ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #1

Reference: Page 6-8

Does Enbridge agree that existing gas consumers should be required to subsidize expansions of Ontario's natural gas distribution system only if all of the following criteria are met:

a) The expansion will lead to a net reduction in Ontario's greenhouse gas emissions [e.g., this could occur if the new customers' previous energy source (e.g., heating oil) had higher greenhouse gas emissions];
b) Expanding the gas system is the most cost-effective, feasible option to achieve the greenhouse gas emission reductions [i.e., do not expand the gas distribution system using existing customer subsidies if the emission reductions could be achieved at a lower cost by energy efficiency or renewable energy investments (e.g., home energy retrofits, heat pumps)]; and
c) The subsidy is necessary to make the project happen [e.g., do not require existing customers to subsidize an expansion of the gas system if the cost could be recovered from the new customers via a surcharge on their gas rates]?

If "no", please fully justify your response. Please specifically address each of the three criteria in your response. Note that the above three criteria would not be to the exclusion of other criteria required for community expansion.

RESPONSE

Enbridge does not agree that the criteria set out above are the determinative considerations.

a) Reduction of greenhouse gas emissions is not the only factor considered in the weighing of the costs and benefits of gas distribution system expansion project.

b) Due to the happenstance of timing and geography there could be situations and reasons where it is desirable and practical to take steps that may not result in the lowest GHG option. For example, electricity generation in Ontario includes natural gas generation. Natural gas generation provides significant societal benefits in terms of economics, reliability and operational flexibility. This component of the electricity generation fleet has also helped Ontario integrate more renewable energy sources into its generation portfolio. It is also important to consider site versus source (a more holistic view of energy use and consumption) in order to understand the net impact of potential changes from the point of generation to the point of end use.

c) Yes the Company agrees that subsidies from existing customers should not be utilized where they are not required. The Company also recognizes that intergenerational and geographical impacts appropriately exist within the design and application of postage stamp rates.

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #2

Reference: Page 15

Please make best efforts to provide an estimate of the greenhouse gas emissions that would be produced by the consumption of natural gas by all customers estimated to convert to natural gas in the 40 communities currently under consideration by Enbridge for community expansion, cumulatively from the present until (a) 2020, (b) 2030, and (c) 2050. Assume that natural gas is expanded to all of the communities under consideration. Please make and state all necessary assumptions on a best efforts basis. Where possible, please use the same assumptions used in the profitability analysis and the stage 2 analysis contained in the Enbridge evidence.

RESPONSE

The greenhouse gas emissions produced by all customers by 2020, 2030 and 2050 are summarized in the following Table:

	Natural Gas Consumption		**GHG Emissions**	
	(106 m3)	GJ	tonnes	
Cumulative from 2017 to 2020 =	41.0	1,558,495	76,886	/c
Cumulative from 2017 to 2030 =	467.4	17,761,755	876,246	/c
Cumulative from 2017 to 2050 =	1,469.2	55,828,330	2,754,197	/c

These GHG emissions are substantially lower than GHG emissions produced from alternate fuels such as propane, light heating oil and electricity.

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #3

Reference: Page 15

Section 3.1 (d) of the Appendix B to EBO 188 refers to “estimates of the NPV and the benefit-cost ratio for the Investment Portfolio using a Societal Cost Test (“SCT”), defined in the Report of the Board, E.B.O. 169 III, as an evaluation of the costs and/or benefits accruing to society as a whole, due to an activity. The SCT analysis should be consistent with that used for the utilities' DSM programs. The benefit-cost ratio shall be presented with and without monetized externalities.”

Please make best efforts to provide a benefit-cost ratio for the expansion of gas to the 40 communities currently under consideration by Enbridge for community expansion. Please use a Societal Cost Test (“SCT”), defined in the Report of the Board, E.B.O. 169 III, as an evaluation of the costs and/or benefits accruing to society as a whole, due to an activity. Please use an SCT analysis that is consistent with the test used by Enbridge in relation to DSM. Please account for the anticipated impact of cap and trade. Please present the ratio with and without monetized externalities. Please make and state all necessary assumptions on a best efforts basis. Please provide a spreadsheet of key assumptions and the underlying calculations.

RESPONSE

Please see Enbridge responses to BOMA Interrogatory #13 at Exhibit S3.EGDI.BOMA.13, OGA Interrogatory #1 at Exhibit S3.EGDI.OGA.1, and Parkland Interrogatories #1 and 2 at Exhibits S3.EGDI Parkland.1 and 2.

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #4

Reference: Page 13

Please describe the contingency planning that has been undertaken by Enbridge to assess the possibility that substantial reductions in natural gas consumption (e.g. 40%) will be required in Ontario in the medium term (e.g. by 2030).

RESPONSE

Please see Enbridge’s response to SEC Interrogatory #12 at Exhibit S3.EGDI.SEC.12.

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #5

Reference: Page 13

a) Please provide a list of all documents that have been prepared by Enbridge to estimate the overall reductions in natural gas consumption that may be needed to meet Ontario's GHG emission reduction targets.
b) Please provide a list of all documents possessed by Enbridge prepared by third parties to estimate the overall reductions in natural gas consumption that may be needed to meet Ontario's GHG emission reduction targets.
c) Please provide a copy of all documents listed in (a) and (b) above. If a document is not provided, please provide a justification. A document need not be provided if it simply repeats the estimates and analysis contained in a document already provided.

RESPONSE

a) Please see c).

b) Please see c).

c) Enbridge jointly procured the services of ICF Consulting with Union Gas Ltd. to develop an understanding of cap and trade and its potential impact on the natural gas utilities and their customers. The ICF Consulting report was foundational work and has been used as a reference informing Enbridge's planning for the introduction of the Province's Cap and Trade Program. Please refer to Enbridge's response to OGA Interrogatory #3 at Exhibit S3.EGDI.OGA.3.

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #6

Reference: Page 13

In its Natural Gas Market Review presentation provided to the Board in January of this year in EB-2015-0237, Enbridge stated as follows at page 16:

> EGD will need to re-imagine infrastructure and business model
> - Residential, commercial, institutional NG consumption could need to decline by ~40% by 2030
> - Even if protection afforded industrial emitters consumption will need to decline by 20 – 30%
> - No net increase in NG consumption for electricity generation
> - Electrification of transport and buildings.

a) Please provide all reports, studies, or other analyses supporting the statement in the first bullet above that “residential, commercial, institutional NG consumption could need to decline by ~40% by 2030.”

b) Please file a copy of the presentation referred to above in response to this interrogatory.

RESPONSE

a) Please see the Company’s responses to Environmental Defense Interrogatory # 5 at Exhibit S3.EGDI.ED.5 and SEC Interrogatory #12 at Exhibit S3.EGDI.SEC.12.

b) Please see attached Natural Gas Market Review presentation.

ENBRIDGE

Lorraine Chiasson
Regulatory Coordinator

tel 416-495-5499
fax 416-495-6072
egdregulatoryproceedings@enbridge.com

Enbridge Gas Distribution
500 Consumers Road
North York, Ontario M2J 1P8
Canada

January 15, 2016

VIA RESS, EMAIL and COURIER

Kirsten Walli
Board Secretary
Ontario Energy Board
2300 Yonge Street, Suite 2700
Toronto, ON M4P 1E4

Dear Ms Walli:

Re: Natural Gas Market Review – EB-2015-0237
Participant Presentation

As requested in the Board's letter dated January 4, 2016, attached please find Enbridge Gas Distribution's presentation for the 2015 Natural Gas Market Review Forum.

If you have any questions please contact the undersigned.

Sincerely,

[original signed]

Lorraine Chiasson
Regulatory Coordinator

Attachment

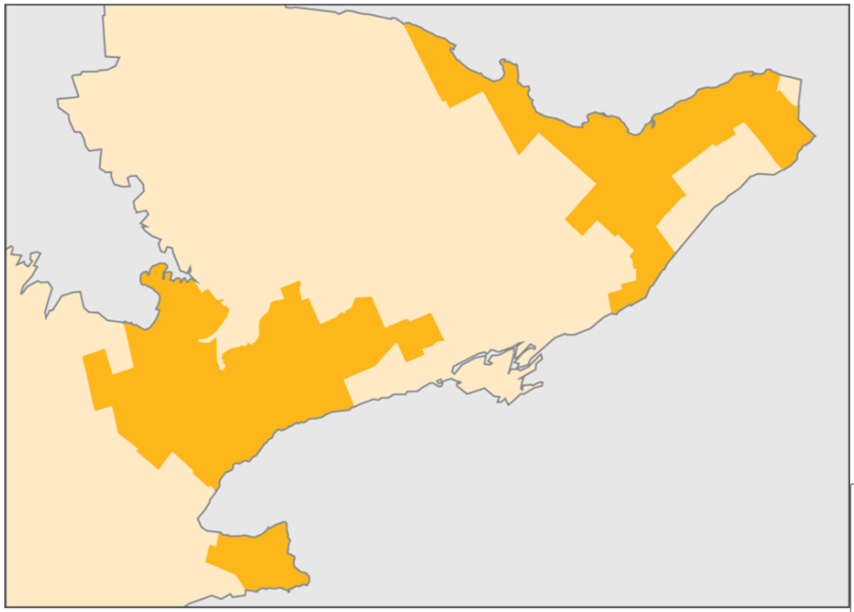
Natural Gas & Ontario’s Energy Mix

EB-2015-0237

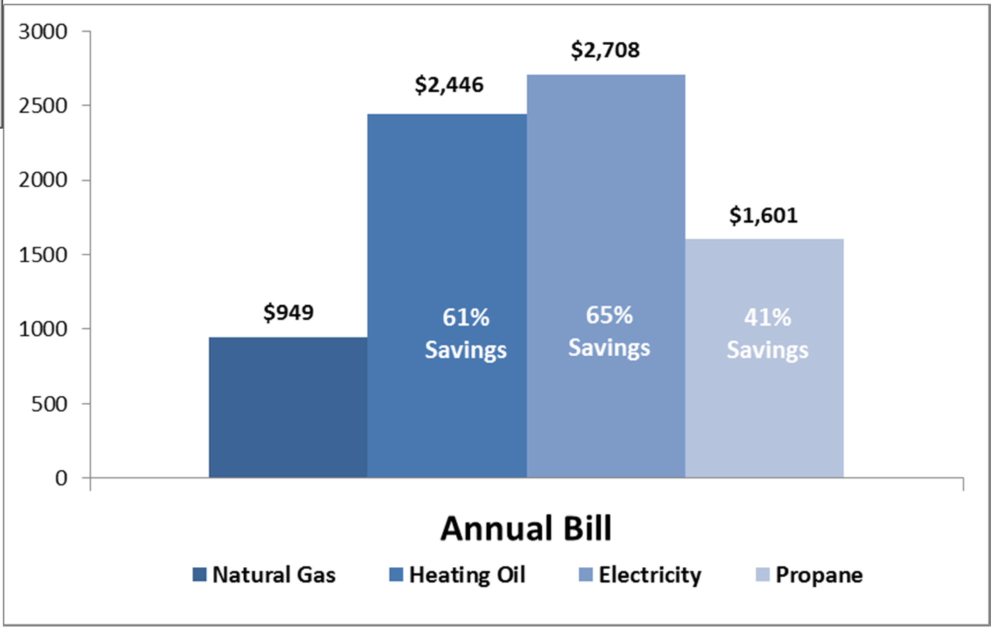
Natural Gas Market Review, January 2016

Norm Ryckman

Enbridge Gas Distribution

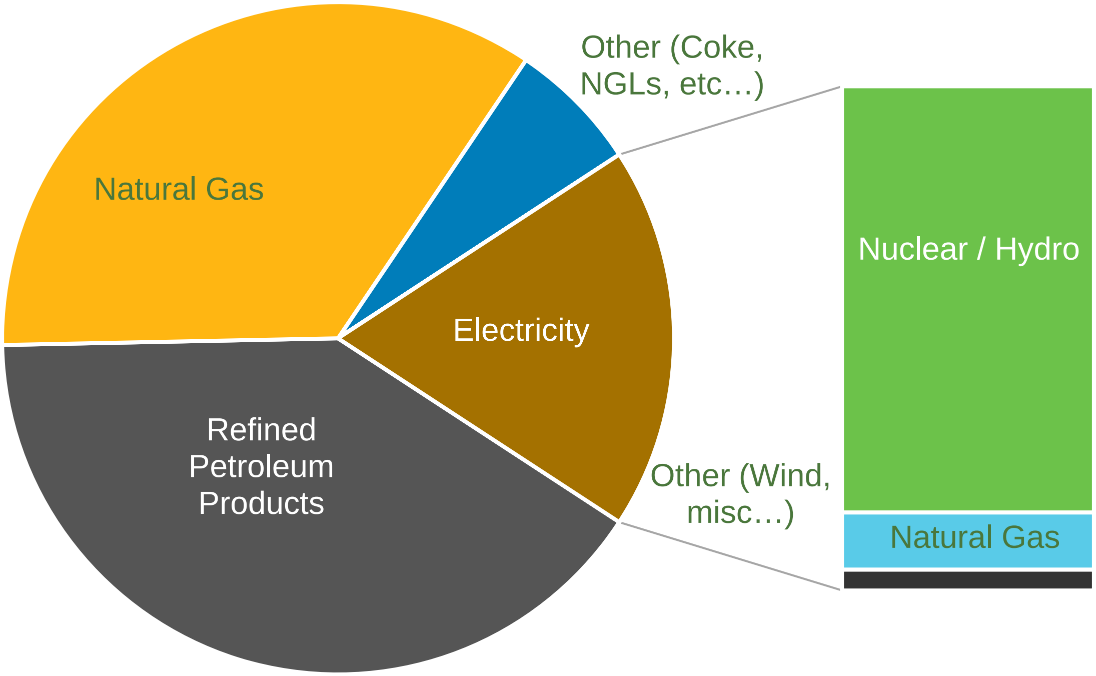


- EGD serves >2 million customers
- Adds ~35,000 customers/year



- Consumers recognize economic benefits of gas

Natural Gas is the largest energy source in Ontario and forecast to grow from 2014 to 2030



Source: ICF

Natural gas’ share of Ontario’s total energy final demand has grown to over 33% of the total (830,000TJ or 770 Bcf);

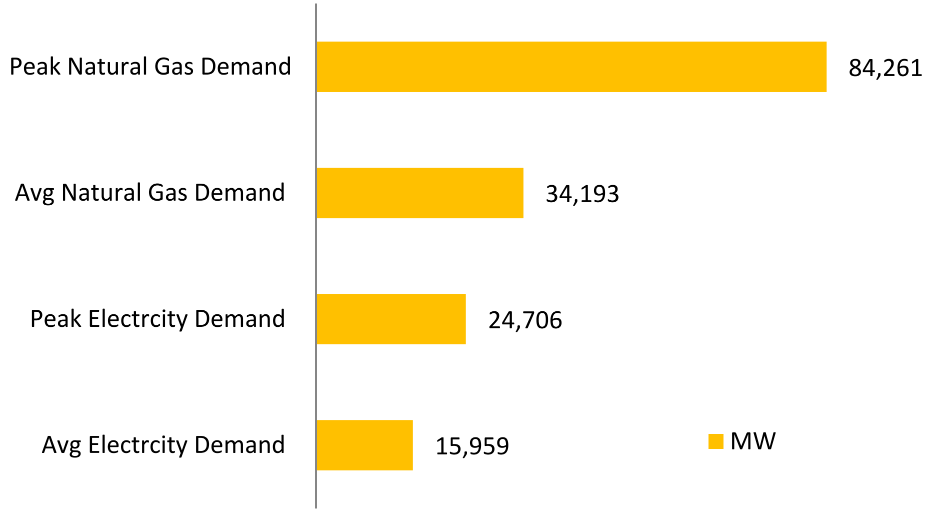
- New supply / demand paradigm in North America.
- Newly connected communities.
- Increasing usage in transport.
- Displacement of coal.
- Enabling renewables.

Electricity demand declined 2004 – 2014 due to CDM and loss of industry demand due to recession.

Importance of Natural Gas Infrastructure

Peak Day and average day demand

Ontario Energy Delivery by Infrastructure Type



Footnotes:

1. Ontario Peak natural gas demand is 6.9 bcf/day
2. Avg. natural gas demand includes refill of storage
3. Peak electricity demand recorded in Summer 2006 (IESO)

- Ontario's electricity grid must balance in real-time or use costly, short-term storage
- Ontario's existing natural gas network offers equivalent of 80 TWh of seasonal storage
- On peak heating days, storage reserves deliver energy equivalent of 90 nuclear reactors (then you would still need to get the power to where it is needed and equipment that can use it)
- Orderly transition to a low-carbon economy can leverage existing pipelines and storage with increasing quantities of green gas supply

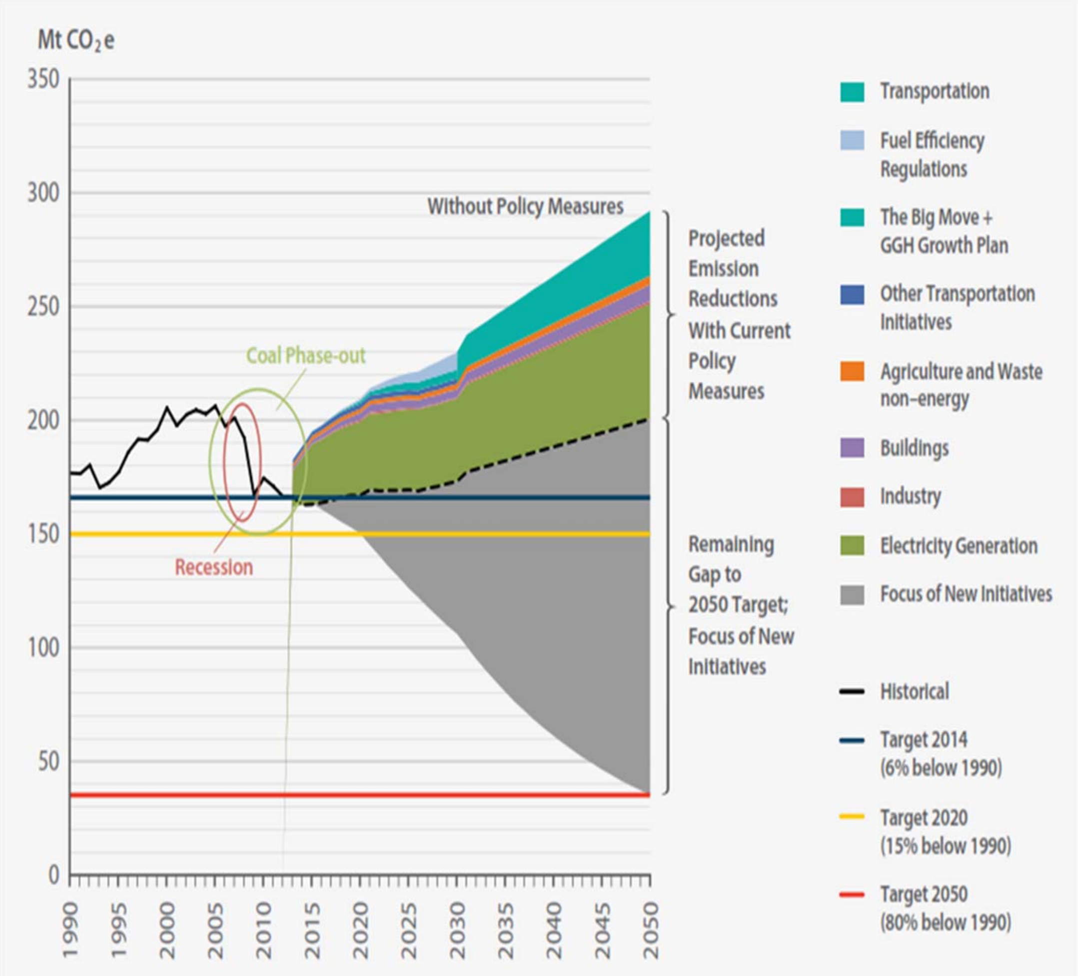
Cap and Trade in Ontario and Impacts to Enbridge Natural Gas Customers

