROFIT PROGRAM is a workhorse program that makes a significant contribution to each LDC's CDM target.

4.1.2 Savings Projections for saveONenergy SMALL BUSINESS LIGHTING

The OPA has determined that the saveONenergy SMALL BUSINESS LIGHTING is not cost effective to be continued as a provincial program under the new 2015 – 2020 CDM framework. However it can operate throughout 2015 under the 2011 – 2014 extension framework. The program is presently being re-designed by a working group but it is uncertain if the program can be adjusted to become cost effective.

As indicated in Figure 5-3, *Participation in saveONenergy SMALL BUSINESS LIGHTING*, within Volume 1 – *Articulation of the Vision* of this CDM Plan, London Hydro is achieving a net annual energy savings of about 565,600 kWh.

If this electricity savings was scaled by the number of small business customers in Tillsonburg compared to London (as tabulated in Table 3-1 herein), then the projected annual energy savings would be:

$$\textit{Projected net energy savings} = 565{,}600\ kWh \times \frac{646\ customers}{12{,}058\ customers} \times 1\ yr$$
$$= 30{,}300\ kWh$$
$$= 30\ MWh$$

4.1.3 Savings Projections for HOME ASSISTANCE Program

As indicated in Figure 4-1, *Participation in HOME ASSISTANCE PROGRAM*, within Volume 1 – *Articulation of the Vision* of this CDM Plan, London Hydro is achieving a net annual energy savings of about 450 MWh.

If this electricity savings was scaled by the number of residential customers in Tillsonburg compared to London (as tabulated in Table 3-1 herein), then the projected annual energy savings would be:

$$\textit{Projected net energy savings} = 450\ MWh \times \frac{6{,}047\ customers}{136{,}032\ customers} \times 6\ yr$$
$$= 120{,}022\ kWh$$
$$= 120\ MWh$$

4.1.4 Savings Projections for HEATING & COOLING INCENTIVES Program

Figure 4-1 below shows the annual results (in terms of numbers of upgraded central air conditioners and furnace blower motors, as well as net annual demand reduction) of the saveONenergy HEATING & COOLING INCENTIVES program within Tillsonburg Hydro's franchise service territory.

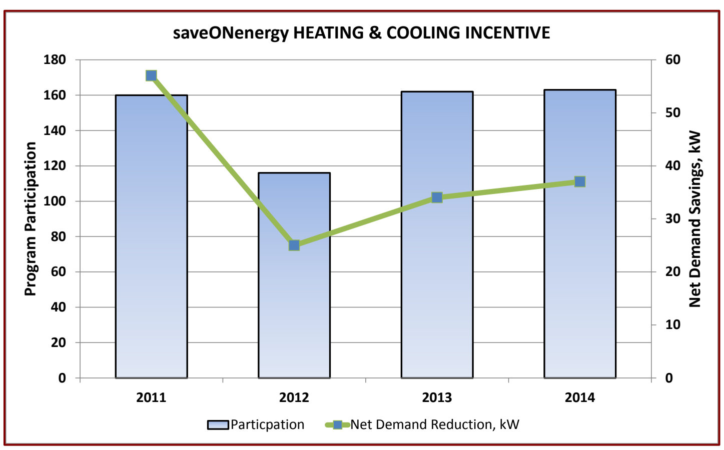


Figure 4-1, Participation in HEATING & COOLING INCENTIVES Program

Although not shown on the graphic, the net annual energy savings associated with this program is about 67 MWh.

The projected net energy savings going forward are:

Projected net energy savings = *67 MWh x 6 yr*

= *402 MWh*

4.1.5 Savings Projections for saveONenergy COUPONS Program

Figure 2-2 below shows the annual results (in terms of numbers of redeemed discount coupons, as well as net annual demand reduction) of the saveONenergy COUPONS program combined with the bi-annual retailer event within Tillsonburg Hydro's franchise service territory.

Note: Similar to London Hydro's approach, the program delivery costs and results from the COUPONS program have been combined with those of the bi-annual retailer event, the latter being essentially coupons that are valid for limited timeframes around the retailer events.

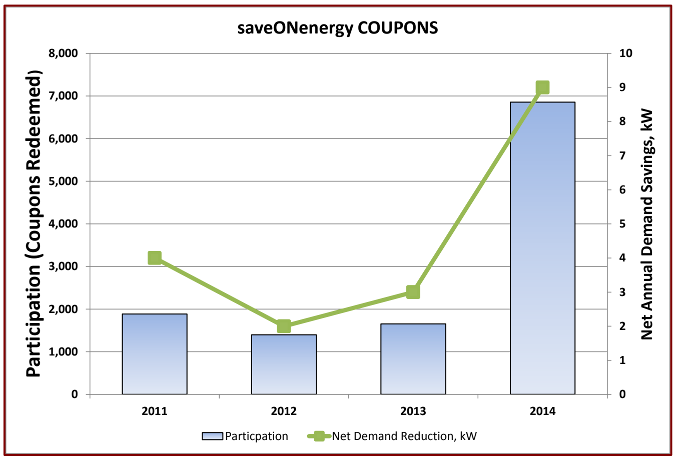


Figure 4-2, Participation in COUPONS Program

Although not shown on the graphic, the net annual energy savings associated with this program is about 68 MWh.

The projected net energy savings going forward are:

Projected net energy savings = *68 MWh x 6 yr*

= *408 MWh*

4.1.6 Savings Projections from saveONenergy NEW HOME CONSTRUCTION

To date, there has been zero participation in the provincial saveONenergy NEW HOME CONSTRUCTION program. This program has had serious design flaws that weren't effectively addressed until 2014, after which uptake in the program at the provincial level only commenced. As such, Tillsonburg Hydro's past experiences are much different than elsewhere. Some nominal activity is expected going forward, but the CDM Plan doesn't predict large electricity savings, i.e. the program will be offered, and any savings resulting from the small participation numbers will be welcome but realistically will be very small in comparison to the CDM target.