EB-2015-0237
Natural Gas Market Review, January 2016

Norm Ryckman

Ontario Emissions and Cap and Trade Policy

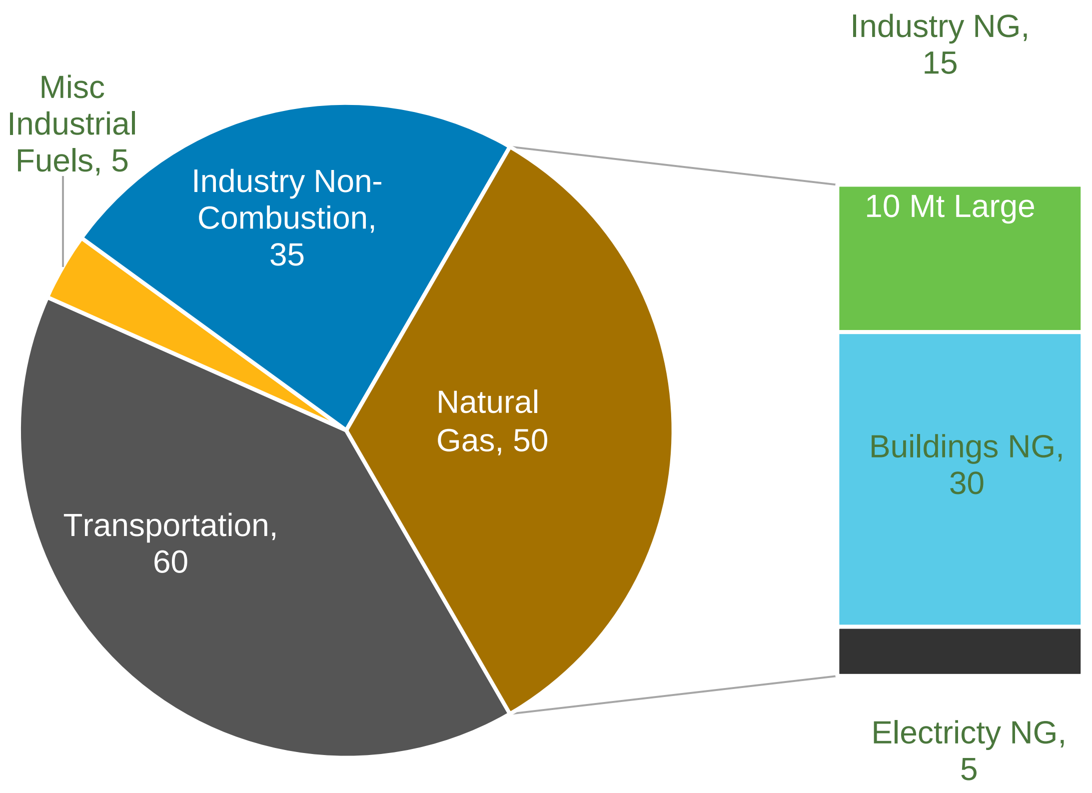
Ontario has defined 2020 and 2030 targets and a path to material de-carbonization by 2050



Source: Ontario's Climate Change Discussion Paper 2015, Ministry of the Environment and Climate Change

- Historic emission reductions from coal shut-downs and decline of industrial sector energy consumption.
- Ontario electricity emissions intensity = 0.05 t/MWh.
- Reductions associated with urban public transportation projects and energy efficiency are factored into the projection.
- Future reductions will need to come from energy efficiency and re-fueling current transport fuel and natural gas consumers.
- Ontario's emissions need to fall to 110 Mt by 2030 and 35Mt CO_2 by 2050.

Based on Ontario's emissions profile reductions must come from reduction in natural gas / transport fuel use



Source: ICF

Ontario Forecast 2017 GHG emissions for sectors /sources covered under proposed cap and trade ($MtCO_2e$)

Ontario's 2017 GHG emissions profile for "Cap" covered sectors;

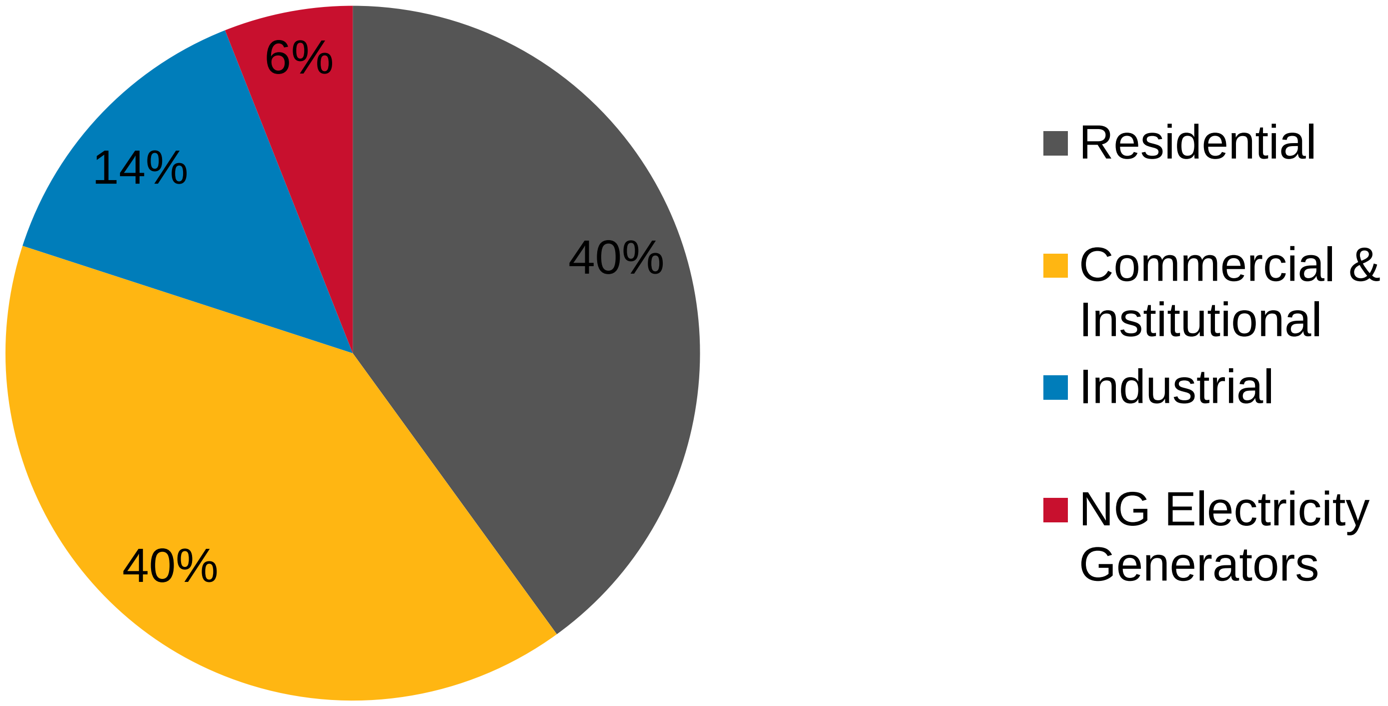
- 60 Mt CO_2e from transport fuel usage
- 50 Mt CO_2e from NG usage (950 Bcf)
    - 15 Mt industry
    - 30 Mt commercial and residential
    - 5 Mt electricity
- 5 Mt CO_2e from miscellaneous fuels
- 35Mt CO_2e from non-combustion / fixed process emissions

Customer Impacts

Emissions by Enbridge's Customer Type

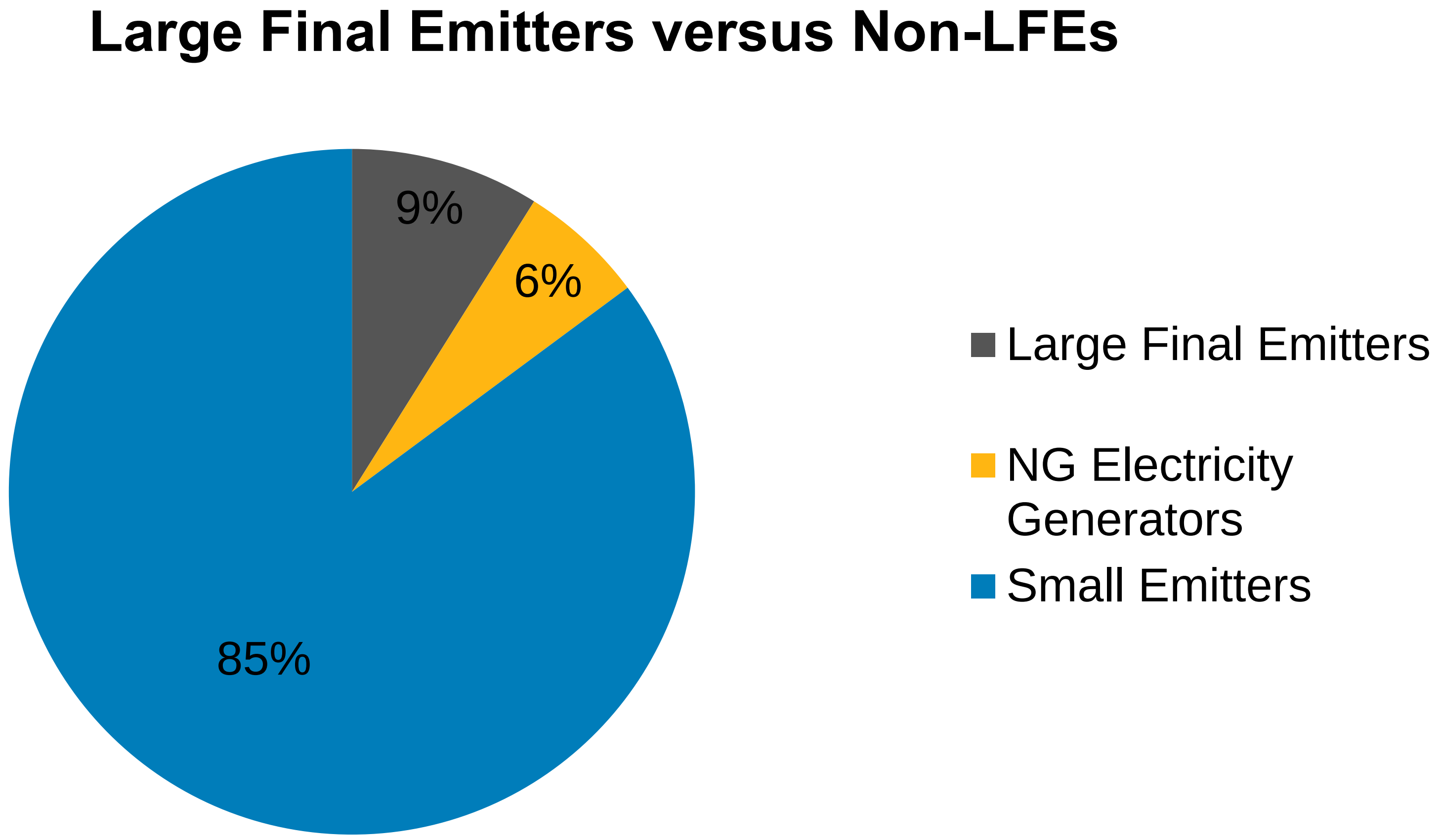
This graph shows where emissions are derived from our customer base due to combustion of NG

Customer Emission Profile



Emissions for Enbridge's Large Final Emitters vs. Non-LFEs

This graph shows the percentage of emissions from those under and over the 25,000 tCO2e threshold for LFE



Enbridge's Cap & Trade Information

Cap & Trade anticipated for January 1st 2017

- Under Ontario's Cap & Trade, EGD expected to purchase Greenhouse Gas (GHG) Allowances on behalf of customers under 25,000 t CO_2e
  - Large Final Emitters > 25,000 tCO_2e will purchase their own allowances
  - Customers between 10,000 and 25,000 tCO_2e required to report their emissions, but EGD will purchase allowances
  - Purchases of Allowances for natural gas power gen customers to be clarified.
- Calculation of allowances based on "custody transfer station" calculation, which would also include EGD's own emissions as unaccounted for gas (calculated as if gas is combusted)
- EGD anticipates recovering costs of purchasing allowances through a separate volumetric charge on customer bills to ensure Company & ratepayers are kept whole
- EGD anticipates maintaining a variance account for allowance purchases
- The volumetric charge likely to be updated quarterly to reflect changes in the price of emission allowances, minimizing volatility in the charge
- Anticipate filing of a GHG application with the OEB in fall 2016

Potential Bill Impact

Rate Class	Cap and Trade Unit Rate	Annual Volume ("Typical Customer")	Current Annual Bill	Annual Cap and Trade Charge	Annual Bill with Cap and Trade	Bill Impact
Rate 1	$0.03/m^3	2,400m^3	$819.63	$77.52	$897.15	9.5%
Rate 6	$0.03/m^3	22,606m^3	$5,982.40	$730.17	$6,712.57	12.2%
Rate 110	$0.03/m^3	9,976,120m3	$1,747,941	$322,229	$2,070,169	18.4%
Rate 115	$0.03/m^3	69,832,850m^3	$11,745,005	$2,255,601	$14,000,606	19.2%
Rate 135	$0.03/m^3	598,567m^3	$98,394	$19,334	$117,683	19.7%
Rate 145	$0.03/m^3	598,567m^3	$108,159	$19,334	$127,493	17.9%
Rate 170	$0.03/m^3	69,832,850m^3	$10,517,949	$2,255,601	$12,773,550	21.4%

Footnotes: Assumes ~$17 per tCO2e. Customer bills based on 2016 Q1 Total Annual Bill excluding Riders.
Rate 100 not included given small sample size (n=2)

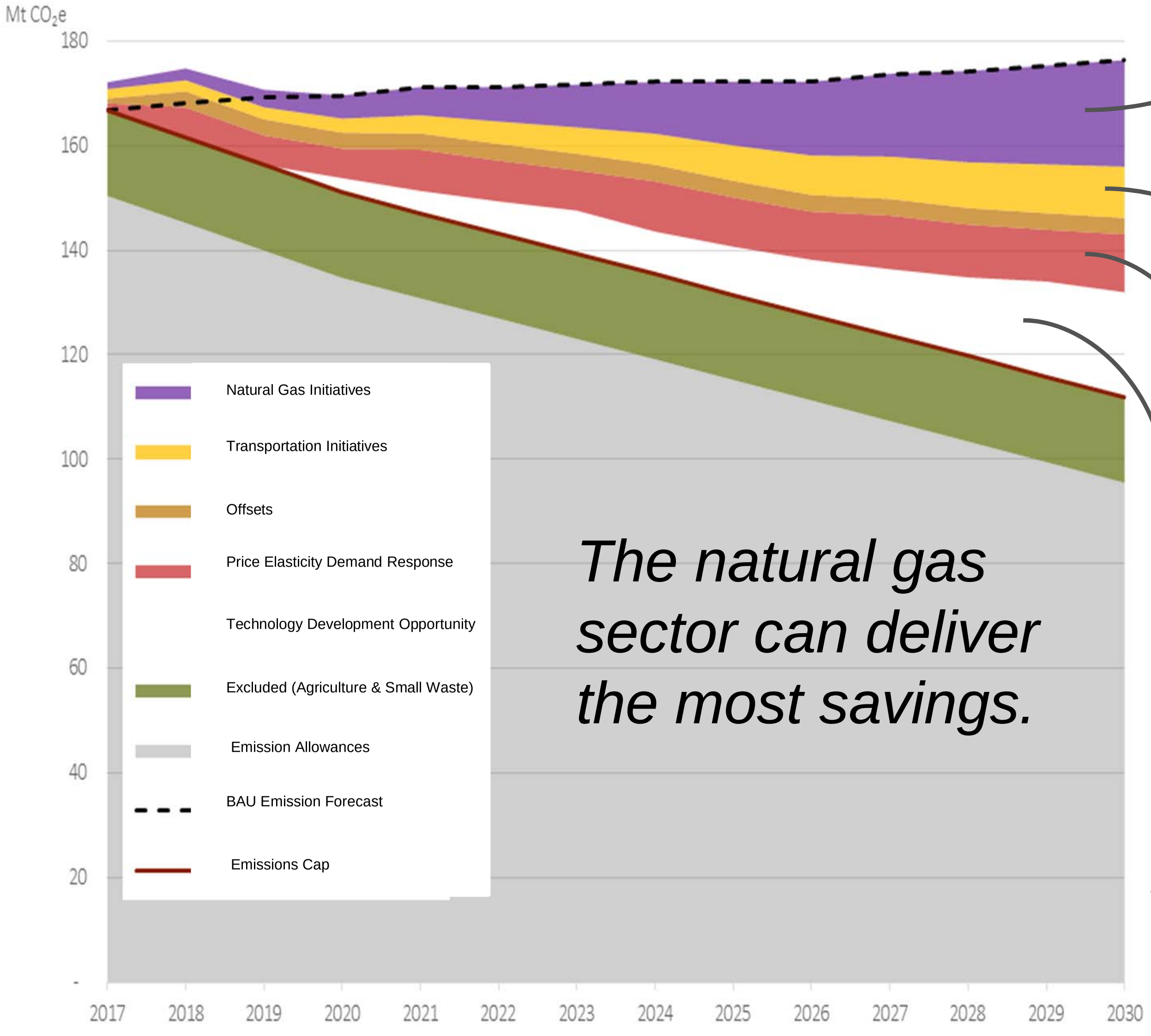
Initial Thoughts From ICF

Potential Implications for Enbridge and Customers

1. Energy Efficiency / Demand Side Management
   - Rate of energy efficiency needs increase dramatically with GHG reductions as the key objective
2. EGD will need to acquire $300M–$500M of allowance per year
   - Current settlement price of $17/t results requires roughly $350M of allowance (depending on inclusion of unbundled customers)
3. EGD will need to build allowance acquisition infrastructure
   - Accounting, finance, trading, analytics, offset/allowance sourcing, brokerage, MM&V, billing, customer relations, DSM, IT, etc.
4. EGD will need to re-imagine infrastructure and business model
   - Residential, commercial, institutional NG consumption could need to decline by ~40% by 2030
   - Even if protection afforded industrial emitters consumption will need to decline by 20 – 30%
   - No net increase in NG consumption for electricity generation
   - Electrification of transport and buildings

Natural Gas is Part of the Solution

Part Of The Solution - Ontario's Emission Reduction Forecast (2017- 2030)



The natural gas sector can deliver the most savings.

Natural Gas Initiatives offer 20 Mt CO2e

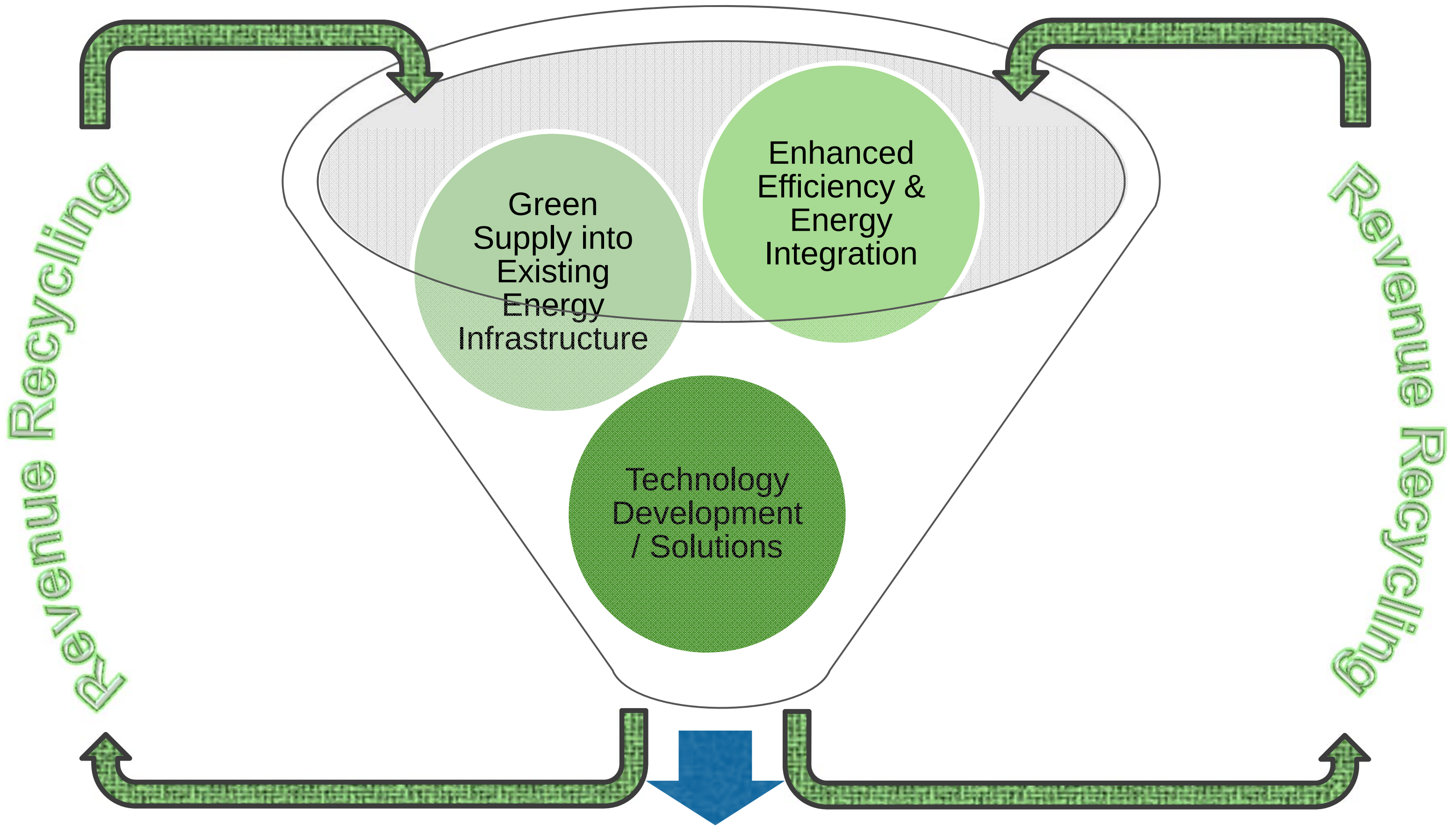
Electrify light-duty cars and biofuels offer 10 Mt CO2e

Price-related demand reductions 11 Mt CO2e

Technology Innovation can address 20 Mt CO2e

Source: ICF

Transforming the Natural Gas Energy Landscape



Revenue Recycling

Green Supply into Existing Energy Infrastructure

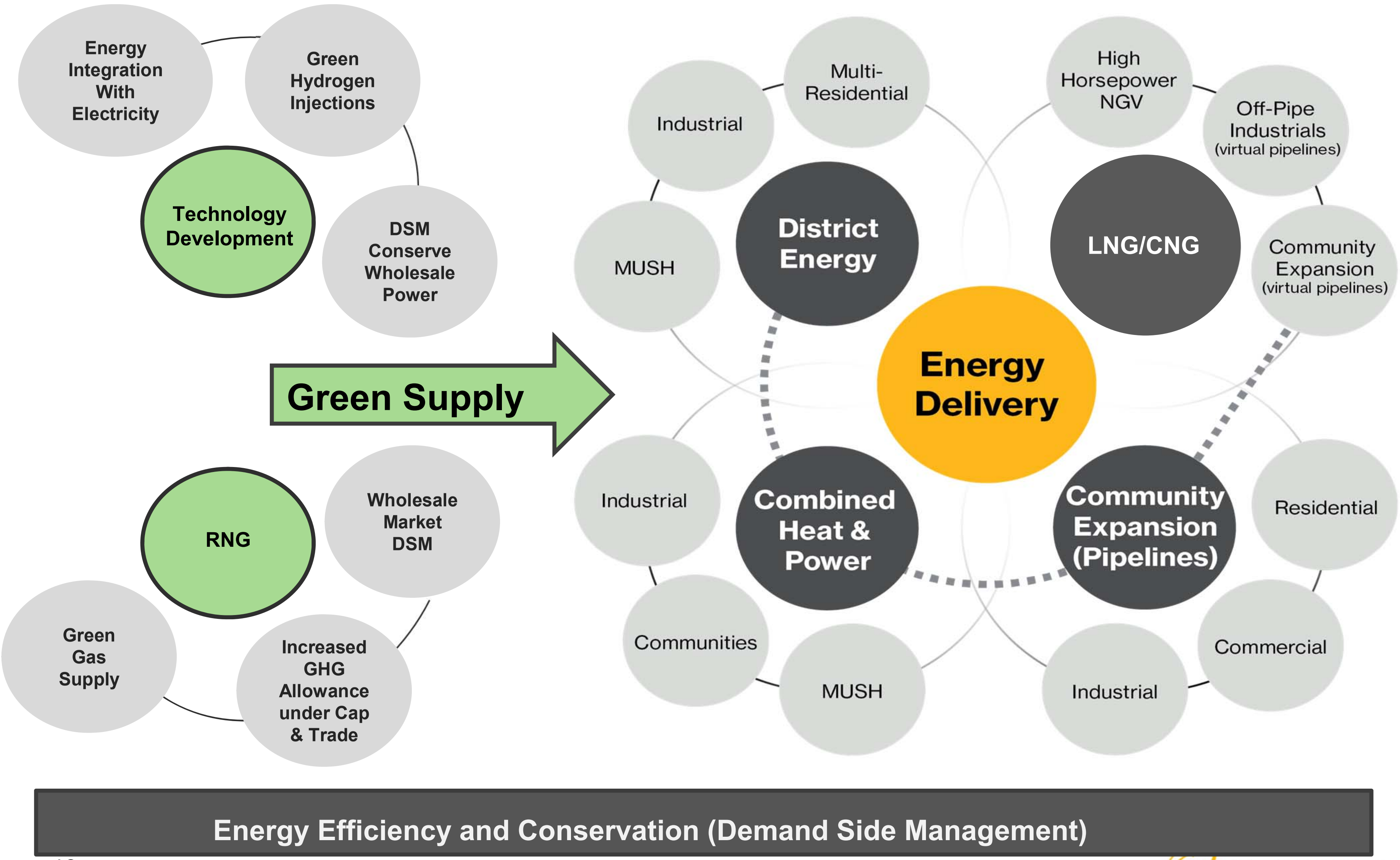
Enhanced Efficiency & Energy Integration

Technology Development / Solutions

Revenue Recycling

Optimized Infrastructure = Material Progress Towards Emission Goals While Maintaining Economic Competitiveness

Transforming the Landscape



Technology Development

Energy Integration With Electricity

Green Hydrogen Injections

DSM Conserve Wholesale Power

RNG

Wholesale Market DSM

Increased GHG Allowance under Cap & Trade

Green Gas Supply

Green Supply

Energy Delivery

District Energy

Multi-Residential

Industrial

MUSH

LNG/CNG

High Horsepower NGV

Off-Pipe Industrials (virtual pipelines)

Community Expansion (virtual pipelines)

Combined Heat & Power

Industrial

Communities

MUSH

Community Expansion (Pipelines)

Residential

Commercial

Industrial

Energy Efficiency and Conservation (Demand Side Management)

Summary

- In partnership with our customers, Enbridge believes we can help government and customers achieve more cost-effective GHG reductions going forward
- Pipelines can offer more cost-effective renewable energy supplies (green or renewable natural gas) - to date, this market remains untapped in Ontario
- Government policies should be tailored to our energy intensive and export-based economy, and must enable us to remain competitive while making meaningful reductions in GHG emissions
- Technology development and commercialization is critical to the creation of a lower carbon economy in Ontario; seek opportunities to support existing industry with new revenue sources (e.g. technology adoption for conversion of CO_2 in high-value commodities such as chemicals, fuels, etc.)
- Compliance options should focus on promoting both near-term reductions and the advancement of technology for larger future reductions over time
- Regulatory considerations need to be given on carbon allowance purchasing strategy and operational needs to implement cap and trade policy, including timelines and additional resources

Community Expansion

EB-2015-0237
Natural Gas Market Review, January 2016

Ian Macpherson

ENBRIDGE®

Natural Gas Expansion

- To review Enbridge’s progress in developing new expanded guidelines to support the OEB’s direction on expansion of natural gas distribution
  - Benefits of system expansion
  - Proposed policy changes
  - High level results
  - Ideas for achieving greater access

Benefits of Natural Gas Expansion

- Supports Government policies:
  - Extending natural gas service to currently unserved communities
  - Significant reductions in GHG and other emissions
  - Economic development in rural areas
  - Fuel displacement to low carbon fuel in transportation sector
- Numerous requests from municipalities for service

Political & Regulatory Environment

- Government Support for extension of natural gas service
  - $200 million in loan funding
  - $30 million in grant funding

- Ontario Energy Board (OEB)
  - February/15 OEB requested proposals to extend gas service that incorporates;
    - Guideline flexibility (e.g. ROE, depreciation period, recovery of capital contribution, etc.),
    - Predictability and cost certainty for consumers, and
    - Reasonable impacts on existing natural gas ratepayers

ENBRIDGE

Current Thinking on Moving Forward

- The Enbridge proposal will take an integrated approach that combines Guideline Flexibility, a Community Expansion Surcharge and Provincial Government financial support

Regulatory Flexibility

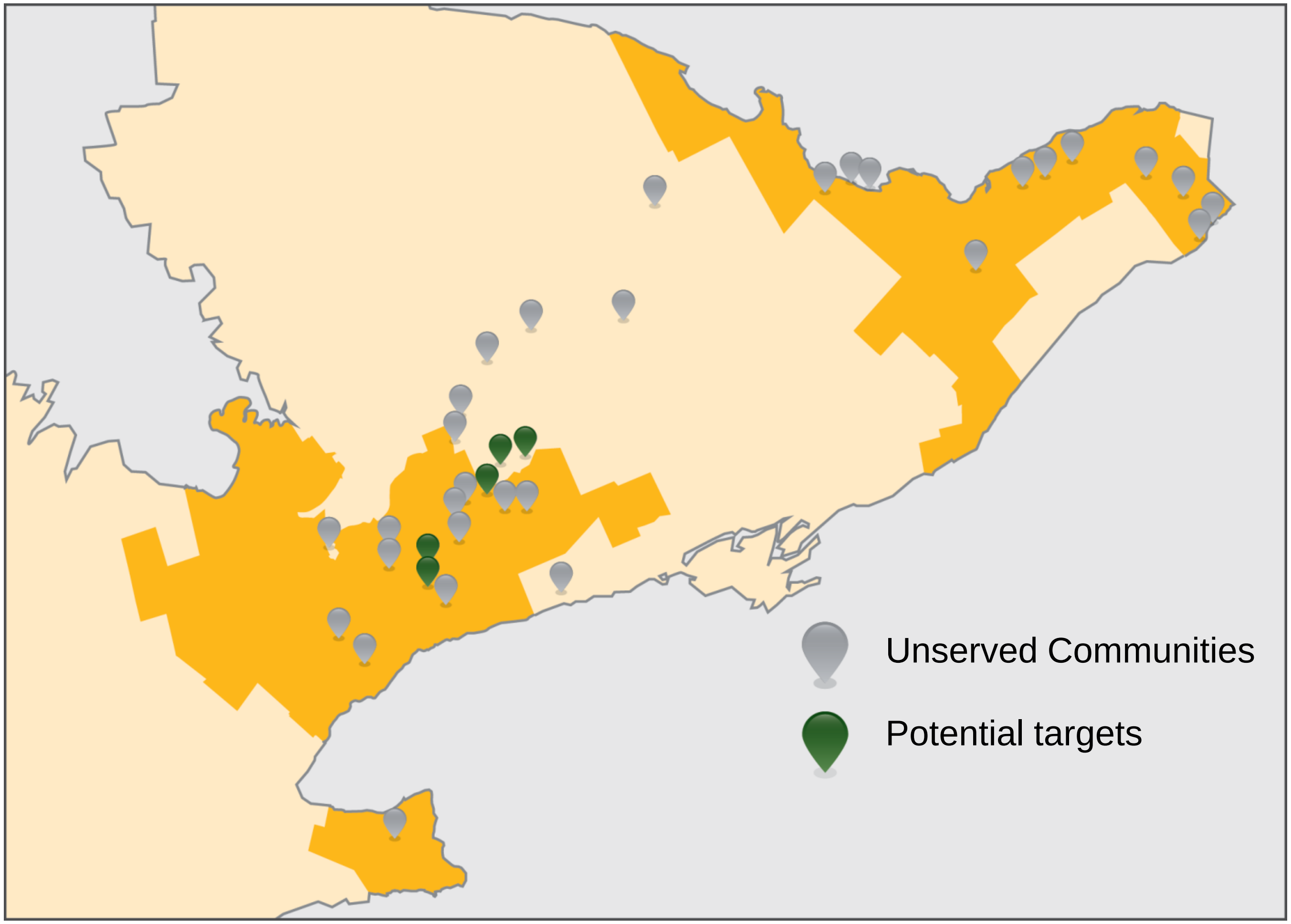
Community Expansion Surcharge

The Province's Grant and Loan Program

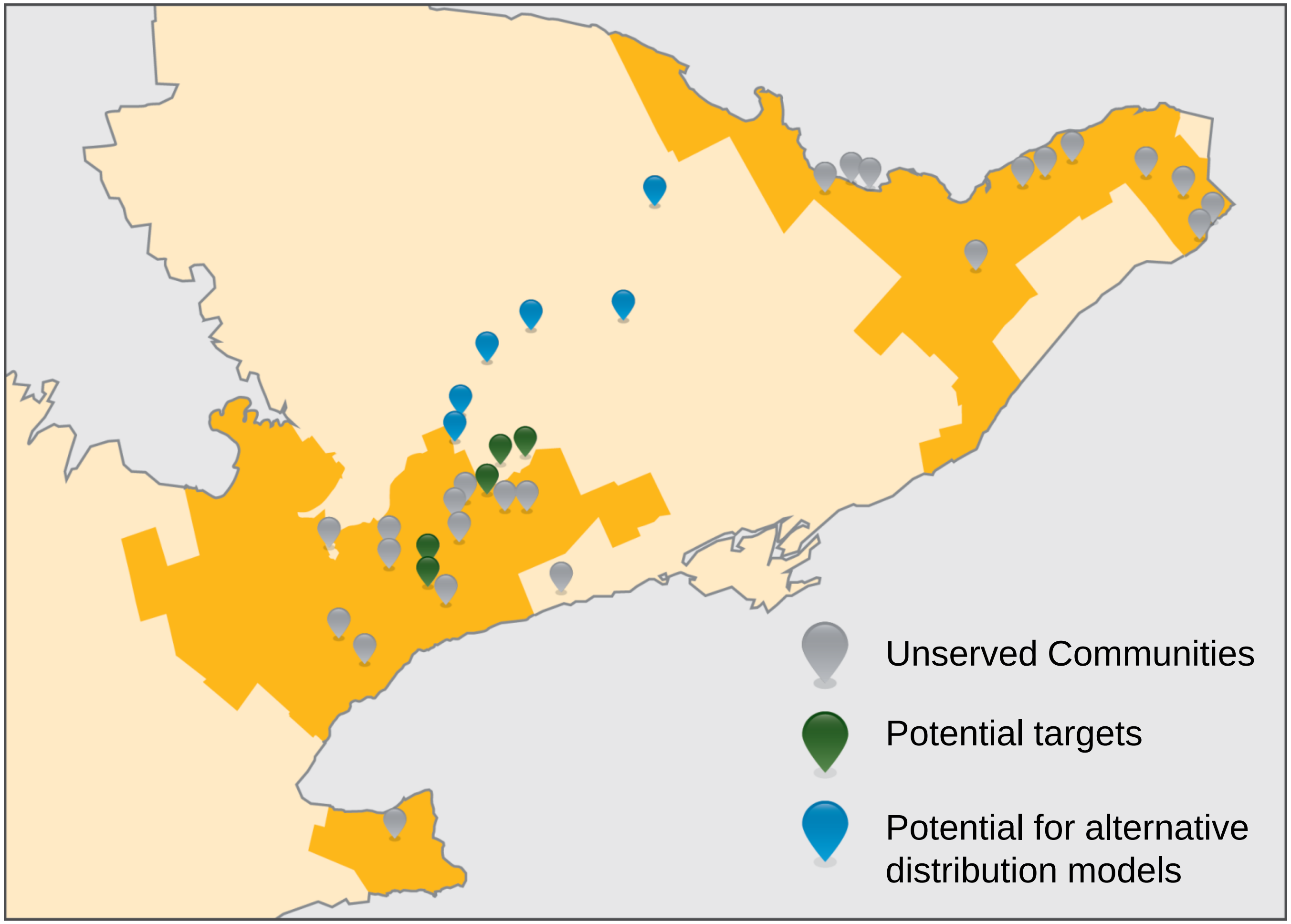
Proposed Policy Changes

Enbridge Gas Distribution	Union Gas
– Profitability index (“PI”) of 0.4 or greater	– Same
– Temporary expansion surcharge (“TES”) rate of $.23 /m3 (volumetric rate rider)	– Same
– TES applied 10 years, commencing from customer in-service date	– TES applied 10 years, commencing from the in-service date of the project
– Incremental tax equivalent (“ITE”) mechanism to collect municipal contributions	– Same
– Capital investment for community expansion not included in current IR, therefore EGD will seek a pass through to rates (‘Y-factor”) for these investments	– Regulatory model includes pass through mechanism

Evaluation of Unserved Communities



Evaluation of Unserved Communities



Alternative Distribution odels → Policy Implications

- LNG/CNG can innovate the distribution model and may be the least cost alternative, or interim methods for a smaller system to achieve scale
- Policy implications:
  - How would costs related to liquefaction/compression and logistics be treated?
    - Simply commodity costs that are part of the supply mix
    - Commodity surcharge to recover some (or all) of the incremental costs
  - Guideline to limit quantity of alternative gas supply within the gas supply mix

Next Steps

- Projects advanced based on policy/guideline clarity
- Additionally EGD may consider alternative distribution models (LNG/ CNG)

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #7

Reference: Page 13

An expert report by Chris Neme filed in EB-2015-0029 / EB-2015-0049 states as follows at pages 15 to 16:

> In 2007, the Ontario government adopted the following set of greenhouse gas emission reductions targets:
> - 6% reduction below 1990 levels by 2014;
> - 15% reduction below 1990 levels by 2020; and
> - 80% reduction below 1990 levels by 2050.
>
> In subsequent years, additional climate policies, including the “conservation first” policy, were adopted. More recently additional significant policy commitments have been made. For example, the province recently joined Quebec, British Columbia, California, and other sub-national jurisdictions in re-affirming a commitment to at least an 80% carbon emission reduction by 2050. In the Spring of 2015 it also established a new commitment to a 37% carbon emission reduction in the province by 2030 and committed to imposing a carbon “cap-and-trade” policy to meet those requirements.
>
> These policy decisions, including the most recent commitments made just several months ago, raise questions about whether the OEB’s 2014 gas DSM budget guidelines are outdated. Though the province was expected to meet its 2014 target, it is currently expected to fall about 30% (about 19 megatonnes) short of the emission reductions required to meet its 2020 target. Absent new policies or programs (i.e. with the current Climate Change Action Plan as the baseline), the province is currently projected to see its emissions gradually increase back to 1990 levels. Thus, the province will need much greater reductions – on the order of 67 megatonnes – to meet its new 2030 target. That translates to about 4.5 megatonnes reduction per year, which is on the order of 2.5% annually, for each of the next 15 years. Natural gas accounts for approximately 30% of all greenhouse gas emissions in the province, so some portion of the additional future emission reductions will almost certainly have to come from the natural gas sector.