4.1.7 Summarized Electricity Savings Projection

The anticipated net energy savings for the various provincial residential CDM programs, marketed under the brand saveONenergy FOR HOME, are tabulated in Table 4-1 below.

Table 4-1, Energy Savings Projections - FOR HOME Programs

Section	Provincial CDM Program	Energy Savings, MWh
4.1.5	COUPONS	408
4.1.4	HEATING & COOLING INCENTIVE	402
4.1.3	HOME ASSISTANCE	120
4.1.6	NEW HOME CONSTRUCTION	--
	Total:	**930**

Overall, the anticipated energy savings (without the introduction of new CDM programs for this sector) will be on the order of 930 MWh (0.93 GWh).

The anticipated net energy savings for the various provincial non-residential CDM programs, marketed under the brand saveONenergy FOR BUSINESS, are tabulated in Table 4-2 below.

Table 4-2, Energy Savings Projections - FOR BUSINESS Programs

Section	Provincial CDM Program	Energy Savings, MWh
4.1.1	RETROFIT PROGRAM	2,688
4.1.2	SMALL BUSINESS LIGHTING	30
	Total:	**2,718**

Overall, the anticipated energy savings (without the introduction of new CDM programs for these sectors) will be on the order of 3,648 MWh (i.e. 3.6 GWh).

4.2 Projected Target Shortfall

Tillsonburg Hydro's CDM target, as given in Section 2.2 (staring on page 9 herein) is 11.31 GWh.

Comparing Tillsonburg Hydro's assigned CDM target to the projected energy savings shown in Table 4-1 and Table 4-2 above reveals a projected shortfall of (11.31 – 3.6 =) 7.71 GWh. This is the amount that needs to be made up via regional or local CDM programs and the manner in which this will be achieved is discussed in Section 5 herein.

5 ADDRESSING THE GAP – VISION FOR NEW CDM PROGRAMS

As noted in Section 11, *Addressing the Gap – Vision for New CDM Programs*, of *Volume 1 – Articulation of the Vision*, of this CDM Plan, there are a number of proposed new residential and business CDM offerings that are described and these are in varying phases of program design.

5.1 Opportunities for New Residential CDM Offerings

There are a number of opportunities for new or re-formulated energy-efficiency programs targeted to the residential marketplace. Those where the energy savings can be estimated are outlined in the sub-sections that follow.

5.1.1 Regional Fridge & Freezer Program

The Ontario Power Authority intends to suspend the saveONenergy FRIDGE & FREEZER PICKUP program in early 2015 on the basis that it is no longer cost-effective as a provincial program.

Note: This decision actually negatively affects two provincial CDM programs since many LDC's leverage the provincial FRIDGE & FREEZER PICKUP contractor as an element of their saveONenergy HOME ASSISTANCE program.

As noted in Section 11.1.2, *Regional Fridge & Freezer Program*, of *Volume 1 – Articulation of the Vision*, of this CDM Plan, London Hydro is spearheading an effort to re-formulate the FRIDGE & FREEZER PICKUP program as a cost-effective regional program (likely with participation from LDC's in southwestern Ontario and the Greater Toronto area).

Figure 5-1 below shows the annual results (in terms of numbers of participation levels, as well as net annual demand reduction) of the saveONenergy FRIDGE & FREEZER PICKUP program within Tillsonburg Hydro's franchise service territory.

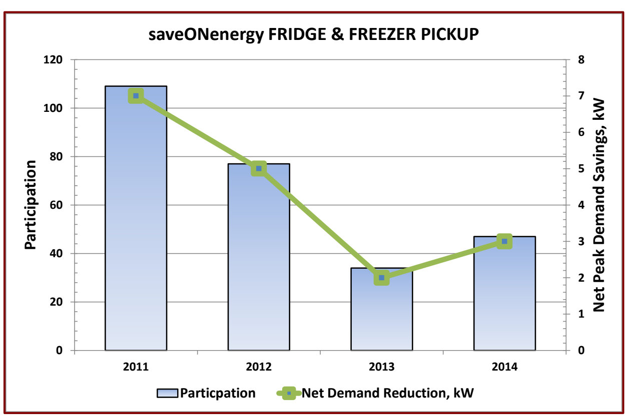


Figure 5-1, Participation in FRIDGE & FREEZER PICKUP Program

Although not shown on the graphic, the net annual energy savings associated with this program is about 27.9 MWh.

Assuming that this regional fridge and freezer pickup program is extended for at least another three (3) years, then the projected net energy savings going forward are:

Projected net energy savings = *27.9 MWh x 3 yr*

= *83.7 MWh*

There may be merit in extending the regional FRIDGE & FREEZER PICKUP program past the 3-year mark, but this will be assessed later.

5.1.2 Behaviour-Based Residential Energy Efficiency Program

Behaviour-based residential energy efficiency programs (also referred to as "*social benchmarking programs*" in the literature) rely on motivations other than financial incentives to influence people's energy consumption. These non-financial influences can be powerful motivators that encourage people to reduce their energy consumption. For example, some programs send their customers home energy reports, which present that customer's energy use relative to a similar home.