(a) Does Enbridge agree that “some portion of the additional future emission reductions will almost certainly have to come from the natural gas sector”? If not, please explain why not.
(b) Does Enbridge agree that this will require overall declines in natural gas consumption in Ontario?
(c) Please indicate if Enbridge disagrees with any sentences in the above passage and why.
(d) Please file a copy of the above-referenced expert report.

RESPONSE

(a) Enbridge believes it has an important role to play in helping Ontario meet the objectives set out in Bill 172, Ontario’s Climate Change Mitigation and Low Carbon Economy Act still in front of the legislature at this time. Whether it’s through the delivery of energy conservation programs, renewable natural gas and hydrogen, natural gas (Liquified Natural Gas or LNG and Compressed Natural Gas or CNG) for truck, rail and marine transportation, combined heat and power solutions or natural gas technology development and innovation, Enbridge can help enable future emission reductions in Ontario.

(b) When a customer is able to convert to natural gas from other energy sources such as heating oil, propane, or diesel fuel for vehicles, natural gas provides a carbon reduction benefit. When natural gas is considered as the marginal fuel supporting electricity generation converting heating and water heating loads from electricity to natural gas will lead to reductions in the Province’s CO_2 emissions.

(c) It is not applicable or helpful in the context of this generic community expansion proceeding for the Company to remark on the validity of comments, or data analysis submitted into evidence by the Green Energy Coalition in proceeding EB-2015-0049 DSM Multi-year plan that was before the Board and for which a decision has been rendered.

(d) The intervenor evidence referred to in this Interrogatory is EB-2015-0049 Exh.L.GEC.1 (GEC_INTRV_EVIDENCE1_CORRECTED_20150813.pdf), a copy of which can be found on the Ontario Energy Board’s web site: http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/rec/490715/view/

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #8

Reference: Page 6-8

An expert report by Paul Chernick filed in EB-2015-0029 / EB-2015-0049 states as follows at pages 22 to 23:

> The Ontario goals include reduction of jurisdictional emissions by about 26% from 2013 to 2030, or about five times the reductions expected from the [U.S.] Clean Power Plan. Ontario's goals are more aggressive than those of the Clean Power Plan. That difference may increase the marginal cost of reaching those goals compared to that of the Clean Power Plan. While the Clean Power Plan relies heavily on renewables, efficiency, and gas backing out coal-fired generation, Ontario has already eliminated coal on its electric system. Additional reductions in Ontario carbon emissions will require such further measures as the following:
>
> - backing down gas generation (which requires twice the load reduction per tonne avoided, compared to backing down coal),
> - reducing usage of natural gas in buildings,…

(a) Does Enbridge agree with the above? If not, please explain.
(b) Does Enbridge agree that this will require overall declines in natural gas consumption in Ontario?
(c) Please indicate if Enbridge disagrees with any sentences in the above passage and why.
(d) Please file a copy of the above-referenced expert report.

RESPONSE

(a) It is not applicable or helpful in the context of this generic community expansion proceeding for the Company to remark on the validity of comments, or data analysis submitted into evidence by the Green Energy Coalition in proceeding EB-2015-0049 DSM Multi-year plan that was before the Board and for which a decision has been rendered.

(b) Enbridge is working with the Province to make certain that natural gas and the infrastructure that delivers it will continue to be a significant part of a low carbon future, and will include conservation initiatives and among other priorities, renewable natural gas. The omitted context of Mr. Chernick's evidence as referenced above, in this Interrogatory is underlined below:

"Additional reductions in Ontario carbon emissions will require such further measures as the following:

- backing down gas generation (which requires twice the load reduction per tonne avoided, compared to backing down coal),
- reducing usage of natural gas in buildings,
- reducing usage of oil in buildings,
- reducing industrial fuel use."[1]

When a customer is able to convert to natural gas from other energy sources such as heating oil, propane, or diesel fuel for vehicles, natural gas provides a carbon reduction benefit. When natural gas is considered as the marginal fuel supporting electricity generation converting heating and water heating loads from electricity to natural gas will lead to reductions in the Province's CO_2 emissions.

(c) It is not applicable or helpful in the context of this generic community expansion proceeding for the Company to remark on the validity of comments, or data analysis submitted into evidence by the Green Energy Coalition in proceeding EB-2015-0049 DSM Multi-year plan that was before the Board and for which a decision has been rendered.

(d) The intervenor evidence referred to in this Interrogatory is EB-2015-0049, Exh.L.GEC.2 (GEC_INTRV_EVIDENCE2_CORRECTED_20150813), a copy of which can be found on the Ontario Energy Board's website: http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/rec/490657/view/

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[1] EB-2015-0049 Exh.L.GEC.2 Page 23

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #9

Reference: Page 6-8

Please provide and file:

(a) Enbridge's most recent DSM Annual Report

(b) A copy of the most recent Ontario Climate Change Update published by the Minister of the Environment and Climate Change;

(c) A copy of the most recent Climate Change Report published by the Environmental Commissioner of Ontario; and

(d) A copy of Ontario's Climate Change Strategy.

RESPONSE

(a) The most recent DSM Annual Report (attachment 1) was filed with the Ontario Energy Board on October 30th, 2015 as part of the Company's 2014 DSM Clearance of Variance Accounts application (EB-2015-0267). The application is currently pending Board approval.

(b) Attachment 2 is a copy of the most recent Ontario Climate Change Update published by the Minister of the Environment and Climate Change;

(c) Attachment 3 is a copy of the most recent Climate Change Report published by the Environmental Commissioner of Ontario; and

(d) Attachment 4 is a copy of Ontario's Climate Change Strategy

2014

DEMAND SIDE MANAGEMENT ANNUAL REPORT

October 19, 2015

ENBRIDGE

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List of Tables

1. Executive Summary

In response to EB-2008-0346, the Demand Side Management Guidelines for Natural Gas Utilities (the Guidelines), published June 30, 2011 by the Ontario Energy Board, in November 2011, Enbridge Gas Distribution Inc. (Enbridge, EGD or the Company) submitted its plan outlining proposed DSM activities for the upcoming three years (EB-2011-0295). Subsequently, following an extensive consultation process in the summer of 2012, the 2013-2014 Update to the Enbridge 2012-2014 Demand Side Management (DSM) Plan (EB-2012-0394) was filed on February 28th, 2013 and reflected a comprehensive agreement reached with intervenor working groups in respect of program updates, budgets, metrics and targets.

The 2013-2014 Update to the Enbridge 2012-2014 DSM Plan continued with aggressive targets to maximize cost-effective natural gas savings. The 2012-2014 Enbridge portfolio of DSM offers was designed to allow all customer classes access to cost-effective energy efficiency offers and to optimize program results. The 2012-2014 DSM Plan uses a scorecard approach for measurement.

The Company is pleased to report that in 2014, the portfolio generated total annual natural gas savings of 43,540,237 cubic meters (m^3) or 719,842,637 lifetime (cumulative) cubic meters (CCM). These savings are a direct result of efforts in delivering the Company's Resource Acquisition and Low Income programs. Natural gas savings attributable to Market Transformation program delivery in 2014 are not captured in these totals as they are not measured on the basis of cubic meters (m^3) or lifetime (cumulative) cubic meters (CCM) saved.

In relation to its core business, as a gas distribution company, the total annual throughput of natural gas to the Company's customers in 2014 was approximately 11 billion cubic meters.[1]

Even though the current framework is based on CCM, total TRC net benefits continue to be an important indicator of the considerable positive impact that Enbridge achieves in respect of its DSM efforts.

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[1] This estimation is based on the total throughput for rate classes that contain 2014 DSM program participants (Rates 1, 6, 110, 115, 135, 145 and 170).

Further, as per the Guidelines, the Board calls for application of the TRC test to screen for cost-effectiveness at the program level. In 2014, the portfolio again demonstrated cost-effective program delivery based on positive TRC screening. The TRC for the Resource Acquisition program was 2.84, while the TRC for the Low Income program was 1.33 – both well above their cost-effectiveness screening thresholds.

DSM natural gas savings results for 2014 were achieved with spending of $32.51 million, 1% or $352,502 over the OEB approved budget.

Table 1. 2014 DSM Overall Results

Program	Annual Net Gas Savings (m3)	Cumulative Net Gas Savings (m3)	Budget	Spending ($)	TRC Ratio
Resource Acquistion					
Residential	5,914,881	89,690,562	$1,836,456	$8,605,657	1.96
Commercial	22,405,020	389,415,717	$8,090,102	$5,760,122	3.25
Industrial	12,474,745	185,261,718	$4,234,020	$2,214,856	3.87
Overheads			$4,638,711	$4,636,555	
Total Resource Acquisition	**40,794,646**	**664,367,997**	**$18,799,289**	**$21,217,190**	**2.84**
Low Income					
Part 9 (Single Family)	1,036,919	25,673,482	$4,564,500	$4,494,530	1.03
Part 3 (Multi Family)	1,708,673	29,801,158	$2,165,000	$1,930,180	2.03
Overheads			$507,831	$507,595	
Total Low Income	**2,745,592**	**55,474,640**	**$7,237,331**	**$6,932,305**	**1.33**
Market Transformation					
SBD Residential	n/a	n/a	$2,445,000	$1,334,035	n/a
SBD Commercial	n/a	n/a	$950,000	$739,435	n/a
Home Labelling	n/a	n/a	$1,400,000	$979,337	n/a
Overheads			$1,327,144	$1,308,965	
Total Market Transformation	**n/a**	**n/a**	**$6,122,144**	**$4,361,771**	**n/a**
Grand Total	**43,540,237**	**719,842,637**	**$32,158,764**	**$32,511,266**	

The Demand Side Management Incentive (DSMI) has been determined based on Enbridge's 2014 DSM performance results in relation to the weighted scoring approach. The 2014 DSM Incentive is calculated at $7,647,242. The maximum shareholder incentive available for the 2014 program year is $10.872 million.

Table 2. 2014 DSM Summary

2014 DSM Results Summary	
Net CCM Savings	**719,842,637 m^3**
DSMIDA amount recoverable from Ratepayers	**$7,647,242**
LRAMVA amount (to be refunded to Ratepayers)*	**($65,339)**
DSMVA amount recoverable from Ratepayers	**$352,502**

*The LRAMVA is negative, indicating that it is money owed by Enbridge to ratepayers

The Company is gratified with its accomplishments overall and was able to demonstrate solid results relative to targets for many of its customer offers.

Overall the Resource Acquisition program contributed 664 million CCM in natural gas savings. Resource Acquisition offers targeted to the Commercial and Industrial sectors did not reach savings targets established for 2014, with gas savings of 389 million and 185 million CCM for the Commercial and Industrial sectors respectively. However, the Residential home retrofit offer which has seen excellent growth since its inception in mid-2012 contributed close to 90 million CCM and reached 5,213 households.

The Low Income program delivered 55 million CCM in 2014. Results relative to target were mixed with Single Family (Part 9) offers performing well relative to targets, and Multi-Residential (Part 3) offers not reaching the 2014 target established for that segment of the program.

Market Transformation offers continued to demonstrate strong results in 2014, with results at, or exceeding weighted scorecard upper targets for all three of the Savings by Design Residential, Savings by Design Commercial and Home Labelling offers.

2. Introduction

Following a directive from the Ontario Energy Board, (EBO 169-III) in 1995, Enbridge began to offer Demand Side Management programs to help customers reduce their demand for natural gas. In 1999, Enbridge was granted Board approval to receive a financial incentive for DSM activities by way of the Shared Savings Mechanism (SSM). The continuing need for DSM efforts in the province of Ontario was outlined by the Ontario Energy Board in the Demand Side Management Guidelines for Natural Gas Utilities (the Guidelines), published June 30, 2011 (in which the Demand Side Management Incentive replaced the SSM). These Guidelines apply to the 2012-2014 Multi-Year Plan period.

"Natural gas demand side management ("DSM") is the modification of consumer demand for natural gas through various methods such as financial incentives, education and other programs. While the focus of DSM is natural gas savings and the reduction in greenhouse gases emissions, it may also result in the saving of a number of other resources such as electricity, water, propane, and heating fuel oil."[2]

The DSM Guidelines sets out three primary objectives to help guide the utilities' DSM portfolios:

- maximize cost-effective natural gas savings;
- prevent lost opportunities;
- and pursue deep savings.

The framework also outlines budget limits and affords utility performance incentives in relation to DSM activities.

Furthermore, the Guidelines also outline a Lost Revenue Adjustment Mechanism (LRAM) and Demand Side Management Variance Account (DSMVA). The LRAM "is a mechanism to adjust for margins the utility loses if its DSM Program is more (or less) successful in the period after rates are set than was planned in setting the rates."[3] The DSMVA allows the Company to exceed the DSM budget in a given year, provided that the

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[2] *Demand Side Management Guidelines for Natural Gas Utilities* (EB-2008-0346), OEB, June 30, 2011, page 1.

[3] EBRO 495, Decision, Page 100.

Company meets the Board approved target. It also requires the repayment of any unspent budget amounts to ratepayers.

The Guidelines provide an overall framework for program design and propose a scorecard approach to measuring DSM programs, including metrics appropriate to different customer offers. The principal measurement metric for evaluating programs is cubic meters (m^3) of cumulative natural gas savings. Cumulative cubic meters (CCM) is defined as the natural gas savings over the life of an installed DSM measure.[4] Performance may however be assessed by other metrics such as number of participants.

As stated in the Guidelines, a cost-efficiency measure, such as the "$ spent per m^3 of cumulative natural gas saved", provides greater transparency to interested participants and the Board. In response, $/CCM savings calculations are included in this report. The Total Resource Cost (TRC) determination is also an important and recognized measure of cost-effectiveness for DSM purposes, and continues to be utilized for program screening, as documented in this report.

The Company's 2012-2014 DSM Plan outlines a three year strategy for the Company's DSM programs, designed to respond to customer needs and changing market conditions. The Plan encompasses Resource Acquisition, Low Income and Market Transformation programs, which reflect extensive consultation and negotiation between Enbridge and intervenors.

The Company's DSM programs are funded through distribution rates and are designed to produce a variety of measured and unmeasured societal benefits, including reduced consumer bills, economic stimulus, environmental benefits and benefits specific to low income consumers.
The 2012-2014 DSM Plan (EB-2011-0295) was approved by the Board on February 9th, 2012. Later, following further negotiations with the DSM Consultative in 2012, the parties reached a Settlement Agreement to establish budget allocations, metrics and targets for 2013 and 2014. The 2013-2014 Update to the Enbridge 2012-2014 DSM Plan (EB-2012-0394) was filed on March 4th, 2013. The Board provided a Decision on the Update on July 4th, 2013:

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[4] Ibid, page 28.

> "The Board approves the Settlement Agreement and its rate consequences on an interim basis. In approving the Settlement Agreement, the Board expects Enbridge to proceed with the corresponding DSM activities in 2013 and 2014. The intent of this Board decision is to provide the opportunity for the 2014 DSM budget to be further reviewed."[5]

On March 13, 2014, the Board provided a further Decision on the Update:

> "The Board agrees with Enbridge that given the findings of the Board in the GTA proceeding, the Settlement Agreement containing the 2013 and 2014 DSM budgets is approved and no additional submissions are required."[6]

Report Overview

The 2014 Annual Report on Enbridge's DSM energy efficiency programs provides an overview of the results achieved over the past program year in terms of scorecard performance. The report also provides a comparison of actual to target results, and incorporates any necessary adjustments to savings outcomes.

The report provides information in support of the Company's 2014 Demand Side Management Incentive Deferral Account (DSMIDA), DSMVA and LRAM claims. Once drafted, the report is reviewed as part of a comprehensive third-party independent audit.

Approach to Natural Gas Savings Calculations

The DSM portfolio encompasses the Resource Acquisition, Low Income and Market Transformation programs which include offers directed toward residential, commercial and industrial customers. The Resource Acquisition and Low Income programs include three major categories of offers – prescriptive, quasi-prescriptive and custom.

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[5] EB-2012-0394, OEB - Decision and Order on Settlement Agreement, July 4, 2013, page 3.

[6] EB-2012-0394, OEB - Decision and Order on Settlement Agreement, March 13, 2014, page 4.

Prescriptive and quasi-prescriptive results are calculated based on the number of units installed along with the deemed savings and related assumptions for specific DSM measures, as filed and submitted to the Board in the Company's 2012-2014 DSM Plan (EB-2011-0295). On March 27, 2015, Enbridge Gas Distribution Inc. and Union Gas Ltd. submitted a joint application that sought approval from the Ontario Energy Board for new and updated Demand Side Management measures. The Board assigned this matter file number EB-2014-0354. With endorsement of the Technical Evaluation Committee (TEC), this most recent joint submission to the Board provided an update to the assumptions for a selected number of measures.

In the case of custom projects, natural gas savings are based on detailed measure/technology related calculations for individual projects undertaken at sites where energy efficiency improvements have been made as a result of Enbridge involvement. Where applicable, Enbridge utilizes its E-Tools calculation software to establish savings estimates.

Energy savings for Community Energy Conservation (CEC), the Residential Resource Acquisition offer (formerly Community Energy Retrofit) and Home Winterproofing (formerly the Low Income Weatherization offer) are determined utilizing Natural Resources Canada (NRCan) accredited software,HOT2000, and the U.S. Department of Energy's REM/Rate software.

The Market Transformation program is assessed in terms of metrics specific to each offer.

3. 2014 DSM Portfolio Scorecard Summary

The 2014 DSM program scorecard results are presented in Table 3.

Table 3. 2014 DSM Program Scorecard Summary

	Component	Metric	Targets				2014 Actual Result
			Weight	Lower	Middle	Upper	
Resource Acquisition	**Volumes**	*Cumulative Savings (million m^3)*	***92%***	744.05	992.06	1240.08	**664.37**
	Residential Deep Savings	*Number of Houses* [1]	***8%***	560	747	934	**5,213**
Low Income	**Single Family (Part 9)**	*Cumulative Savings (million m^3)*	***50%***	17.70	23.60	29.50	**25.67**
	Multi-residential (Part 3)	*Cumulative Savings (million m^3)*	***45%***	48.15	64.20	80.25	**29.80**
	Multi-residential (Part 3) LIBPM [2]	*Percent of Part 3 Participants Enrolled* [3]	***5%***	30%	40%	50%	**74%**
Market Transformation	**Residential Savings by Design**	*Completed Units*	***40%***	750	1,000	1,250	**1,059**
		Previously Non-Participating Builders Enrolled [4]	***60%***	12	16	20	**23**
	Commercial Savings by Design	*New Developments Enrolled*	***100%***	8	12	19	**19**
	Home Labelling	*Number of Committed Realtors* [5, 6]	***70%***	N/A	5,000 [5]	10,000 [5]	**40,040**
		Ratings performed	***30%***	750	1,500	2,250	**662**

[1] Number of houses with at least two major measures and where average annual gas savings across all participants is at least 25% of combined baseline space heating and water heating usage.

[2] LIBPM - Low Income Building Performance Management is the Low Income offer complement to the Commercial Run It Right (RIR) offer.