On average, when informed that they use more energy than a similar home, people will take steps to reduce their consumption and across a population households can save 1-3 percent (with a mean of 2.1%).[5]

Note: The underlying theory of such programs is behavioral science that indicates "… *individuals are motivated much more by their perceptions of what other people do and find acceptable than they are by other factors such as the opportunity to save money or conserve resources, contrary to even their own perceptions of motivation*." [6] Interestingly, studies show that "… *respondents do not rate normative information (i.e. reports showing how much energy other people were consuming) as an important influence to their behavior. These results illustrate the potential power of normative messages for reshaping behavior despite the fact that their influence is often under-detected by individuals themselves.*" [7]

Given that the average annual energy consumption for a Tillsonburg Hydro residential customer is 8,127 billed kWh per residential customer (as per page 93 in the OEB publication: *2013 Yearbook of Electricity Distributors*), and the treatment group will likely be on the order of 3,000 participants (i.e. half of the residential customers) then the projected energy savings is calculated to be:

Projected energy savings = *3.000 participants x 8,127 kWh/yr x 2.1%*

= *512,000 kWh*

[5] "*Are Savings from Behavior Programs Ready for TRM Prime Time?*" Scott Dimetrosky, Apex Analytics 2013, http://www.iepec.org/wp-content/uploads/2013/03/Presentations/Dimetrosky.pdf

[6] Minnesota Department of Commerce - Office of Energy Security Research Study: *Residential Energy Use Behavior Change Pilot*; by Ed Carroll – Franklin Energy, Eric Hatton – Franklin Energy, and Mark Brown – Greenway Insights; April 2009; page 5.

[7] *Understanding the Residential Customer Perspective to Emerging Electricity Technologies: Informing the CSIRO Future Grid Forum*; Naomi Broughen, Zaida Contreras Castro and Pete Ashworth; July 2013; pg 15.

= *512 MWh*

5.2 Opportunities for New Business CDM Programs

There a number of opportunities for new or re-formulated energy-efficiency programs targeted to the business marketplace. The energy savings cannot be estimated at this time.

5.3 Unallocated Energy Savings

Recall from Section 4.2 (on page 18 herein) that continuing to operate only the provincial CDM programs isn't sufficient and the projected shortfall will be 7,710 MWh. The two regional / local CDM programs described above are projected to yield only (83.7 MWh + 512 MWh =) 595.7 MWh, still leaving a significant shortfall of 7,114 GWh or 63% of Tillsonburg Hydro's CDM target.

While some of the new local / regional CDM programs outlined in Section 11, *Addressing the Gap – Vision for New CDM Programs*, of *Volume 1 – Articulation of the Vision*, of this CDM Plan will whittle this number down, the inability to connect embedded load-displacement generation (see discussion in Section 3.3 starting on page 13 herein) clearly makes the possibility of Tillsonburg Hydro achieving its CDM target very challenging.

Note: To provide context, London Hydro is relying on embedded load displacement generation to achieve 40% of its assigned CDM target.

It is understood that the OPA has compiled a list of a number of pilot project proposals by various LDC's that may ultimately evolve into provincial or regional CDM programs that could be offered to Tillsonburg Hydro's customers.

Note: The governing Energy Conservation Agreement (ECA) between Tillsonburg Hydro and the IESO allows LDC's to update and re-file their CDM Plans as needed. It is expected that the joint London Hydro / Tillsonburg Hydro CDM Plan will be updated and re-filed as concepts for new CDM offerings evolve into designed CDM programs with associated energy savings forecasts.

6 PREDICTING THE MONTHLY PEAK DEMAND REDUCTION

Whereas the 2015 – 2020 CDM delivery framework establishes net energy reduction targets (in Megawatt-hours), the regional supply planning exercise is based on predictions of monthly peak loads (in Megawatts). This section presents a methodology for ascertaining reasonable estimates of the peak demand reductions (in kW or MW) based on achieved net energy reductions (in kWh or MWh)

6.1 Outline of Approach

Tillsonburg Hydro distributes both electricity that is received from the provincial transmission grid and exported electricity from various solar photovoltaic energy systems.

One way of looking at Tillsonburg Hydro's CDM target over the 2015 – 2020 delivery framework is that it doesn't matter whether the target (previously defined in Section 2.2 – starting on page 9 herein) is achieved via energy-efficiency measures or embedded load displacement generation projects. Both will have the same effect of reducing Tillsonburg Hydro's energy procurements from the provincial transmission grid by the same amount. The challenge is converting diminished energy procurements into an estimate of seasonal demand reductions that will be observed at the delivery points (i.e. transformer stations).

6.2 Review of Interconnection to Provincial Transmission Grid

Tillsonburg Hydro's medium-voltage distribution system is connected to and supplied from the provincial transmission grid via Tillsonburg transformer station.

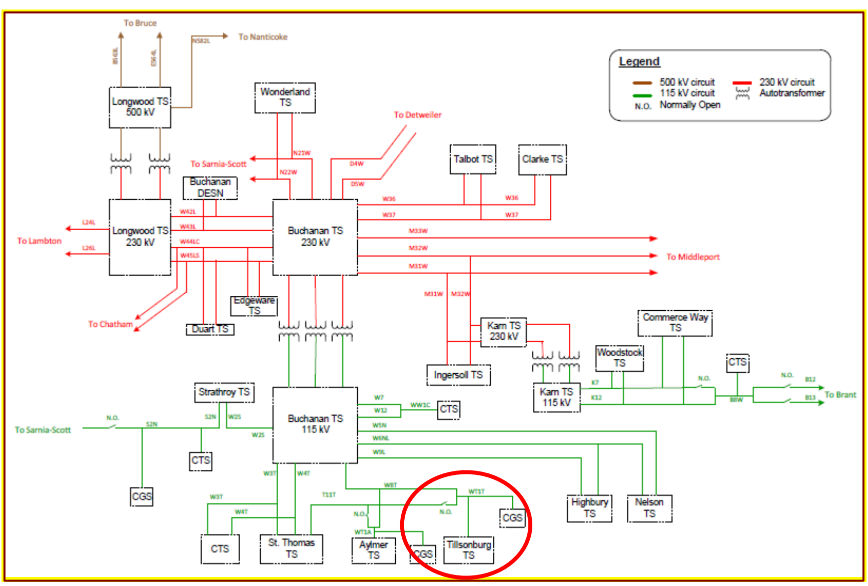


Figure 6-1, Interconnection of Tillsonburg TS to Transmission Grid

Tillsonburg TS is somewhat of an anomaly. Whereas most transformer stations have a dual-element spot-network arrangement (i.e. supplied via two transmission circuits and two power transformers with the secondary windings connected in parallel to form a spot network), it can be seen from Figure 6-1 above[8] that there is only a single 115 kV transmission circuit to connect Tillsonburg TS to the provincial transmission grid.