[3] Low Income Building Performance Management (LIBPM) percentage of Part 3 buildings enrolled in the current year program = (x+y)/(x+y+z):

> x = # of new LIBPM buildings in the current year that have participated in another aspect of the Low Income program in a previous year of 2012-2014 plan; y = # of new LIBPM buildings participating in current year that have not previously participated in the Low Income program; z = # of buildings in the current year that have implemented custom projects other than LIBPM.

[4] Eligible builders based on a minimum of 50 homes built in the prior year.

[5] Commitments to make provision for a data field to show home energy ratings for all homes listed by participating realtors (industry-wide commitment to include such a field on MLS or similar listing service and/or realtors' commitment to do so with all the homes they list on their own websites, handouts and other consumer material).

[6] Commitment from realtors collectively responsible for more than 5,000 (middle target) or 10,000 (upper target) listings/year.

As outlined in the Update to the 2012 to 2014 Demand Side Management Plan (EB-2012-0394), program scorecard results are weighted (see Table 3 above). These weighted scorecards are the basis for the calculation of the Demand Side Management Incentive. DSMI amounts for the 2014 program year are outlined in Section 8 of this report.

As summarized in Table 4, in terms of CCM savings, the 2014 DSM portfolio did not reach the overall CCM savings target. Actual results totalled 719,842,637 cumulative m^3 for all offers that include CCM as a metric.

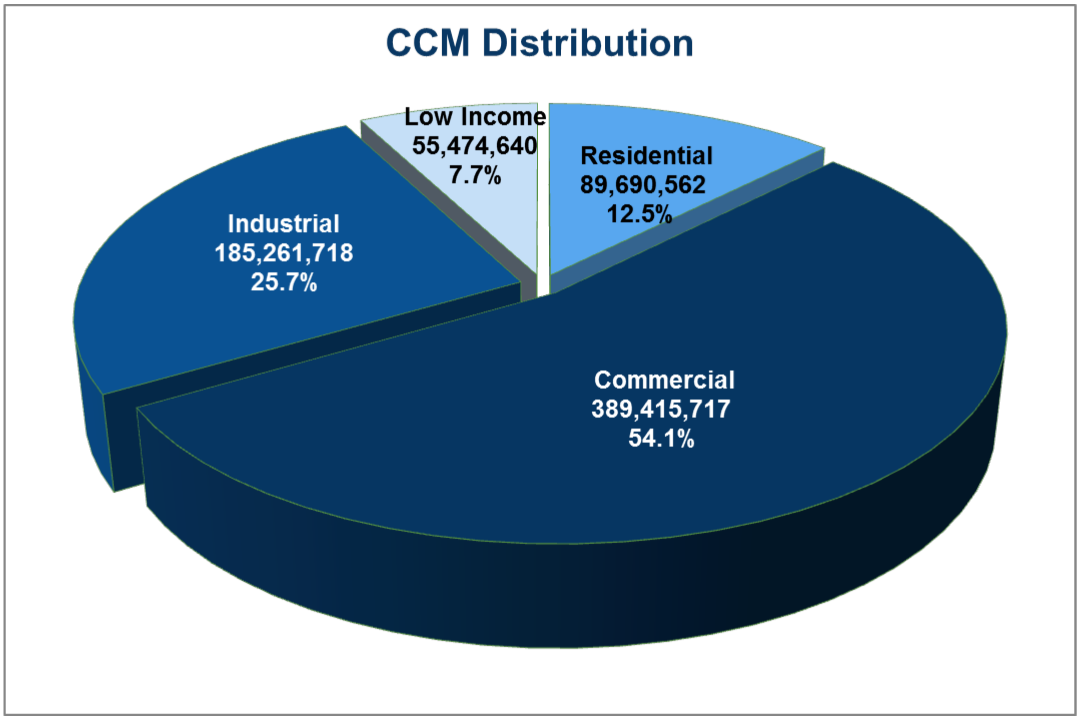
Table 4. 2014 CCM Savings Results – Target vs. Actual

Program/Sector	CCM Target (100%)	CCM Actual Results
Residential	*11,735,669*	*89,690,562*
Commercial	*633,804,658*	*389,415,717*
Industrial	*346,554,000*	*185,261,718*
Resource Aquisition	**992,094,327**	**664,367,997**
Low Income	**87,853,420**	**55,474,640**
Total	**1,079,947,747**	**719,842,637**

Results were below target in both the Commercial and Industrial sectors as well as in the Low Income sector. Conversely, results were significantly above the target originally put forth for the Residential sector due to the growing success of the Community Energy Conservation (CEC) offer. An overview of 2014 DSM spending vs. budget is provided in Section 5 of this report.

As illustrated in Table 5, in 2014 the Commercial sector was the largest overall contributor to CCM savings, accounting for 381 million CCM or 54.1% of the total CCM results. Industrial sector offers contributed 25.7% of the total CCM savings followed by the Residential sector and the Low Income program responsible for 12.5% and 7.7% of CCM, respectively.

Table 5. 2014 Distributed CCM Savings by Sector



In 2014, Enbridge delivered three Market Transformation offers, all of which performed well in relation to performance targets. As outlined previously in Table 3, on a weighted scorecard basis, all three offers approached or exceeded upper targets. Results for the Market Transformation program offers are reviewed in Section 7 of this report.

4. Annual and Cumulative 2014 Natural Gas Savings

Table 6. 2014 Annual and Cumulative Natural Gas Savings

	Program	Gross Annual Gas Savings (m^3)	Net Annual Gas Savings (m^3)	Gross CCM (m^3)	Net CCM (m^3)
Resource Acquisition	**Residential**				
	Community Energy Conservation	6,958,684	5,914,881	105,518,309	89,690,562
	Total Residential	**6,958,684**	**5,914,881**	**105,518,309**	**89,690,562**
	Commercial				
	Commercial Custom	19,708,793	16,371,408	373,800,192	307,222,026
	Commercial Prescriptive	6,573,118	5,408,523	97,136,791	79,068,251
	Run It Right	625,088	625,088	3,125,440	3,125,440
	Total Commercial	**26,906,999**	**22,405,020**	**474,062,423**	**389,415,717**
	Industrial				
	Industrial Custom	23,440,752	12,001,904	349,395,582	177,663,455
	Industrial Prescriptive	542,215	472,840	8,887,940	7,598,262
	Total Industrial	**23,982,967**	**12,474,745**	**358,283,522**	**185,261,718**
	Low Income				
	Single Family (Part 9)	1,039,428	1,036,919	25,698,580	25,673,482
	Multi-Residential (Part 3)	1,734,457	1,708,673	30,058,993	29,801,158
	Total Low Income	**2,773,885**	**2,745,592**	**55,757,573**	**55,474,640**
	Grand Total	**60,622,535**	**43,540,237**	**993,621,826**	**719,842,637**

Table 6 details the annual gas savings and cumulative lifetime natural gas savings results (in cubic meters) for each of the program components that have CCM as a performance metric. Savings results are summarized for both gross and net savings (net of applicable adjustment factors).

5. 2014 Budget and Program Spending

Budget

As stated in EB-2012-0394, "In 2012, following consultation with stakeholders, the Base Budget of $28.1 million was increased by 10% or $2.81 million (which was the allowable increase as indicated in the DSM Guidelines, Section 8.3, page 26), resulting in a total budget of $30.91 million and including a total Low Income budget of $7.025 million. Following consultation with stakeholders regarding the budget for 2013 and 2014, it was agreed that the 2013-2014 Update would propose to continue with the allowable increase to the Low Income Budget for 2013 and 2014 and a 2% annual increase based on the 2011 GDP-IPI."[7]

"For 2013, this base budget has been escalated by the GDP-IPI for 2011, which is 2%. The resulting budget for 2013 is $31.588 million. Escalating the 2013 budget by the 2011 GDP-IPI of 2%, the aggregate budget for 2014 is $32.158 million."[8]

Table 7 provides the breakdown of the 2014 budget for each of the Resource Acquisition, Low Income and Market Transformation programs as approved in the Update to the 2012 to 2014 DSM Plan (EB-2012-0394).

Table 7. 2014 DSM Plan Budget

Program	**Program Budget**	**Overheads**	**Total Budget**	**% of Total**
Resource Acquisition	$14,160,578	$4,638,711	$18,799,289	58%
Low Income	$6,729,500	$507,831	$7,237,331	23%
Market Transformation	$4,795,000	$1,327,144	$6,122,144	19%
Total	**$25,685,078**	**$6,473,686**	**$32,158,764**	**100%**

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[7] *Update to the 2012 to 2014 Demand Side Management ("DSM") Plan* (EB-2012-0394), Exhibit B, Tab 1, Schedule 2, Page 1 of 13.

[8] Ibid, Exhibit B, Tab 2, Schedule 9, Page 8 of 28

2014 Spending

Table 8 outlines actual spending vs. budget for each program.

Table 8. 2014 OEB Approved Budget vs. Spending

Program	OEB Approved Budget	Actual	Variance	%
Resource Acquisition	**$18,799,289**	**$21,217,190**	**$2,417,901**	**13%**
Residential	*$1,836,456*	*$8,605,657*	*$6,769,201*	
Commercial	*$8,090,102*	*$5,760,122*	*-$2,329,980*	
Industrial	*$4,234,020*	*$2,214,856*	*-$2,019,164*	
Overheads	*$4,638,711*	*$4,636,555*	*-$2,156*	
Low Income	**$7,237,331**	**$6,932,305**	**-$305,026**	**-4%**
Part 9 Residential	*$4,564,500*	*$4,494,530*	*-$69,970*	
Part 3 Multi residential	*$2,165,000*	*$1,930,180*	*-$234,820*	
Overheads	*$507,831*	*$507,595*	*-$236*	
Market Transformation	**$6,122,144**	**$4,361,771**	**-$1,760,373**	**-29%**
Residential SBD	*$2,445,000*	*$1,334,035*	*-$1,110,965*	
Commercial SBD	*$950,000*	*$739,435*	*-$210,565*	
Home Labeling	*$1,400,000*	*$979,337*	*-$420,663*	
Overheads	*$1,327,144*	*$1,308,965*	*-$18,179*	
Program Cost Sub Total	**$25,685,078**	**$26,058,152**	**$373,074**	
Overhead Sub Total	**$6,473,686**	**$6,453,114**	**-$20,572**	
Total	**$32,158,764**	**$32,511,266**	**$352,502**	**1%**

Total spending in relation to EGD's DSM programming in 2014 was $32,511,266, resulting in a variance of $352,502 or 1% over budget for the year.

Within the Resource Acquisition program, spending in the Commercial and Industrial sectors was lower than 2014 plan budget amounts. As the year unfolded, forecasts of program results clearly indicated that established budgets for both of these sectors could not be fully utilized. Available program dollars were used within the RA program for the Residential Community Energy Conservation offer to support the growing energy savings opportunities arising from the successful delivery and momentum of this offer. These funds supported gas savings results well above targets for the Residential sector and allowed the Company to expand its ability to offer energy efficiency opportunities to its largest customer segment.

As per the Guidelines, "the design of natural gas DSM programs and the overall portfolio should be guided by the following three objectives: maximization of cost effective natural gas savings; prevention of lost opportunities; and pursuit of deep energy savings."[9] The Guidelines further explain this "guidance is meant to ensure that adequate flexibility in DSM program and portfolio design is maintained, while recognizing that the natural gas utilities are ultimately responsible and accountable for their actions. This flexibility should ensure that the natural gas utilities can continuously react to and adapt to current and anticipated market developments."[10]

Further, EB-2008-0346 states that "the utilities should inform the Board, as well as their stakeholders, in the event that cumulative fund transfers among Board-approved DSM programs exceed 30% of the approved annual DSM budget for an individual natural gas DSM program."[11] Though the Company did transfer funds from the Market Transformation program to the Resource Acquisition program, the Company confirms it did not exceed 30% of the approved budget for the Market Transformation program.

In addition, as per the Guidelines, a DSMVA "over-spend" provision allows Enbridge to spend and recover funds above the approved annual DSM budget: "This option is meant to allow the natural gas utilities to aggressively pursue programs which prove to be very successful."[12] The total amount of the overspend may not exceed 15% of the total DSM budget and can only be used on scorecards once the Company has achieved the weighted scorecard target (i.e. 100%) on a pre-audit basis.

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[9] *Demand Side Management Guidelines for Natural Gas Utilities* (EB-2008-0346), OEB, June 30, 2011, page 4.

[10] Ibid, page 4.

[11] Ibid, page 4.

[12] Ibid, page 26.

The Resource Acquisition program was delivered with spending 13% over the 2014 plan budget. Most of this additional spending came from funds re-allocated from the Market Transformation program.

In the Low Income program, in particular, given the challenges in achieving targets in the Multi-Residential (Part 3) offer, actual spending for this segment was below budget levels, with total spending 4% below the original budget.

Finally, the Market Transformation program ended the year with total spending 29% below budget. This underspend primarily was related to the Residential Savings by Design offer. With the offer providing a three-year time horizon to complete homes for eligible incentives, initial plan forecasts for incentives were not realized in the 2014 program year. Enbridge has proposed the establishment of a deferral account to address this challenge in the next multi-year plan.

Ultimately, the entire portfolio for 2014 was delivered with spending of $32,511,266. An amount of $352,502 (or approximately 1% of the 2014 budget) was accessed from the DSMVA to support the Residential Resource Acquisition results through the Community Energy Conservation offer and was permitted based on the RA weighted scorecard target exceeding 100% on a pre-audit basis.

6. TRC Screening

As per the Guidelines, the Board calls for application of the Total Resource Cost (TRC) test to screen for cost-effectiveness at the program level. TRC benefits include the avoided costs associated with natural gas, electricity and water savings over the life of the energy efficient equipment. TRC costs include the incremental equipment costs associated with the energy efficient equipment in relation to its less efficient equivalent, as well as any program or administrative costs attributed directly to the program.

Cost-effectiveness screening of DSM programs is valuable as a means for assessing the economic merit of a DSM program. Screening also helps with the process of prioritization among offers if budget constraint considerations need to be addressed.

As prescribed, Enbridge has utilized the TRC test to screen for cost-effectiveness of its 2014 programs. In the case of the Resource Acquisition program, if the TRC ratio (which compares the present value of the natural gas, electricity and water savings benefits to the present value of the costs) exceeds 1.0, the program is considered cost-effective.

In recognition that the Low Income program may include benefits that are not reflected in the TRC test, the Low Income program is screened using a TRC threshold of 0.7.

The Market Transformation program cannot be screened by using a systematic screening approach such as TRC, and is instead assessed on its own merits based on the objectives of the offers.

Recognizing that the current framework is based on CCM, TRC net savings nonetheless remains an important indicator of the extremely large and positive impact that Enbridge has with respect to DSM.

Table 9 summarizes the TRC screening estimates for the 2014 Enbridge DSM portfolio for illustrative purposes. The portfolio as a whole was cost-effective with an overall TRC ratio of 2.67. Further, Resource Acquisition

(2.84 TRC ratio) and Low Income (1.33 TRC ratio) were also cost-effective to deliver as individual programs.

Table 9. 2014 TRC Screening Summary

Sector/Program	NPV Total TRC Benefits	Total TRC Costs	TRC Net Benefit	TRC Ratio
Residential				
Community Energy Conservation	14,606,308	7,449,092	7,157,215	1.96
All Residential Total	**14,606,308**	**7,449,092**	**7,157,215**	**1.96**
Commercial				
Commercial Custom	69,287,837	22,384,331	46,903,506	3.10
Commercial Prescriptive	21,677,576	3,875,477	17,802,099	5.59
Run It Right	531,867	1,852,553	-1,320,686	0.29
All Commercial	**91,497,280**	**28,112,361**	**63,384,919**	**3.25**
Industrial				
Industrial Custom	28,299,123	7,265,868	21,033,256	3.89
Industrial Prescriptive	1,034,526	306,831	727,696	3.37
All Industrial	**29,333,650**	**7,572,698**	**21,760,951**	**3.87**
Overheads		4,636,555	-4,636,555	
Overall Resource Acquisition	**135,437,237**	**47,770,706**	**87,666,531**	**2.84**
Low Income				
Single Family (Part 9)	3,309,433	3,209,595	99,838	1.03
Multi-Residential (Part 3)	4,652,220	2,288,652	2,363,568	2.03
Overheads		507,595	-507,595	
Overall Low Income	**7,961,653**	**6,005,842**	**1,955,811**	**1.33**
Combined RA/Low Income *	**$ 143,398,890**	**$ 53,776,548**	**$ 89,622,342**	**2.67**

*This summary does not include TRC calcuations for the Market Transformation program.
All values are provided for illustrative purposes only.

7. 2014 DSM Program Review

This section provides an overview of Enbridge's 2014 DSM portfolio and details results for offers across all three programs: Resource Acquisition, Low Income and Market Transformation.

Resource Acquisition offers focus on achieving direct, measureable savings customer by customer and commonly involve the installation of energy efficient equipment or the implementation of operational improvements. The Resource Acquisition program is delivered across three sectors: Residential, Commercial and Industrial. Performance for the Resource Acquisition program is measured primarily in terms of net CCM of natural gas savings but also includes a residential deep savings metric based on participants.

Enbridge's current Low Income offers are similar in nature to Resource Acquisition offers in that they generally consist of the installation of energy efficient equipment or measures. However Low Income offers are set apart to recognize the unique needs of their target customer base. Though these offers may result in a lower benefit/cost ratio – Total Resource Cost (TRC) – than similar offers delivered to non-low income customers, they are designed to address the needs of these consumers and include other important societal benefits. The Low Income program comprises two segments: Single Family (Part 9) Residential buildings and Multi-Residential (Part 3) buildings. Performance in the Low Income program is measured primarily in terms of net CCM of natural gas savings but also includes a metric based on program enrolment.

The Market Transformation program includes two segments: Residential existing housing and Residential and Commercial new construction. Performance in the Market Transformation program is assessed in terms of metrics specific to each offer. Market Transformation offers are designed with the aim of influencing consumer behaviour and attitudes in support of reducing natural gas consumption. Market Transformation activities focus on enabling fundamental changes that lead toward increased market shares of energy efficient products and services.

This section of the report provides an overview of the offers within each program and summarizes the natural gas savings and related scorecard achievements for each program. This section further details the following (as applicable):

- Objectives
- Target Customer
- Metrics
- Tracking Methodology
- Offer Description
- Cost-Effectiveness
- 2014 Results
- Multi-Year 2012-2014 Result Summary
- 2014 Highlights and Lessons Learned

Resource Acquisition Program

Table 10. 2014 Resource Acquisition Scorecard

Component	Metric	Targets				2014 Actual Result
		Weight	Lower	Middle	Upper	
Volumes	*Cumulative Savings (million m^3)*	***92%***	744.05	992.06	1,240.08	**664.37**
Residential Deep Savings	*Number of Houses* [1]	***8%***	560	747	934	**5,213**

[1] Number of houses with at least two major measures and where average annual gas savings across all participants is at least 25% of combined baseline space heating and water heating usage.

Results for Enbridge's 2014 Resource Acquisition (RA) program were 664.37 million CCM. These results were below the lower target for this metric. The Residential Acquisition program scorecard also includes a deep savings metric specific to the Residential sector. There were 5,213 houses counted towards this metric. This result was significantly above the upper scorecard target.

Within the RA program, each of the Residential, Commercial and Industrial sectors had specified CCM savings targets established in the plan as outlined below in Table 11. Further detail regarding the results for each of these sectors is provided in the following pages.

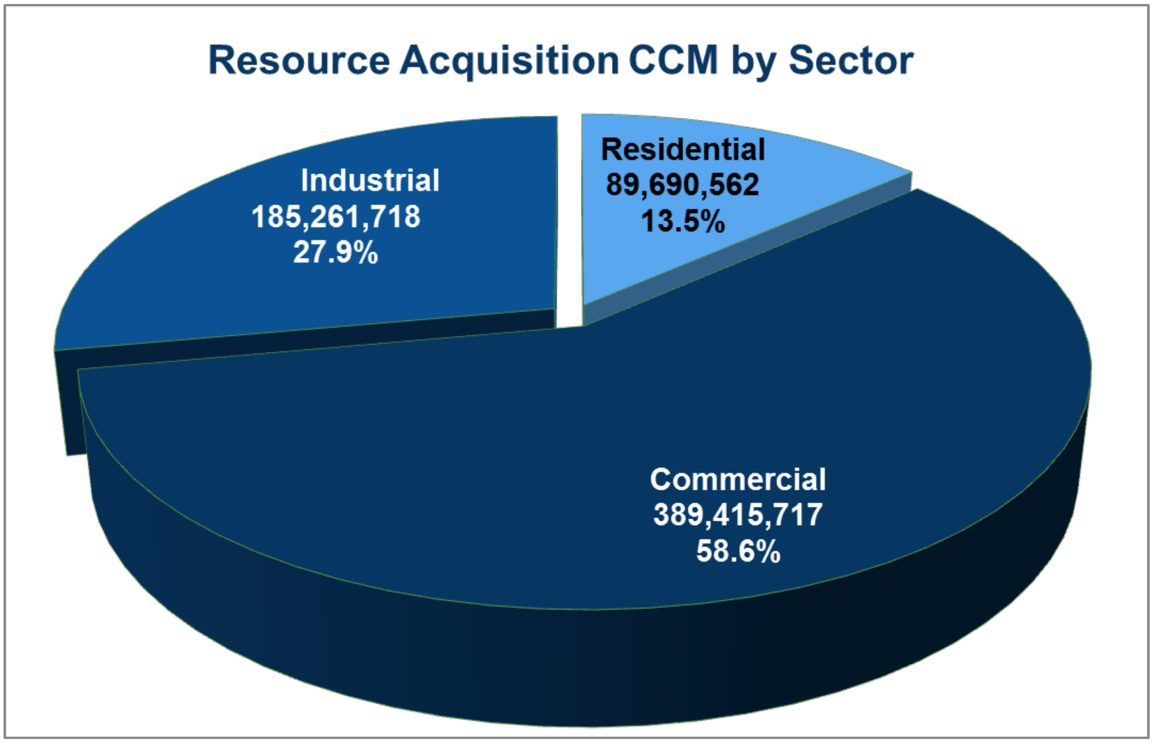
Table 11. 2014 Resource Acquisition Program Results

Resource Acquisition Program Sector	CCM Target (100%)	Actual CCM	$/CCM	Participants [2]	Units Installed [1]
Residential	11,735,669	89,690,562	$0.0959	5,213	---
Commercial	633,804,658	389,415,717	$0.0148	546	18,811
Industrial	346,554,000	185,261,718	$0.0120	128	108
Total/Average	**992,094,327**	**664,367,997**	**$0.0250**	**5,887**	**18,919**

[1] Units installed refers to the number of units for prescriptive offers.

[2] Participants refers to the number of unique addresses for custom projects and CEC (Residential).

Table 12. 2014 Resource Acquisition – CCM Results by Sector



CCM savings contributions from each sector within the RA program are illustrated in Table 12. Commercial offers were responsible for 58.6% of the total CCM savings in the RA program. Industrial and Residential offers contributed 27.9% and 13.5% of results, respectively.

Residential Resource Acquisition

Residential - Community Energy Conservation (CEC) – formerly Community Energy Retrofit (CER)

Objectives	The Residential component of the RA program focuses on the existing home sector through the marketing and delivery of a home energy conservation initiative. The goal of the CEC offer is to achieve deep energy savings in existing homes and to raise awareness of the benefits of energy efficiency. The initiative is designed to reduce gas use for space and water heating using a holistic approach, which encourages conservation through the installation of high efficiency equipment as well as thermal envelope improvements to reduce the space heating load. With financial incentives, the offer helps homeowners make their homes more energy efficient and reduces the burden of high energy costs.
Target Customer	CEC is targeted to Rate 1 residential customers.
Metrics	The first metric is cumulative cubic meter (CCM) savings generated by participants. The second metric is total number of participants – specifically, the number of houses with at least two eligible measures implemented and where average annual gas savings across all participants is at least 25% of combined baseline space heating and water heating usage.
Tracking Methodology	Gas savings are claimed based on results calculated through the use of accredited modeling software utilized by Certified Energy Auditors (CEAs). Reports summarizing participant numbers and gas savings (m^3) are maintained and tracked monthly. The number of participants (houses) with at least two major

	measures and where average annual gas savings across all participants is at least 25% of combined baseline space heating and water heating usage are tracked and counted toward the deep savings participant metric.
Offer Description	This offer was introduced in mid-2012 to encourage and support gas savings opportunities in existing residential houses and to meet the priorities outlined in the Board's DSM Guidelines, in particular, the goal of pursuing deep savings. CEC is designed to capture deep energy efficiency savings opportunities through the delivery of a holistic, "whole home" approach. Following the cancellation of the federal government funded ecoENERGY program that ran from 2007 and ended in early 2012, there has been a market need for initiatives that drive energy efficiency in the existing housing sector. The CEC offer utilizes accredited software such as Natural Resources Canada's (NRCan) HOT2000 and the US Department of Energy REM/Rate as the foundation in calculating annual gas savings for each participant. The software provides an effective building energy simulation tool to model the savings. Participants receive a pre-retrofit energy audit evaluation by a certified energy advisor before starting work and a post-retrofit energy audit to calculate gas savings. With the emphasis on deep savings, measures include home envelope improvements and mechanical system upgrades as these measures offer the greatest opportunity for "deep", long-term energy conservation through gas savings. Enbridge offers qualifying customers incentive dollars towards the pre-retrofit energy audit of their home and the opportunity for additional incentives if the participant completes at least two

	upgrades from a list of qualifying measures. The offer aims to ensure that the installation of these measures contributes to the achievement of an average 25% annual gas savings over the participant portfolio, based on pre- and post-energy audit results. The qualifying measures included for CEC are as follows: • Heating system replacement; • Foundation insulation; • Water heating system replacement; • Air sealing; • Attic insulation; • Window replacements; • Wall insulation; • Drain water heat recovery; and • Exposed floor insulation. To be eligible for the offer, customers must meet the following criteria: • Be a residential homeowner in the EGD franchise area; • Have a valid Enbridge Gas account in good standing; • Use an approved Certified Energy Evaluator/Auditor; • Install at least two measures; and • Complete a pre- and post-energy audit.
Cost-Effectiveness	The CEC offer is cost-effective as supported by the TRC screening summarized in Table 9 in Section 6. Gas savings results from the Residential CEC offer were realized at an average cost of $0.096/CCM as highlighted in Table 13 below.
2014 Results	The CEC offer contributed 89.7 million CCM in 2014. As summarized in Table 13, this result exceeded the 100% target initially established for the sector.

	As previously summarized in Table 10, which provides the 2014 Resource Acquisition Scorecard results, a total of 5,213 households participated and counted toward the Residential Deep Savings metric, well exceeding the upper target of 934 households for this metric.

Table 13. 2014 Residential Resource Acquisition Results

Resource Acquisition Program Sector	CCM Target (100%)	Actual CCM	$/CCM	Participants
Residential - CEC	11,735,669	89,690,562	$0.0959	5,213

Table 14. 2012-2014 Multi-Year Residential RA Results

Resource Acquisition Program Sector	Actual 2014	Actual 2013	Actual 2012
Residential (CCM)	89,690,562	38,980,521	5,296,300
Residential Deep Savings (participants)	5,213	1,649	271

2014 Comments and Lessons Learned:

- ★ Feedback from customers and energy advisors engaged to deliver the offer indicated that the term ‘retrofit’ was not well understood by the typical residential customer. Consequently, the offer was renamed Community Energy Conservation beginning in 2014 to incorporate a term and a concept more clearly understood by homeowners.

- ★ In its third year, the CEC offer has demonstrated great success. A key focus for 2014 was on expanding the offer to a much broader customer base in line with a more long term goal of making the offer accessible across the Enbridge franchise area.

Do you know how to improve your home's energy score?

An energy score is an energy rating that is provided after a home energy audit is completed. The higher the score, the more energy efficient your home is. The Enbridge Community Energy Conservation Program provides incentives up to $2,000 for which you can apply to your home's energy upgrades and audit costs. The program is being offered to Enbridge customers in York Region and select areas in Toronto, Niagara and Ottawa until December 31, 2014.

Visit knowyourenergyscore.ca for more information.

- ★ In conjunction with the Ministry of Municipal Affairs and Housing efforts to enable Ontario municipalities to use Local Improvement Charges (LICs) to finance energy retrofits on private property, in 2013, the City of Toronto established the Home Energy Loan Program (HELP) pilot to selected Toronto communities. The Home Energy Loan Program (HELP) is a financing tool to assist homeowners with improving their home's energy efficiency. Enbridge continued to work with the City of Toronto in 2014 to expand the delivery of the CEC offer in Toronto with a simultaneous expansion of the regions that could qualify for HELP.

- ★ Close to 55% of the participants in 2014 were households in York Region (there continues to be a concentrated effort in this area since this was the initial area target when the offer was launched in mid-2012). Over 32% of the participants came from the Metropolitan Toronto area and 12% were dispersed throughout the GTA; less than 1% participants came from the Niagara and Ottawa areas.

- Ongoing engagement with energy auditors by way of training sessions and meetings ensured that procedures and processes required for tracking were understood and followed.

- As outlined previously in Section 5 of this report, to support the growing savings opportunities arising from the expanding delivery and growing momentum of this offer in 2014, and in line with provisions set out in the Guidelines, available funds from within the Resource Acquisition program were accessed to support the opportunity for additional contributions to gas savings within the Residential sector. Budget dollars also were reallocated from the Market Transformation program to further support the Residential RA efforts.

- On average in 2014, CEC participants installed more than two (2.3) eligible measures. The majority of participants installed heating system replacements; the next most common measures installed were air sealing and attic insulation. On average, annual gas savings per project were calculated to be 1,335 m^3.

- CCM savings from the offer were calculated based on an updated dual measure life input assumption as a result of a 2012 audit recommendation negotiated with the AC.[13] These values were subsequently endorsed by the TEC. Specifically, for participants where projects included a furnace replacement as one of the measures – a deemed 15 year measure life was utilized to calculate CCM; for participants where projects did not include a furnace as one of the measures – a deemed 25 year measure life was utilized to calculate CCM.

- Marketing efforts for CEC have been well received and included the following activities:
    - Enhancement and promotion of Enbridge's online Residential energy efficiency microsite - www.knowyourenergyscore.ca.

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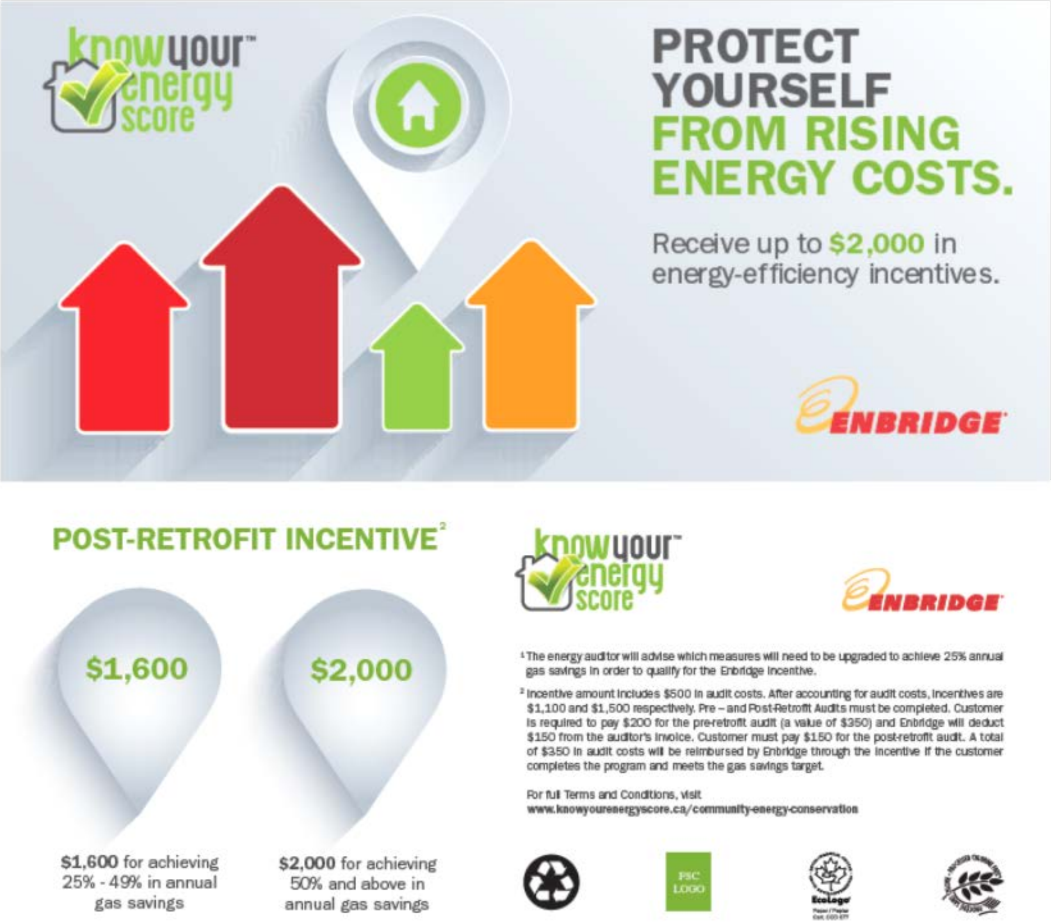
[13] 2012 DSM Clearance of Variance Accounts (EB-2013-0352), Exhibit B, Tab 3, Schedule 1, Page 19 of 41



[1] The energy auditor will advise which measures will need to be upgraded to achieve 25% annual gas savings in order to qualify for the Enbridge incentive.

[2] Incentive amount includes $500 in audit costs. After accounting for audit costs, incentives are $1,100 and $1,500 respectively. Pre – and Post-Retrofit Audits must be completed. Customer is required to pay $200 for the pre-retrofit audit (a value of $350) and Enbridge will deduct $150 from the auditor's invoice. Customer must pay $150 for the post-retrofit audit. A total of $350 in audit costs will be reimbursed by Enbridge through the incentive if the customer completes the program and meets the gas savings target.

For full Terms and Conditions, visit
www.knowyourenergyscore.ca/community-energy-conservation

- Engagement via EGD Channel Consultants in communicating and managing marketing approaches to contractors and business partners including e-blasts to the HVAC and insulation contractor community regarding program updates and expansion.

- Local print advertising in selected community newspapers and lifestyle magazines to highlight the offer and gas savings opportunities directly with homeowners.

To maximize opportunities to draw attention to the CEC offer, the offer was also promoted along with Home Labelling communication and marketing efforts to realtors.

Commercial Resource Acquisition

Offers designed for commercial customers include incentives to invest in energy efficient technologies in commercial buildings, such as the purchase and installation of efficient heating, ventilation and air conditioning (HVAC) systems as well as custom solutions specific to a customer's particular building or facility. Commercial RA offers in 2014 also included audit incentives as well as energy management offers focusing on operational improvements to support savings opportunities.

Enbridge provides service to over 150,000 Commercial sector customers across the Company's franchise area. These customers are segmented across widely diverse sub-sectors, which include: Multi-Residential (not including social housing), Commercial Office Buildings, Schools/Universities, Hotels/Motels, Warehouses, Retail, Food Services, Hospitals/Health-Care Facilities and Government/Municipal.

Energy efficiency initiatives available to commercial customers are delivered directly both by Enbridge's Energy Solutions Consultants (ESCs) to customers and building owners/operators and through supply chain channels and business partners, including HVAC contractors, engineering firms and energy service advisors.

Table 15. 2014 Commercial Resource Acquisition Results

Commercial Sector	Actual CCM	$/CCM	Participants [2]	Units Installed [1]
Custom	307,222,026	$0.0116	501	---
Prescriptive	79,068,251	$0.0088	---	18,811
Run It Right	3,125,440	$0.4763	45	---
Total/Average	**389,415,717**	**$0.0148**	**546**	**18,811**

1. Units installed refers to the number of units for prescriptive offers.
2. Participants refers to the number of unique addresses for custom projects and RIR.

Table 16. 2012-2014 Multi-Year Commercial RA Results

Resource Acquisition Program Sector	Actual CCM 2014	Actual CCM 2013	Actual CCM 2012
Commercial	389,415,717	505,133,591	658,836,828

Commercial – Custom and Prescriptive Fixed Incentive Offers

Objectives	The goal of the Commercial Custom offer is to reduce natural gas use through the capture of energy efficiency opportunities in commercial buildings, including retrofits of building components and upgrades at the time of replacement. The offer aims to promote the highest level of energy efficiency. The Commercial Prescriptive offer is designed to capture energy savings in the Commercial sector associated with the installation of prescriptive and quasi-prescriptive technologies.
Target Customer	Both the Custom and Prescriptive offers target commercial customers who are primarily in Rate 6 as well as commercial customers in Rates 135, 145, 110, 115 and 170.
Metrics	As part of the Resource Acquisition program, the primary metric for the Commercial Custom and the Prescriptive offer is lifetime natural gas savings - cumulative cubic meters (CCM) savings.
Tracking Methodology	Savings for each custom project are calculated on an individual basis and then tracked monthly by the Tracking and Reporting team, utilizing EGD's sales tracking software.

	Data is compiled for Prescriptive offer participants and tracked on a monthly basis by the Tracking and Reporting team, utilizing EGD's sales tracking software.
Offer Description	The Custom Commercial offer provides incentives for customers undertaking capital and operational improvements. Typical measures include boiler and HVAC retrofits, controls and building automation systems, heat recovery projects and building envelope improvements. The offer is primarily promoted and delivered by ESCs who are active in the marketplace. ESCs are trusted energy advisors; their technical and energy efficiency sales experience is fundamental to the successful execution of custom projects. ESCs work directly with customers, meeting with building operators and facility managers to conduct site visits and make custom recommendations based on each building's unique systems. ESCs provide advice for customized energy solutions to suit customers' energy efficiency goals in consideration of their budget and business needs. ESCs work with national chain and large property management firms to introduce savings strategies and align DSM offers with the customers' long term energy plans. ESCs use their technical expertise to work with smaller firms and managers of standalone buildings by educating them on savings concepts and providing recommendations and savings estimations for potential projects. The Commercial Prescriptive offer for 2014 included fixed incentives for various prescriptive and quasi-prescriptive

	energy efficiency measures impacting space heating, water heating and food service energy requirements. Measures included:[14] • Demand Control Ventilation (DCV); • Condensing Boilers <300MBH; • High Efficiency Boilers; • Air Doors; • Energy Recovery Ventilation (ERV); • Heat Recovery Ventilation (HRV); • Infrared Heaters; • Condensing Make-Up Air Units; • Ozone Laundry System; • Low-Flow Showerheads; • Demand Control Kitchen Ventilation System (DCKV); • Energy Star Qualified Dishwashers; • Energy Star Qualified Natural Gas Convection Ovens; • Energy Star Qualified Natural Gas Fryers; • Energy Star steam cookers; and • High efficiency under-fired broilers.
Cost-Effectiveness	Both the Commercial Custom and Prescriptive offers were cost-effective, as supported by the TRC screening summarized in Table 9 in Section 6. Gas Savings from the Commercial Custom offer were realized at an average cost of $0.0116/CCM, as highlighted in Table 15. Prescriptive savings were delivered at an average cost of $0.0088/CCM.
Evaluation Activities	Savings for each project are determined with project-specific savings calculations. Where applicable, ESCs utilize standardized engineering calculators developed by

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[14] Specific details regarding measures included can be found at enbridgegas.com/commercial

	Enbridge's technical engineering team. Projects are screened for an additional internal technical review to verify savings calculations as appropriate. An independent third-party engineering review, the Commercial Custom Project Savings Verification (CPSV), is conducted annually. The scope of work for this review is set out in a Terms of Reference established by the TEC. This verification study consists of a detailed review of the savings calculations for a statistically representative sample of Commercial sector custom projects claimed in 2014. The Commercial CPSV is summarized in Appendix A, and the prescribed sampling methodology followed to establish the selected projects is referenced in Appendix I. Reported results include adjustments recommended by the engineering review in conjunction with the application of determined realization rates as outlined in Appendix C.
2014 Results	As summarized in Table 15, 501 commercial custom projects were completed in 2014; these projects accounted for more than 307 million CCM in natural gas savings. Custom projects traditionally drive the highest percentage of Commercial results. This trend continued in 2014, with custom projects contributing 78.9% of Commercial results. As per Table 15, Commercial Prescriptive measures contributed over 79 million CCM, or 20.3% of the overall Commercial RA results. Overall, Commercial results were below target with savings of 389.4 million CCM (see Table 11).