6.3 Tillsonburg Hydro's Load Profile

There are many ways of describing the profile of Tillsonburg Hydro's annual energy procurements from the provincial transmission grid. One such method that is often used to ascertain avoided upstream costs associated energy efficiency measures is an "*allocation*" method whereby the annual energy procurements are divided into a number of time periods (e.g. winter off-peak, winter mid-peak, winter on-peak, etc.).

Such an allocation for the three-year period 2012, 2013 and 2014 is shown in Table 6-1 below.[9]

Table 6-1, Allocation of Annual Energy Procurements from Transmission Grid

Calendar Year	Percentage of Annual Energy Consumption in Each Defined Period (%)							
	Winter On-Peak	Winter Mid-Peak	Winter Off-Peak	Summer On-Peak	Summer Mid-Peak	Summer Off-Peak	Shoulder Mid-Peak	Shoulder Off-Peak
2014	8.06%	9.02%	17.22%	7.16%	10.09%	16.62%	15.78%	16.05%
2013	7.72%	8.64%	16.89%	7.27%	10.18%	16.94%	16.49%	15.87%
2012	7.66%	8.59%	16.52%	7.55%	10.51%	17.12%	16.43%	15.63%

Table 6-1 above shows that, for example, in 2014, 8.06% of the annual energy procurements from the provincial transmission grid occurred during the defined "*winter on-peak*" period and 7.16% occurred during the defined "*summer on-peak*" period.

Although the overall energy procurements from the provincial transmission grid can vary somewhat year over year (e.g. 191,144,226 kWh in 2012, 196,924620 kWh in 2013, and 200,748,992 kWh in 2014), the allocation of the overall annual energy procurements into the various time-of-use periods doesn't vary substantially year over year.

For consistency with transmission system rate design, the seasons are as defined in Table 6-2 below.

---

[8] Source of schematic diagram: Hydro One Networks document: *Needs Assessment Report for London Region*; April 1, 2015; Figure 2: *Single Line Diagram – London Area*; pg 12.

[9] Source: E-mail dated April 28, 2014 to Gary Rains (London Hydro) from Mark Rosehart (Tillsonburg Hydro), attached Powerpoint file named *THI Allocated Percentages*.

Table 6-2, Seasons for Avoided Cost Assessments

Season	Months Included
Winter	December – March
Summer	June – September
Shoulder	April, May, October & November

Similarly, the time-of-use periods are defined in Table 6-3 below.

Table 6-3, Time-of-Use Periods for Avoided Cost Assessments

Time-of-Use Period	Season		
	Winter	Summer	Shoulder
On-Peak	07:00 – 11:00 and 17:00 – 20:00 weekdays (602 Hours)	11:00 – 17:00 weekdays (522 hours)	None
Mid-Peak	11:00 – 17:00 and 20:00 – 22:00 weekdays (688 hours)	07:00 – 11:00 and 17:00 – 22:00 weekdays (783 hours)	07:00 – 22:00 weekdays (1,305 hours)
Off-Peak	00:00 – 07:00 and 22:00 – 24:00 weekdays; All hours weekends and holidays (1,614 hours)	00:00 – 07:00 and 22:00 – 24:00 weekdays; All hours weekends and holidays (1,623 hours)	00:00 – 07:00 and 22:00 – 24:00 weekdays; All hours weekends and holidays (1,623 hours)

Note: Of the 8,760 hours in a year, the numbers in brackets show the number of hours in each TOU period.

6.4 Predicted Seasonal Peak Demand Reductions

The methodology assumes that:

- The annual energy savings will be achieved in a uniform manner throughout the six-year period (even though there is normally a participation lag at the beginning of any new programs or framework); and
- The energy savings are allocated into the same seasonal time-of-use periods as the load, e.g. if 7% of Tillsonburg Hydro's energy procurements from the transmission grid occur during the defined summer on-peak period, then it is assumed that 7% of the energy savings accrue during this same time period.

From Table 6-2 it can be seen that the 3-year average summer on-peak allocation is 7.33% and it can be seen from Table 6-3 that there are 522 hours in the summer on-peak period. This means that the predicted average hourly demand reduction during the summer peak period is:

$$\textit{Predicted \underline{Summer} On-Peak Demand Reduction} = \frac{11.31\ GWh\ x\ 7.33\%}{522\ h}$$

$$= 1.6\ MW$$

From Table 6-2 it can be seen that the 3-year average winter on-peak allocation is 7.81% and it can be seen from Table 6-3 that there are 602 hours in the winter on-peak period. This means that the predicted average hourly demand reduction during the winter peak period is:

$$\textit{Predicted \underline{Winter} On-Peak Demand Reduction} = \frac{11.31\ GWh\ x\ 7.81\%}{602\ h}$$

$$= 1.5\ MW$$

For electrical power transmission and distribution systems, the load typically isn't constant but rather fluctuates throughout the day as illustrated in Figure 6-2, throughout the week, and throughout the season. For power system planning, it is common to use the term "*load factor*" which is simply the ratio of "*average*" load throughout a given time period to the "*peak*" load throughout that same time period. In Figure 6-2, the daily load factor can be calculated to be (14,096 MW / 15,980 MW =) 88%.

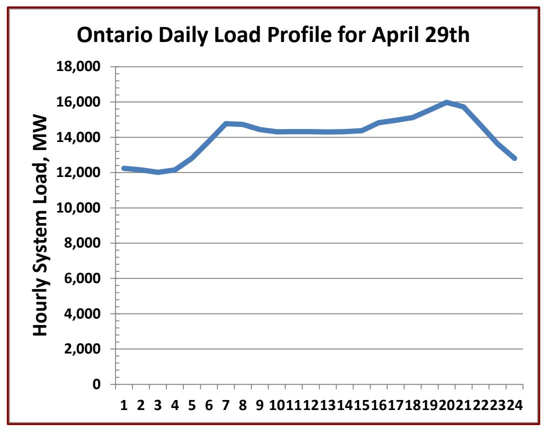


Figure 6-2, Example Fluctuating Load Pattern

The predicted load reduction during the summer on-peak period of 1.6 MW refers to the average reduction during this time period. However the predicted demand reduction at the time of system peak will certainly be larger than 1.6 MW, i.e. most certainly closer to 2 MW due to two (2) factors, namely:

- As illustrated in Figure 3-10 (on page 36 in Volume 1), all types of air conditioners and refrigerated appliances are becoming more energy efficient with the passage of time, i.e. newer HVAC units consume significantly less electricity during heat waves than the units they are replacing; and
- Interactive effects – as other loads such as lighting, computer systems, etc. become more

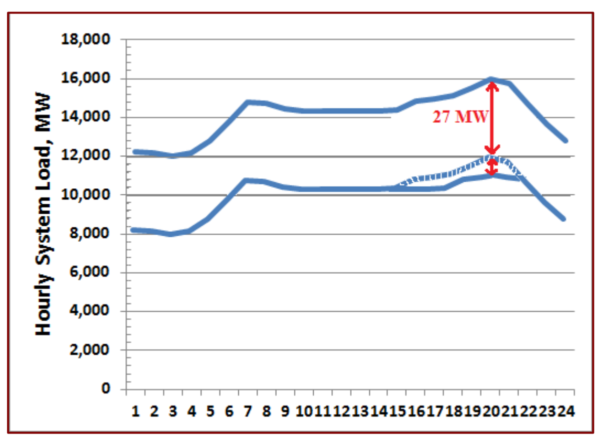


Figure 6-3, Impact of Energy-Efficiency on Summer Peak Load

energy efficient (i.e. they dissipate less heat), then the air conditioning system doesn't have to work so hard, i.e. it consumes less energy during heat waves.

Future revisions to this report will attempt to quantify this greater demand reduction due to the decreased sensitivity of air conditioning load to summer ambient temperatures.

It is assumed that Tillsonburg Hydro will progress in a uniform manner towards its assigned CDM target, and as such, the predicted demand reductions will progress from 0 MW at present to the predictions given above in year 2020.

6.5 Limitations of Prediction Methodology

The methodology used above to convert a net energy savings target to a predicted demand reduction is straightforward, but has a short-coming as described in the subsections below:

6.5.1 Weather-Sensitivity of Predicted Demand Reduction

Tillsonburg Hydro's peak system load is highly influenced by weather conditions, i.e. the system load during a prolonged heat wave is significantly more than would be the case during more moderate summer weather conditions.

An energy savings target makes no distinction between energy-efficiency measures that are independent of ambient temperature (e.g. a lighting retrofit produces the same energy savings irrespective of ambient weather conditions and those that are influenced by ambient weather conditions (e.g. a new HVAC system using modern refrigerants will consume less energy during a heat wave than the HVAC system it replaced, thereby decreasing the weather-sensitivity of the load).

As such, the predicted system demand reductions are based on nominal weather patterns. Depending on the penetration of HVAC upgrades, the peak demand reduction during heat waves may be greater than the prediction given herein.

7 COST EFFECTIVENESS

It is imperative that CDM Plans be "*cost effective*". This section provides an introduction to the requisite cost effectiveness metrics, the underlying assumptions used (including historical insight into incentives and program administration costs), and finally reports on the cost effectiveness of Tillsonburg Hydro's CDM Plan.

7.1 Primer on Cost Effectiveness Tests

Though there are several different tests that evaluate cost-effectiveness from a variety of perspectives, all of them compare the net present value of the benefits of the energy efficiency resource (lifetime savings) with the net present value of the cost of the energy efficiency resource. Results are typically expressed as a benefit-cost ratio or as the net present value of benefits (NPV benefits - NPV costs).[10]

Clause 3.5 (v) of the Minister's March 2014 directive[11] has been replicated below for convenience of reference:

> *v. The OPA shall ensure that there is a positive benefit-cost analysis of each CDM Plan and each Province-Wide CDM Program and Local Distributor CDM Program utilizing the OPA's Total Resource Cost Test and the Program Administrator Cost Test found in the OPA's Cost-Effectiveness Guide, dated October 15, 2010 (OPA Cost-Effectiveness Tests), which may be updated by the OPA from time to time. The OPA will establish hurdle rates to consider the cost of delivering Province-Wide Distributor CDM Programs and Local Distributor CDM Programs against the avoided cost of procuring supply.*

7.1.1 Total Resource Cost (TRC)

The TRC is an indicator of a measure, program or portfolio's attractiveness from a societal perspective.

The following equation summarizes the calculation of the TRC benefit/cost ratio:

$$\text{TRC} = \frac{NPV\ of\ Lifetime\ Generation\ Costs\ Avoided}{Measure\ Costs}$$

This test compares benefits to society as a whole (avoided supply-side cost benefits, additional resource savings benefits) with the participant's cost of installing the measure plus the cost of energy efficiency program administration (non-incentive

[10] *The Energy Efficiency Guidebook for Public Power Communities*; Energy Centre of Wisconsin; October 2009; Chapter 9, *Program Screening*.
[11] Directive, dated March 31, 2014 to Ontario Power Authority from Ministry of Energy; re: *2015 – 2020 Conservation First Framework*.

costs). Incentives are considered a transfer payment from program to participant and thus are not explicitly accounted for in the calculation.

Since the TRC test takes a societal perspective into account, it is the appropriate test for regulatory agencies and other policymakers to use in establishing energy conservation goals.