2014 Highlights and Lessons Learned:

- ★ The Commercial Custom offer continues to be the largest contributor to the overall Resource Acquisition gas savings result. Commercial custom projects accounted for 307 million (or 46%) of the 664.4 million RA CCM results. The Commercial Prescriptive offer contributed 79 million CCM to the RA CCM total.

- ★ The Multi-Residential sector, followed by the University and Health-Care sectors, was the largest contributor to 2014 Commercial project results.

2014
Custom
Retrofit
Incentives

At Enbridge we're committed to helping you reduce your energy consumption and improve your bottom line. Custom Retrofit Incentives offset the cost of equipment upgrades, major repairs and maintenance that improve your building's energy efficiency.

enbridgegas.com/commercial

CUSTOM RETROFIT INCENTIVES

At Enbridge, we know Commercial buildings have unique energy efficiency opportunities that may fall outside our Fixed Retrofit Incentives. That's why Enbridge's Custom Retrofit Incentives pay qualified Enbridge customers \$0.10 per m^3 of natural gas saved (up to \$100,000!) after implementing any number of energy saving measures*. These one-time incentives are calculated based on projected first year's natural gas savings and paid once the project is complete.

QUALIFYING COMMERCIAL RETROFIT PROJECTS MAY INCLUDE:

- Upgrading to high-efficiency and condensing boilers
- Improving boiler controls
- Improving ventilation controls
- Installing demand control ventilation
- Installing energy or heat recovery systems
- Installing energy management systems and other automated controls
- Steam trap, economizer or condensate leak repairs
- Insulation upgrades
- Installing reflective panels on radiators
- High extraction washers

YOUR ENBRIDGE ENERGY SOLUTIONS CONSULTANT CAN HELP WITH:

- Technical Expertise
- Energy Efficiency Planning
- Reliable Energy Solutions
- Program Support
- Financial Incentives
- Business Partner Networks

CONDENSING BOILER INCENTIVE

Enbridge offers an increased incentive for upgrading your existing boilers to condensing boilers with 90% or greater combustion efficiency†. If you qualify, we will pay \$0.12 per m^3 of natural gas you save, up to \$30,000 per building. Your incentive will be calculated based on your projected first year's natural gas savings and paid once your project is complete.

2014 Custom Retrofit Incentives

Existing Commercial Buildings

- ★ The Commercial and Prescriptive offers remained largely unchanged in 2014. Of note, condensing make-up air units (MUAs) and demand control ventilation (DCV) for single-zone retail and office locations were added to the suite of Prescriptive offers promoted in 2014. Incentives remained the same as 2013 at \$0.10/m^3 of gas saved.

- ★ The strategy of implementing targeted campaigns to promote specific technologies to applicable sectors continued in 2014. These campaigns are often best-suited for less complex projects with relatively simple project execution.

Get started today!

Contact your Enbridge Energy Solution Consultant (ESC) today to learn more about our Commercial Incentives and start reducing your energy costs.

1-888-427-8888
energyservices@enbridge.com
enbridgegas.com/commercial

Terms and Conditions

2014 Fixed Retrofit Incentives

At Enbridge we're committed to helping you reduce your energy consumption and improve your bottom line. Fixed Retrofit Incentives are the quick and easy way to offset the cost of installing energy-efficient equipment in your existing building.

enbridgegas.com/commercial

- Several time-limited campaigns were promoted to commercial customers to drive greater participation and uptake of certain technologies. Campaigns focused on selected measures and included destratification fans, air doors, demand control kitchen ventilation (DCKV) and infrared heaters. For a period of three months, doubled incentives were offered to support the purchase and installation of each of these technologies.

2014 LIMITED TIME DOUBLE INCENTIVE OFFERS

Shipping Air Doors

Save $900 to $4,800.*

For a limited time, receive an incentive of up to $4,800 for the purchase and installation of shipping air doors.

*Incentive determined by size of the unit(s) installed and paid on a per unit basis. Offer ends June 30th, 2014. Units must be installed and operating between March 3, 2014 and June 30, 2014. Other Terms and Conditions apply.

Prevent money from going out the door by installing shipping air doors. An air door provides a continuous stream of air across a doorway, preventing heat and air conditioning from escaping. Air doors are ideal for high traffic warehousing and retail shipping and receiving entryways. In addition to significantly reducing your energy costs, air doors help improve comfort for staff, reduced infiltration of dust, fumes and insects, and have little to no maintenance costs.

Take advantage of this limited-time incentive today.
Contact your Energy Solutions Consultant.
1-866-844-9994 | energyservices@enbridge.com

- Infrared heaters, high-efficiency boilers, DCKVs, ozone laundry systems and Energy Star dishwashers were the technologies that had the largest contribution to the Commercial Prescriptive results in 2014.

- Where appropriate, resources were directed to developing focused key account relationships within specific commercial sectors. In 2014, efforts to increase sector penetration concentrated on institutional customers (e.g. universities/ colleges and hospitals). There was also a focused effort on the Multi-Residential building sector; leveraging communication through industry associations -- i.e. the Federation of Rental Providers of Ontario (FRPO) and the Building Owners and Managers Association (BOMA), to complete projects with these customers, including direct install low flow showerhead upgrades. Enbridge has seen success with this focused key account approach and will continue to build on it's efforts.

- Relatively low natural gas prices in 2014 continued to impact customers' decisions regarding implementation of natural gas efficiency projects. Competing offers from LDCs in support of electricity efficiency improvement projects are often a priority for limited capital spending, given the prospect for higher electricity cost savings.

- The Commercial DSM team has been undergoing significant rebuilding following the retirement of three ESCs in 2014 as well as staff changes on the marketing team. The process of training new staff and transferring/building relationships with customers has had an impact on results from this sector.

- Looking forward, ESCs will continue to focus on directly supporting commercial customers by providing education, helping to identify capital and operational improvements and assisting with the development of energy efficiency plans. In addition, dedicated efforts to maintain engagement with service organizations and industry contractors will continue to be an important element in identifying opportunities and realizing commercial gas savings.

Commercial – Run it Right and Energy Compass

Objectives	The goal of Run it Right (RiR) and Energy Compass is to encourage building owners to improve the energy performance of their buildings through operational improvements and benchmarking. These offers promote the awareness / visibility of building consumption patterns through energy monitoring information services (EMIS), low cost/no cost re-commissioning measures and energy savings opportunity assessments. Ultimately, these offers aim to lead commercial customers toward data-driven decision-making.
Target Customer	These offers are targeted to commercial customers in Rate 6, 110, 115, 135, 145 and 170 (with most commercial customers falling in the Rate 6 category). More specifically, the offers are designed for energy managers and building operators of commercial, multi-family and institutional buildings where daily consumption data is accessible. The Energy Compass initiative is marketed to commercial customers that have a portfolio of buildings.
Metrics	As part of the Resource Acquisition program, the primary metric for RiR is lifetime natural gas savings - cumulative cubic meters (CCM) savings. The Energy Compass initiative does not have a defined scorecard metric.
Tracking Methodology	The 2014 results are based on participants that registered for the RiR program and completed the implementation of the agreed-upon operational measures in 2013. For these participants, gas consumption data for the 12 months prior to implementation (the base year) was used as the base case gas usage. Gas consumption then was

	monitored for 12 months following implementation (the reference year). The monitoring for 2014 participants was completed in 2014. Program savings results are based on a regression analysis of actual consumption data. The participant's base year natural gas consumption is compared to the weather normalized consumption of the post-implementation reference year.
Offer Description	The RiR offer, as well as the Energy Compass initiative, is designed to motivate commercial customers towards performance-based conservation. The provision and analysis of detailed energy data aims to allow building operators and managers to make strategic data-driven decisions regarding energy savings and capital investments. Through Energy Compass and RiR, the Company helps commercial customers better manage their buildings, implement operational improvements to achieve energy savings and identify future cost-effective capital improvements. Savings that result from operational improvements implemented in any given year are recorded in the next year, following monitoring and verification.
Cost-Effectiveness	The RiR offer is not cost-effective in 2014, as illustrated by the TRC screening summarized in Table 9 in section 6. However, the Resource Acquisition program as a whole screens at 2.84.
Evaluation Activities	Further to an audit recommendation made in 2013, a third-party firm was retained by Enbridge to conduct a survey of all 2014 RiR participants to confirm savings attributed to the offer. The survey was conducted during

	Q2 of 2015, with input from the 2014 Auditor and Audit Committee. Due to a low survey response rate, the results of the survey were inconclusive and no quantitative adjustment was recommended. However, qualitative insights were gained and will be considered going forward.
2014 Results	In 2014, volumetric savings of 3 million CCM were achieved, whereas in 2013 savings of 11 million CCM were realized. Although 217 participants signed up for the program in 2013, only 53 implemented measures during the monitoring period. For 2014, the results are based on 45 claimed participants. The savings of seven participants were removed from the results due to the inclusion of capital measures.

2014 Highlights and Lessons Learned:

- ★ In comparison to 2013, the number of participants that signed up for the program in 2014 was similar – 202 compared to 217, respectively. However, the number of participants that implemented measures in 2014 compared to 2013 saw a significant decrease – 192 compared to 53, respectively. This decrease was partly due to a new standardized approach implemented by Enbridge in the building investigation phase of the offer. A further review of this process revealed a need to increase the level of engagement between the investigation agents and the customers after Enbridge issued savings reports to customers. Enbridge has implemented improvements to the process as a result of this finding.

- ★ In 2014, some customers were not able to participate in the offer because they did not meet the minimum threshold of 5% estimated operational savings. In an effort to improve participation in 2015, Enbridge is removing this criteria.

- ★ As was the case in 2013, an analysis of RiR participant results continues to show that average savings levels are significantly lower than the initial targets, which were based on anticipated savings of greater than 10%. The average savings are 2.8% and 2.5% for 2014 and 2013, respectively. It should be noted that, as a result of the 2013 Audit, the average savings of 2.8% and 2.5% includes projects for which an increase in consumption, rather than a reduction, was observed. Consequently, potential savings derived from implemented operational measures for these projects could not be quantified.

RunitRight

At Enbridge, we're committed to helping you reduce your energy consumption and improve your bottom line. RunitRight analyzes your building's energy performance, identifies and helps you implement low- and no-cost operational improvements and monitors your building to ensure you save energy.

REDUCE ENERGY CONSUMPTION. BOOST YOUR BOTTOM LINE. WITH HELP EVERY STEP OF THE WAY.

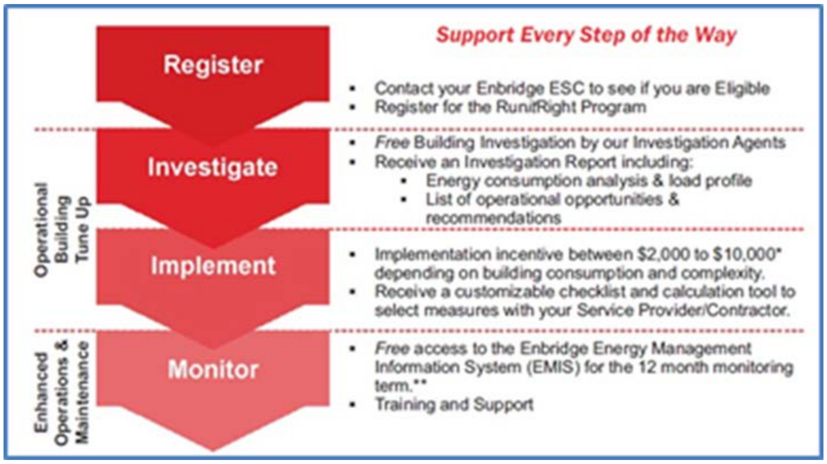
1 INVESTIGATE

2 IMPLEMENT

3 MONITOR

- ★ Adequately assessing and interpreting actual results remains a challenge. Although metered data reflects building consumption, it does not accurately reflect the building conditions that can change year-over-year. An increase in consumption has a negative impact on the savings realized through the building's participation in the RiR offer.

- ★ There are programs in other jurisdictions, such as BC Hydro Continuous Optimization Program, that use deemed savings for each of the operational improvement measures that commercial customers implement in their buildings. This methodology overcomes the challenges in normalizing consumption year-over-year to accurately reflect the savings achieved by implementing operational improvement measures.



Support Every Step of the Way

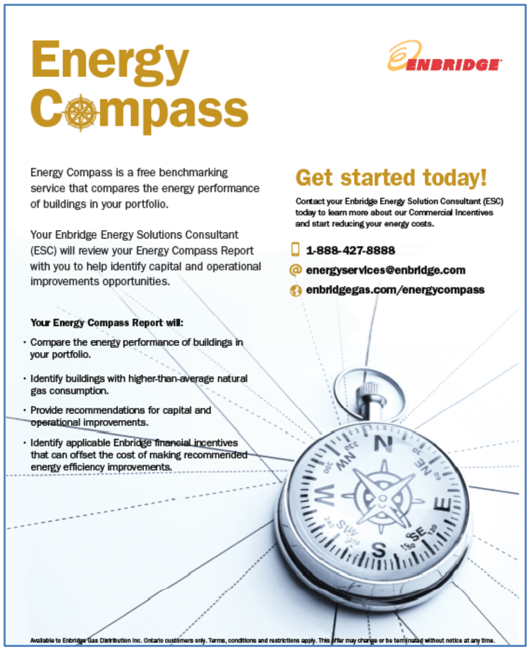
- Contact your Enbridge ESC to see if you are Eligible
- Register for the RunitRight Program

- *Free* Building Investigation by our Investigation Agents
- Receive an Investigation Report including:
  - Energy consumption analysis & load profile
  - List of operational opportunities & recommendations

- Implementation incentive between $2,000 to $10,000* depending on building consumption and complexity.
- Receive a customizable checklist and calculation tool to select measures with your Service Provider/Contractor.

- *Free* access to the Enbridge Energy Management Information System (EMIS) for the 12 month monitoring term.**
- Training and Support

★ As noted in 2013, RiR savings results are generated through operational improvements and do not involve implementation of capital measures. Many other utility re-commissioning/retro-commissioning programs, as well as local initiatives such as Greening Healthcare and Race to Reduce, take a broader approach and include both capital and operational measures. For the RiR offer, there are cases where customers have declined to participate due to the offer parameters stating that customers cannot implement capital equipment. Inclusion of capital measures would allow for a more holistic approach and result in an increase in participation as well as potentially additional savings for customers.



Energy Compass

Energy Compass is a free benchmarking service that compares the energy performance of buildings in your portfolio.

Your Enbridge Energy Solutions Consultant (ESC) will review your Energy Compass Report with you to help identify capital and operational improvements opportunities.

Your Energy Compass Report will:

- Compare the energy performance of buildings in your portfolio.
- Identify buildings with higher-than-average natural gas consumption.
- Provide recommendations for capital and operational improvements.
- Identify applicable Enbridge financial incentives that can offset the cost of making recommended energy efficiency improvements.

Get started today!

Contact your Enbridge Energy Solution Consultant (ESC) today to learn more about our Commercial Incentives and start reducing your energy costs.

☎ 1-888-427-8888
@ energyservices@enbridge.com
enbridgegas.com/energycompass

Available to Enbridge Gas Distribution Inc. Ontario customers only. Terms, conditions and restrictions apply. This offer may change or be terminated without notice at any time.

Industrial Resource Acquisition

Industrial – Custom Solutions and Prescriptive Fixed Incentives Offers

Objectives	The Industrial Custom Solutions offer is designed to capture cost-effective energy savings within the Industrial sector by delivering customized energy solutions aimed at supporting customers through a continuous improvement approach. Industrial Energy Solutions Consultants (ESCs) focus on assisting customers with the adoption of energy efficient technologies by overcoming financial, knowledge or technical barriers. The Industrial Prescriptive offer aims to capture energy savings in the Industrial sector by installing applicable prescriptive and quasi-prescriptive technologies, with a focus on increasing the adoption of energy efficient technologies among small industrial customers.
Target Customer	Both the Custom Solutions and Prescriptive offers are available to industrial customers (including Agricultural customers) in Rates 6, 110, 115, 135, 145 and 170. Custom projects encompass opportunities where savings are linked to unique building specifications, uses, technologies and industrial processes. With the Custom Solutions offer, Enbridge is primarily targeting industrial customers (both large and small) with significant process loads and high annual consumption. The target market for the Prescriptive offer is smaller industrial customers.
Metrics	As part of the Resource Acquisition program, the primary metric for the Industrial Custom and the Prescriptive offer is lifetime natural gas savings - cumulative cubic meter (CCM) savings.

Tracking Methodology	Savings for each custom project are calculated on an individual basis and then tracked monthly by the Tracking and Reporting team, utilizing EGD's sales tracking software. Data is compiled for Prescriptive offer participants and tracked on a monthly basis by the Tracking and Reporting team, utilizing EGD's sales tracking software.
Offer Description	In the Industrial sector, the Continuous Energy Improvement (CEI) approach includes the Industrial Custom Solutions offer and the Prescriptive offer together with a number of enabling initiatives, such as support for industrial customers in identifying energy-saving opportunities through to assistance with project implementation. These offers are primarily promoted and delivered by ESCs (professional engineers) who are active in the marketplace. ESCs are trusted energy advisors that work with customer to determine solutions to address multiple objectives – production, energy efficiency and budgetary considerations. Work involves addressing technical barriers to energy efficiency adoption as well as financial barriers that may hinder business justification and implementation. Enabling initiatives allow ESCs to work with the customers to identify potential opportunities, quantify benefits, and justify action. Such initiatives include: ESCs leveraging their skills and tools to identify efficiency opportunities; involvement of third-party vendors to conduct specific types of audit or assessments of facilities; and/or ESCs assisting with the development of project implementation plans.