7.1.2 Program Administrators Cost (PAC)

The Program Administrator Cost (PAC), sometimes referred to as the utility cost test, compares the utility's avoided cost benefits with energy efficiency program expenditures (incentives plus administrative costs). Along with the TRC test, the PAC test is one of the most commonly-used tests for energy efficiency program planning purposes. It is also frequently used in a resource planning context to evaluate energy efficiency investments against supply-side alternatives.

To calculate PAC, the following equation is used:

$$\text{PAC} = \frac{NPV\ of\ Lifetime\ Generation\ Costs\ Avoided}{Incentive\ Costs + Other\ Program\ Costs}$$

The PAC has the same numerator as the TRC: the total benefits of the measures in the program. Again, typically this is the net present value of the lifetime stream of generation costs avoided due to the measure savings. The denominator is the program cost, which is the sum of the incentive costs (if any) and the other program costs as described above. All costs and benefits are expressed in constant dollars (with a defined base year).

7.1.3 Levelized Unit Electricity Cost (LUEC)

Levelized Unit Electricity Cost (LUEC), also referred to in the literature as "*Levelized Delivery Cost (LC)*", is a measure of how much it costs for each kilowatt-hour of electricity conservation.

To calculate LUEC, the following equation is used:

$$\text{LUEC} = \frac{Incentive\ Costs + Other\ Program\ Costs}{NPV\ of\ energy\ savings}$$

The Levelized Delivery Cost Metric provides a basis for comparing energy-efficiency programs with other electricity supply resources. The metric expresses delivery costs (all costs associated with designing, delivering and evaluating a program) per unit of energy saved on an annualized basis in terms of $/MWh. It accounts for the energy savings that persist over the minimum expected useful life of all technologies and initiatives associated with the implementation of a conservation program.[12]

[12] Ontario Power Authority publication: *2011 Conservation Results*; December 2012; pg 7.

7.2 Program Assumptions

The assumptions concerning program administrator's costs (i.e. LDC program delivery costs) are defined in Section 3.2, *Program Assumptions*, within Volume 2. These are London Hydro's historical delivery cost structures, but since this is a joint CDM Plan with the same resources used to deliver CDM programs in both service territories, this is a reasonable approach.

7.3 Tillsonburg Hydro's Budget Allocation

In the same fashion that Tillsonburg Hydro has been assigned a CDM target, a threshold budget allocation of $2,881,461 is available to Tillsonburg Hydro to carry out delivery of CDM programs.[13]

7.4 Cost-Effectiveness Analysis of CDM Portfolio

The Ontario Power Authority developed an Excel spreadsheet (referred to as the "*IESO CDM EE Cost Effectiveness Tool*") for carrying out cost-effectiveness analysis.

For the portfolio of programs identified herein as the CDM Plan for Tillsonburg Hydro, the outcome is as tabulated below:

SUMMARY OF CDM PORTFOLIO COST EFFECTIVENESS									
	TRC			PACT			Levelized Cost		
Program Year	Benefits ($)	Costs ($)	Ratio	Benefits ($)	Costs ($)	Ratio	Benefits (Energy)	Costs ($)	($/kWh)
2015	476,619	269,323	1.8	402,487	184,628	2.2	7,484,538	184,628	0.025
2016	483,643	250,760	1.9	408,595	167,100	2.4	7,105,896	167,100	0.024
2017	517,589	245,843	2.1	438,112	163,824	2.7	6,966,565	163,824	0.024
2018	489,692	237,896	2.1	413,854	155,786	2.7	6,572,546	155,786	0.024
2019	495,806	233,231	2.1	419,171	152,731	2.7	6,443,672	152,731	0.024
2020	498,385	228,658	2.2	421,413	149,736	2.8	6,317,326	149,736	0.024
Plan Total	**2,961,734**	**1,465,710**	**2.0**	**2,503,632**	**973,805**	**2.6**	**40,890,543**	**973,805**	**0.024**

Figure 7-1, Cost Effectiveness of Tillsonburg Hydro's CDM Plan

It can be seen from the foregoing chart that Tillsonburg Hydro's CDM Plan meets all three (3) criteria for a cost effective CDM Plan.

It will also be seen that there is remaining budget allocation that should be sufficient for the "unallocated" energy savings quantified in Section 5.3 (starting on page 21 herein.

[13] Ontario Power Authority document entitled: *LDC CDM Target and Budget Allocations - as of October 31, 2014*; a document included in the Conservation First Framework LDC Toolkit.

8 COLLABORATION

The new 2015 – 2020 CDM Framework has an emphasis on "*collaboration*" presumably in the belief that collaboration amongst LDC's and between the community of LDC's and natural gas distributors will lead to both greater cost effectiveness and a more seamless customer experience. Tillsonburg Hydro is a part of the collaborative efforts described in Section 4, *Collaboration*, of *Volume 2 – Budget & Resource Plan*, of this overall CDM Plan.

9 CHANGE MANAGEMENT

The "*change management*" strategy planned for London Hydro, as described in Section 5, *Change Management*, within Volume 2 – *Budget & Resource Plan*, of this overall CDM Plan will be replicated (with suitable adjustments) for Tillsonburg Hydro staff.

10 Summary, Conclusions & Recommendations

Under the 2015 – 2020 CDM delivery framework, Tillsonburg Hydro's allocation of the provincial 7 TWh energy savings target is 11.31 GWh. Whereas under the previous 2011 – 2104 CDM delivery framework, energy savings were cumulative, this has changed under the new 2015 – 2020 CDM delivery framework (i.e. they aren't cumulative). As such, the new CDM targets (for the 2015 – 2020 CDM framework) are about double the targets under the previous 2011 – 2015 CDM delivery framework.

Establishment of the CDM targets was informed by three (3) Achievable Potential studies that were carried out [Ref 2, 3 and 4]; one for the "*residential*" sector, one for the "*commercial*" sector, and the final for the "*industrial*" sector. The CDM targets were seemingly based on the "*realistic*" achievable potential, a point midway between the upper economic achievable potential and the lower economic achievable potential.

Section 4, *Discussion*, herein provides a prediction of net energy savings solely via the continuation of the existing provincial saveONenergy FOR HOME and saveONenergy FOR BUSINESS programs. Such CDM programs are anticipated to yield about 3.6 GWh in net energy savings, leaving a shortfall of (11.31 – 3.6 =) 7.71 GWh.

Section 5, *Addressing the Gap – Vision for New CDM Programs*, herein provides several concepts for new CDM programs that are under development by London Hydro and will be made available to Tillsonburg Hydro customers. Where such local or regional CDM programs are sufficiently developed that one can reasonably predict the energy savings potential, such CDM programs are projected to yield only about 600 MWh, still leavings a significant shortfall in achievement of Tillsonburg Hydro's CDM target.

Note: The Ontario Power Authority has compiled a list of potential pilot CDM projects. For any of these that eventually evolve into cost-effective provincial CDM programs, Tillsonburg Hydro will certainly adopt such offerings into its overall CDM portfolio.

Certainly one of the challenges described in Section 3.3 (starting on page 13 herein) is the technical constraint that precludes the interconnection of embedded load-displacement generation. To put this into context, London Hydro expects to meet 40% of its CDM target via embedded load-displacement generation.

The Energy Conservation Agreement between Tillsonburg Hydro and the IESO provides for an LDC to submit revised CDM Plans as their circumstances change. It is fully expected that the joint London Hydro / Tillsonburg Hydro CDM Plan will be updated and re-submitted roughly on an annual basis to reflect the introduction of new local and regional CDM programs and their respective predicted impact on meeting each organization's respective CDM target.

Energy conservation is considered an "*investment*" and like any other investment, it is prudent to predict whether the investment is a good one, i.e. the benefits outweigh the costs.

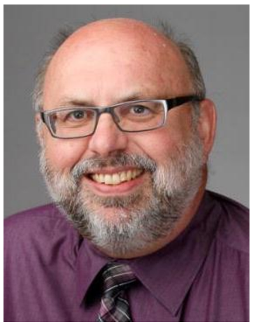
This document has introduced the reader to the three (3) cost effectiveness tests used in Ontario to screen energy conservation measures, programs and portfolios for cost effectiveness. Furthermore, in the interest of transparency, it has defined the basis for the various program administrator's costs used in the evaluation of cost-effectiveness and to predict cash flows over the time period 2015 – 2020.

Finally, it has replicated the output from the Ontario Power Authority's cost-effectiveness analysis tool to show that Tillsonburg Hydro's CDM Plan is cost-effective from the perspective of TRC, PAC and LUEC tests.

In time, as new provincial, regional and local programs emerge and are incorporated into Tillsonburg Hydro's CDM Plan, it is expected that the cost-effectiveness analysis will need to be updated (in conjunction with updates to the joint CDM Plan) to demonstrate that the portfolio of CDM programs remain cost effective.

♣ - ♣ - ♣

ABOUT THE AUTHORS



Gary Rains, P.Eng., Director of Energy Management Programs, has had a career in the electric distribution utility sector (Ontario Hydro, Scarborough PUC, Toronto Hydro, and now London Hydro) that now spans 35 years. His responsibilities over the years have included various SCADA and Distribution Automation systems, standards, revenue metering, and distribution system planning and Smart-metering. His present responsibilities include developing and overseeing implementation of London Hydro's CDM initiatives.

Hans Schreff, Program Manager – Conservation Activities, has held various positions in the utility for over 14 years. His responsibilities have included development of solar water heating systems, load controls for water heaters and air conditioners. Hans has also been involved in the marketing and communication divisions in London Hydro and has over the years been involved in many special projects. Hans presently manages the day-to-day operation of CDM projects in London Hydro and has been the driving force behind several initiatives for which London Hydro has been bestowed NRCan's ENERGY STAR Utility of the Year awards in 2007 and 2009.

Appendices

Appendix A, Yearbook Data for Tillsonburg Hydro

The following data, excerpted from page 93 of the Ontario Energy Board publication *2012 Yearbook of Electricity Distributors*,[14] are inputs to the Ontario Power Authority's *Achievable Potential* spreadsheet tool, and are replicated below for convenience of reference.

Billed kWh:

- Residential: ....49,401,384 kWh
- General Service < 50 kW:..............................21,887,576 kWh
- General Service > 50 kW & Large User:.......112,551,412 kWh

As an input parameter, the achievable potential spreadsheet tool seeks a breakdown between annual energy sales to industrial customers and annual energy sales to commercial customers. Since such data is not readily available (and would take considerable time and effort to derive), it is simply assumed that 1/3 of the non-residential load is consumed by industrial customers and 2/3 of the non-residential load is consumed by commercial customers. Therefore:

Assumed industrial load	=	1/3 x (21,887,576 + 112,551,412)
	=	44,812,996.0 kWh
	=	44.8 GWh
Assumed commercial load	=	2/3 x (21,887,576 + 112,551,412)
	=	89,625,992.0 kWh
	=	89.6 GWh

✂ --

[14] Ontario Energy Board website; *Yearbook of Electricity Distributors and Yearbook of Natural Gas Distributors*; see URL:: http://www.ontarioenergyboard.ca/OEB/Industry/Rules+and+Requirements/Reporting+and+Record+Keeping+Requirements/Yearbook+of+Distributors

This Page Intentionally Left Blank....

3-VECC-29

Reference: E3/T1/S2, pages 18-23

a) It is noted that the same growth rate in use per customer (99.82%) is applied to both the Market Participants (page 17) and the non-Market Participants (page 20) in the GS>50 class. Does the data used to calculate this growth rate (Tables 3.2.1.5 and 3.2.1.16) include the count and usage for both categories of customers.

LH Response:

The customer counts and consumption amounts did include the WMP customers up to the transition date where they were billed as London Hydro consumers and did exclude those amounts after the transition when they were billed by the IESO directly for consumption. London Hydro would acknowledge that the 2012 value includes 5,220,726 kWh. London Hydro would suggest that this is an immaterial oversight.

b) If the response to part (a) is no, please explain why it is appropriate to apply this growth rate to both categories of customers?

LH Response:

London Hydro chose to use the GS>50 kW class growth rate as a reasonable proxy for the WMP class as a whole.

c) If the response to part (a) is no, please recalculate the average annual use per customer for the combination of the two categories for each of 2011 through 2016; the resulting growth rates for 2012-216 and the resulting overall geomean growth rate.

LH Response:

The following shows the requested calculation using the data from 2012 to 2015 only.

Historical kWh			Proposed	Average	GeoMean
2011			-		
2012			12,561,209		
2013			17,002,607		
2014			16,769,932	98.63%	
2015			17,665,651	105.34%	
Geometric Mean (2012 to 2015) GS>50 kW Class			100.01%	101.99%	101.93%
Forecasted kWh					
2016			17,666,883	18,016,557	18,006,807
2017			17,668,115	18,374,433	18,354,551

Historical kW			Proposed	Average	GeoMean
2011			-		
2012			24,440		
2013			31,196		
2014			30,245		
2015			31,912		
Percentage kW/kWh					
2011					
2012			0.19%		
2013			0.18%		
2014			0.18%		
2015			0.18%		
Average (2012 to 2015)			0.18%		

Total kW Forecast					
2016			32,064	32,699	32,681
2017			32,066	33,348	33,312

The following shows the requested calculation using the data from 2011 to 2015.

				Average	Geomean
Row Labels	**Sum of Consumption kWh**				
2012	12,561,209	5,220,746	17,781,955		
2013	17,002,607		17,002,607	0.956172	
2014	16,769,932		16,769,932	0.986315	
2015	17,665,651		17,665,651	1.053412	
Grand Total	**63,999,399**			0.998633	0.997815

London Hydro would note that the purpose of calculating the WMP kWh value is to include this value in the calculation of the RTSR component of working capital and the calculation of RTSR rates. Additionally it is included to estimate the valuation of GS>50 kW volumetric rate. As this final calculated values of kWh and kW for this group is immaterial to the GS>50 kW class at large, being 0.01% of the class, that London Hydro' original proposal of using the GS>50 kW growth rate is reasonable.

d) If the response to part (a) is no, please recalculate for just the GS>50 customers that are not market participants - the average annual use per customer using for the GS>50 each of 2011 through 2016; the resulting growth rates for 2012-216 and the resulting overall geomean growth rate

LH Response:

Year	Adjusted General Service > 50 kW
Consumption (kWh)	
2006	1,608,473,485
2007	1,595,425,678
2008	1,541,096,158
2009	1,426,537,474
2010	1,550,511,761
2011	1,518,936,151
2012	1,508,216,004
2013	1,485,615,093
2014	1,499,515,193
2015	1,484,614,973

Year	Adjusted General Service > 50 kW
Average Consumption per Custom	
2006	1,030,070
2007	1,008,733
2008	970,024
2009	896,324
2010	957,957
2011	940,518
2012	926,992
2013	919,886
2014	937,490
2015	940,821

Year	Adjusted General Service > 50 kW
Average Growth per Customer	
2006	0.00%
2007	97.93%
2008	96.16%
2009	92.40%
2010	106.88%
2011	98.18%
2012	98.56%
2013	99.23%
2014	101.91%
2015	100.36%
Geomean (2012 to 2015)	**100.01%**

e) Please confirm that, for purposes of the weather normalization adjustment (Table 3.2.1.22) London has assumed that 100% of Residential and GS<50 load is weather sensitive. If so, why is this assumption reasonable?

LH Response:

The intent of the application of 100% for Residential and GS<50 kW is to assume that both of these classes are more impacted by weather than the remaining metered classes, and to assume that they are 100% weather sensitive.

3-VECC-30

Reference: E3/T1/S2, pages 23-24

a) Please explain why, for Co-generation, the average last four year's historical use (2012-2015) was used to establish the forecast kW when the number of Cogeneration customers increased in 2014 and (per Table 3.1.2.26) there was a significant increase in this class' use post 2012.

LH Response:

At the time of calculating the original load forecast there was a suspicion that one of the accounts was to curtail its usage, however that has not occurred. London Hydro will adjust this calculation in its final calculation.

3-VECC-31

Reference: E3/T3/S1, page 7

Please explain the decrease in Miscellaneous Service Revenues between 2014 and 2015.

LH Response:

The decrease in Miscellaneous Services Revenue between 2014 and 2015 is due to a special project undertaken in 2014 to assist Hydro One with the implementation of their SAP billing system. Customer Service Staff were deployed to assist Hydro One with the implementation of their SAP billing system. London Hydro was engaged to work specifically with the ongoing Ombudsman investigation and handle customer complaints and inquiries that were routed from that office. London Hydro's involvement entailed utilizing knowledgeable and experienced staff to identify and correct problem accounts, correct failed CRM replications, adjust "Move in" and "Move out" transactions, request corrected meter data, correct billing calculation issues, push out back billings, identify and correct bill print errors, work with the retailer and settlement teams to correct account billing transactions, and work with the metering teams to have meters exchanged and/or installed, meter routes corrected, smart meters removed from bad mesh network areas, and correct mixed meter situations.

Revenues were particularly high in 2014 and not indicative of normal activity – this project was responsible for $273k in Miscellaneous Services Revenue in 2014 and $37k in Q1 of 2015. Therefore, the effect from this project alone resulted in a decrease of $236k between 2014 and 2015.