	Due to the unique nature of industrial customers, custom solutions developed by ESCs are designed and engineered to meet the specific requirements of each particular customer's facility. Five core components are common to the Custom offer in 2014: • **Knowledge Development**: Technical publications, quarterly updates and themed workshops are offered to provide customers with the knowledge to make informed decisions through education. • **Opportunity Identification:** ESCs provide support to assist customers in the identification of efficiency opportunities, such as equipment testing and assessment and thermal imaging. • **Measurement**: ESCs assist customers in selecting appropriate means of measurement to quantify key energy inputs. • **Engineering Analysis**: ESCs assist customers who do not have the resources needed to conduct financial, technical and enterprise risk evaluations for potential projects. • **Implementation Support**: ESCs work with customers on an implementation plan and connect them with business partners to complete the project. The Industrial Prescriptive offer evolved by leveraging existing Commercial offers applicable to the industrial customer base. The Industrial Prescriptive offer incorporates a fixed incentive approach and includes incentives designed to help offset the cost of energy efficiency upgrades specifically relevant to industrial facilities such as Air Doors, Heat Recovery Ventilators, Energy Recovery Ventilators and Infrared Heaters.
Cost-Effectiveness	Enbridge continues to demonstrate a high level of cost-effectiveness for Industrial sector offers as supported by

	the TRC screening summarized in Table 9 in Section 6. Savings delivered from the Industrial Custom offer were realized at an average cost of $0.0121/CCM as highlighted in Table 17. Prescriptive savings were delivered at an average cost of $0.0095/CCM.
Evaluation Activities	In the case of custom projects, each project is assessed individually for inclusion in the offer. Subsequent to project-specific savings calculations being completed by ESCs, an internal technical review of project applications and savings calculations is conducted. ESCs utilize standardized engineering calculators developed by EGD's technical engineering team. Where required, savings calculations are specialized based on project-specific engineering analysis. Where applicable and appropriate, consumption information is reviewed to confirm expectations. An independent third-party engineering review, the Industrial Custom Project Savings Verification (CPSV), is conducted annually. The scope of work for this review is set out in a Terms of Reference established by the Technical Evaluation Committee (included as Appendix A). This verification study consists of a detailed review of the savings calculations for a statistically representative sample of Industrial sector custom projects. The Industrial CPSV is summarized in Appendix C and the prescribed sampling methodology followed to establish the selected projects is referenced in Appendix I. Reported results incorporate adjustments, as recommended by the engineering review following the determination of a realization rate adjustment as outlined in Appendix D.
2014 Results	There were 128 Industrial custom projects completed in 2014 contributing 177.7 million CCM. Prescriptive results

	totalled 7.6 million CCM and included 108 separate installations.

Table 17. 2014 Industrial Resource Acquisition Results

Industrial Sector	**Actual CCM**	**$/CCM**	**Participants** [2]	**Units Installed** [1]
Custom - Industrial	177,663,455	$0.0121	128	---
Prescriptive - Industrial	7,598,262	$0.0095	---	108
Total/Average	**185,261,718**	**$0.0120**	**128**	**108**

1. Units installed refers to the number of units for prescriptive offers.
2. Participants refers to the number of unique addresses for custom projects.

Table 18. 2012-2014 Multi-Year Industrial Results

Resource Acquisition Program Sector	**Actual CCM 2014**	**Actual CCM 2013**	**Actual CCM 2012**
Industrial	185,261,718	222,575,355	305,915,406

2014 Highlights and Lessons Learned:

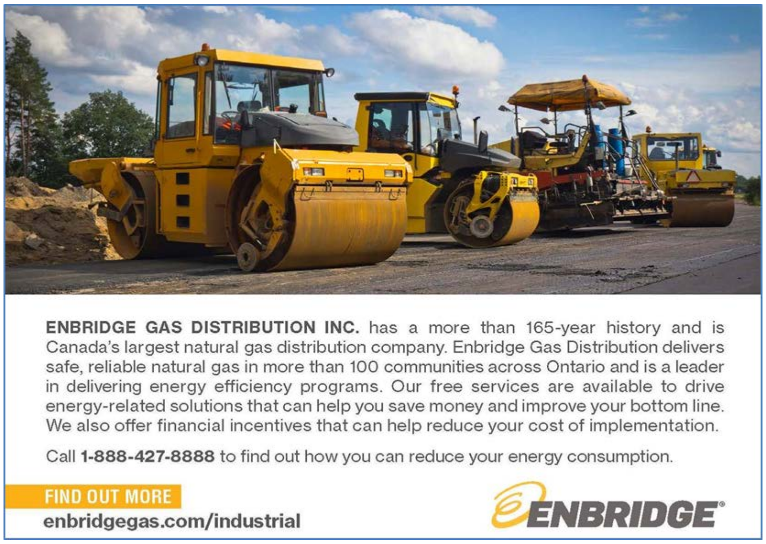
- ★ Overall, the Custom Solutions offer remained largely unchanged from 2013 to 2014. However, a revised incentive structure was introduced – the flat rate of $0.07/m^3 offered previously was revised as follows:
  - o $0.20/m^3 for first 50,000 m^3 gas saved
  - o $0.05/m^3 for gas savings above 50,000m^3

  This revision was considered as a result of missed opportunities and was intended to provide additional support to customers (both large and small) to implement smaller projects.

- ★ There is a developing trend of opportunities shifting from capital-intensive projects such as equipment upgrades to opportunities focusing on process improvements – projects which tend to yield good annual savings but lower CCM.

- Projects completed in 2014 yielded lower average per project savings in comparison to previous years. As noted above, there were 128 custom projects completed in 2014 with a combined 177 million CCM saved. In comparison, in 2013, there were 118 Industrial custom projects completed, contributing almost 222 million CCM. In other words, in 2014, the number of projects increased by 8%, the associated annual savings decreased by approximately 10% and the associated CCM decreased by 25%. Going back another year, there were 91 custom projects completed in 2012 with 306 million CCM saved. Though the Company has been able to grow the number of projects completed year-over-year, results for the overall savings are decreasing in terms of annual savings and, more significantly, in terms of cumulative gas savings.

- Custom projects can be highly resource intensive and require extensive technical expertise and data analysis; conversely Prescriptive, fixed incentive projects are less complex to execute, making them well-suited for smaller customers. An established distribution network of business partners and service providers was leveraged as a key means of promoting the Prescriptive offer. In 2014, two technologies in particular were marketed to the industrial market. Industrial customers benefitted from financial incentive support tied to the installation of Infrared Heaters as well as Industrial Air Curtains; in all, 108 projects were completed.



ENBRIDGE GAS DISTRIBUTION INC. has a more than 165-year history and is Canada's largest natural gas distribution company. Enbridge Gas Distribution delivers safe, reliable natural gas in more than 100 communities across Ontario and is a leader in delivering energy efficiency programs. Our free services are available to drive energy-related solutions that can help you save money and improve your bottom line. We also offer financial incentives that can help reduce your cost of implementation.

Call **1-888-427-8888** to find out how you can reduce your energy consumption.

- In 2014, as in prior years and as outlined in the DSM plan, budget spending on programs and activities for rate classes 110, 115 and 170 is capped. As stated in EB-2012-0394:

> "In general, Enbridge will have the right, in the manner described in the Guidelines, to re-allocate budget between customer classes and groups to optimize the effectiveness of its DSM Plan. However, the Parties agree, for …2014 …that the total budget spent on programs and activities (including allocated overheads but excluding Low Income Allocations) for all customers in rate classes 110, 115, and 170 shall not exceed the following annual limits:"[15]

Table 19. Rate Class 110, 115 and 170 Spending Limits vs. 2014 Actual Spending

Rate Class	2014 Spending Limit	2014 Actual Spending*
110	$1,687,000	$902,696
115	$1,307,000	$423,423
170	$2,220,000	$352,414

- Table 19 details the actual spending (including allocated overheads but excluding Low Income Allocations) relative to prescribed spending limits for each rate class and shows that spending is below the limits set out for all three rate classes.

- In an attempt to reach a wide market of customers regardless of size while maintaining cost-effectiveness, Enbridge offered a variety of materials and forums aimed at increasing awareness of energy efficiency opportunities and benefits, educating customers and providing resources to research and evaluate potential improvement solutions. Enbridge focused efforts on a number of initiatives which included:
    - Energy efficiency workshops and webinars;
    - Quarterly newsletters (via email blasts);

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[15] *Update to the 2012 to 2014 Demand Side Management ("DSM") Plan* (EB-2012-0394), Exhibit B, Tab 1, Schedule 3, page 5 of 20.

  - Audits and Assessments (including targeted assessment campaigns);
  - Telemarketing Campaigns; and
  - Industrial Energy Solutions Portal.

Reminder:
Industrial HVAC Customer Workshop

Limited space left in the workshop,
Register Today!

It is a good time to start thinking about maximizing your HVAC efficiency

You are invited to attend a **free workshop** on HVAC.

ENBRIDGE

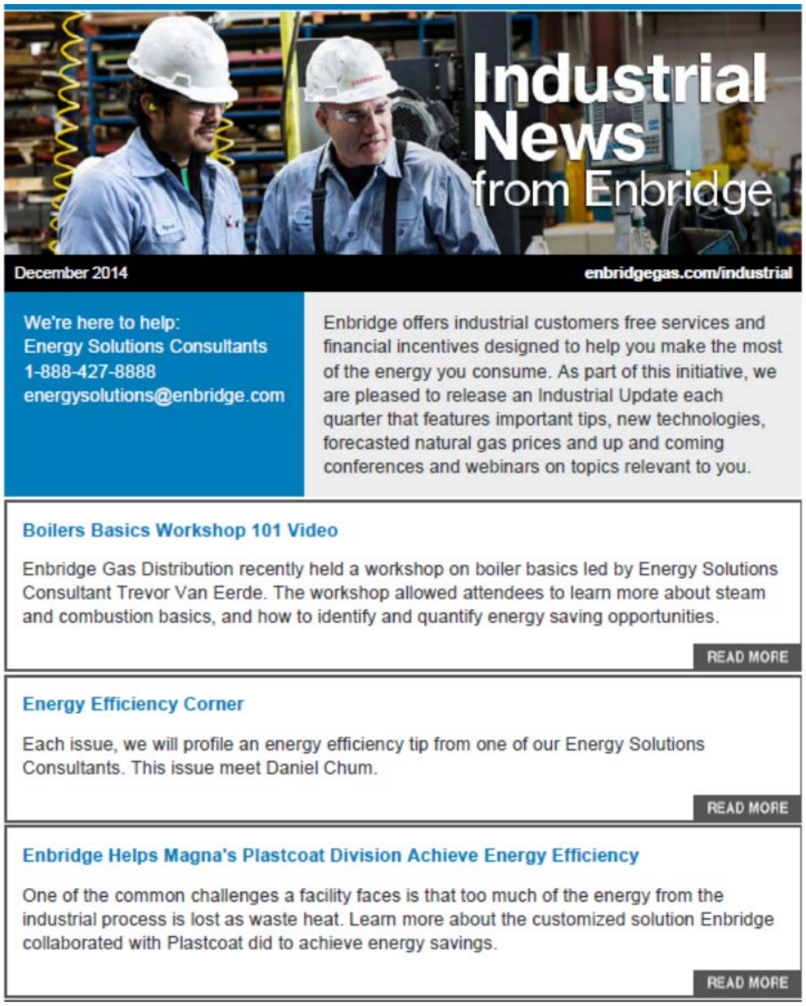
Led by Energy Efficiency Manager Damir Naden, take this opportunity to learn more about heat recovery through a special case study and learn how you can apply these principles to your facility.

- Throughout the year, the industrial team hosted one-day workshops aimed at building awareness for energy efficiency in the customer's facility. The focus of these efforts was on educating the customer and their employees on identifying energy conservation opportunities and providing information to help evaluate potential projects. The workshops included the following:
  - **Energy Management 101:** Attendees were shown how to begin to map the energy profile for their facilities, explore ways of building and integrating an energy management system and evaluate industry recognized energy management standards.
  - **Combustion Equipment Maintenance Safety Workshop:** Industrial customers were educated on maintaining the integrity of combustion equipment to prevent equipment failure while enhancing safety.
  - **HVAC Audit Workshop:** Through a case study analysis, attendees learned about heat recovery and how they can apply these principles to their facilities.

    - **Boiler Basics Workshop:** Attendees learned about steam and combustion basics and how to identify and quantify energy saving opportunities.

Over 100 participants took part in these workshops. Feedback survey responses indicated that 83% of participants rated the workshops as excellent in providing relevant and useful content.

- The Company also published quarterly newsletters which were distributed through e-mail blasts to over 1000 industrial customers. These publications feature information regarding upcoming conferences, webinars and Enbridge workshops, highlight energy efficiency technologies, spotlight case studies, and provide natural gas price forecasts.



Industrial News from Enbridge

December 2014

enbridgegas.com/industrial

We're here to help:
Energy Solutions Consultants
1-888-427-8888
energysolutions@enbridge.com

Enbridge offers industrial customers free services and financial incentives designed to help you make the most of the energy you consume. As part of this initiative, we are pleased to release an Industrial Update each quarter that features important tips, new technologies, forecasted natural gas prices and up and coming conferences and webinars on topics relevant to you.

Boilers Basics Workshop 101 Video

Enbridge Gas Distribution recently held a workshop on boiler basics led by Energy Solutions Consultant Trevor Van Eerde. The workshop allowed attendees to learn more about steam and combustion basics, and how to identify and quantify energy saving opportunities.

Energy Efficiency Corner

Each issue, we will profile an energy efficiency tip from one of our Energy Solutions Consultants. This issue meet Daniel Chum.

Enbridge Helps Magna's Plastcoat Division Achieve Energy Efficiency

One of the common challenges a facility faces is that too much of the energy from the industrial process is lost as waste heat. Learn more about the customized solution Enbridge collaborated with Plastcoat did to achieve energy savings.

- ★ Although the Company has developed strong relationships with many of the larger industrial customers, Enbridge recognizes there is more work to do in building engagement and developing contacts with the smaller industrial customer base. In 2014, two telemarketing campaigns targeting this customer segment were conducted. The campaigns were designed to enhance the Company's customer contact and customer information database for the smaller industrial segment. Efforts also focused on building awareness of the DSM program and increasing the newsletter audience.

- ★ Enbridge launched the Industrial Energy Solutions Portal in April of 2014. The portal is designed to help engage industrial customers and make it possible for customers and service providers to secure the information they require to make an informed decision online – anytime – as needed.

Introducing the Enbridge Industrial Energy Solutions Portal

ENBRIDGE

The portal provides free tools to:

- Identify and quantify energy efficiency opportunities
- Get information on energy saving technologies
- Calculate energy savings
- Apply for Enbridge financial incentives and an energy assessment

Some of the technologies featured on the portal include:

- Air Compressors
- Air Curtains/Rapid Air Doors
- Condensing/Feedwater Economizers
- Destratification Fans
- Steam Traps
- Insulation
- Heating and Ventilation
- Self Assessments/Energy Audits

Take advantage of the Enbridge program! Get up to 50%* off of the cost to implement an energy efficiency technology.

Register for the portal!
www.enbridgegas.com/industrialportal

*Terms and conditions apply. Visit www.enbridgegas.com/industrial

- ★ The portal provides industrial customers, contractors and business partners with the tools to:
  - o Help evaluate efficiency opportunities;
  - o Review energy savings and payback period estimates;
  - o Request Enbridge incentive quotes;

  - Access technical resources such as calculators, brochures and articles;
  - Learn about upcoming training workshops and events; and
  - Request support from an Enbridge Energy Solutions Consultant.

Interest and traffic to the site has been encouraging and several opportunities for the Company to assist customers with uncovering energy efficiency improvements were generated through the portal.

- ★ Ontario's industrial/manufacturing sector continues to face numerous challenges in the face of global competition which include the high cost of electricity. Enbridge expects electricity energy efficiency considerations will continue to be a higher priority to customers relative to gas savings. For the majority of Enbridge's customers however, an individualized, customer-focused approach to education will help increase awareness of the opportunities and benefits associated with gas savings solutions.

- ★ The industrial sector utilizes most of its energy for process related consumption as opposed to heating and ventilation purposes. Consequently energy efficiency opportunities focused on the improvement and optimization of these processes would benefit these customers. Many industrial customers lack technical knowledge regarding energy efficient technologies that may help improve these processes and reduce overall energy consumption.

- ★ Enbridge continues to look for ways to improve and build on current offers including examining approaches to support operational improvements through energy monitoring and targeting. The Company plans to launch a Comprehensive Energy Management offer as part of the next Multi-Year DSM plan. The proposed offer will aim to encourage customers to incorporate operational efficiency as part of their culture to ensure improvements and investments are sustainable.

Low Income Program

Enbridge is a recognized leader in the area of energy efficiency programs specifically designed for low income consumers and has been particularly effective in building collaborative partnerships in the marketplace with LDCs, municipalities and community service providers. Programming has evolved considerably since DSM activities for this market were initially offered in 2004.The Low Income program focuses on helping to reduce the energy costs facing low income consumers and housing providers through thermal envelope improvements as well as the installation of measures to achieve water and space heating savings.

Specifically, the Company's program delivery strategy focuses on leveraging available tools and resources, community-based organizations (CBOs) and local community channels. These groups have established relationships with trusted organizations that support the social service needs (housing affordability and environmental sustainability) of low income consumers. Enbridge has recognized the benefits of collaboration with these partners, including social and assisted housing support networks, in helping to inform and improve program delivery.

There are two primary streams in the Low Income program targeting distinct segments of this market: Single Family Buildings (Part 9) and Multi-Residential Social Housing Buildings (Part 3). Programming for the low income sector requires design and delivery considerations that are in many ways unique from traditional approaches in the manner they reach out to these vulnerable customers, encourage customer awareness and, in turn, build participation. This community includes seniors, low wage households, recent immigrants to Canada and people with special needs.

The Low Income program produced mixed results in 2014 relative to scorecard performance targets. Results in the Single Family (Part 9) segment were strong, totaling 25.67 million CCM, surpassing the middle (100%) target. Results in the Multi-Residential (Part 3) segment, however, continued as in 2013 to be significantly below expectations with 29.80 million CCM[16], which is under the lower target.

Table 20. 2014 Low Income Scorecard

Component	Metric		Targets			2014 Actual Result
		Weight	Lower	Middle	Upper	
Single Family (Part 9)	*Cumulative Savings (million m³)*	***50%***	17.7	23.6	29.5	**25.67**
Multi-residential (Part 3)	*Cumulative Savings (million m³)*	***45%***	48.15	64.2	80.25	**29.80**
Multi-residential (Part 3) LIBPM [1]	*Percent of Part 3 Participants Enrolled* [2]	***5%***	30%	40%	50%	**74%**

1. LIBPM - Low Income Building Performance Management is the Low Income offer complement to the Commercial Run It Right (RIR) offer.
2. Low Income Building Performance Management (LIBPM) percentage of Part 3 buildings enrolled in current year program = (x+y)/(x+y+z):
x = # of new LIBPM buildings in the current year that have participated in another aspect of the Low Income program in a previous year of 2012-2014 plan; y = # of new LIBPM buildings in the current year that have not previously participated in the Low Income program; z = # of buildings in the current year that have implemented custom projects other than LIBPM.

Participation in the low income benchmarking initiative, LIBPM, continued to be excellent in 2014 resulting in an achievement of 74% for this metric, exceeding the upper target of 50%.

As outlined in Table 21, overall cumulative natural gas savings totalled 55.47 million CCM for the Low Income program.

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[16] This value is net of CPSV adjustment. Low Income Part 3 custom projects results are subject to the Commercial CPSV realization rate adjustment as they are included in that verification study.

Table 21. 2014 Low Income Results

Low Income Component	CCM Target (100%)	Actual CCM	$/CCM	Participants [2]	Units Installed [1]
Single Family (Part 9)	23,598,260	25,673,482	$0.1751	1,107	557
Multi-Residential (Part 3)	64,255,160	29,801,158	$0.0648	66	3,043
Total/Average	**87,853,420**	**55,474,640**	**$0.1158**	**1,173**	**3,600**

1. Units installed refers to the number of units for prescriptive offers.
2. Participants refers to the number of unique addresses for custom projects.

In the social housing space, a key partner in the Enbridge franchise area is Toronto Community Housing (TCH). As the largest social housing provider in Canada and the second largest in North America, this group provides homes to almost 59,000 low income households.

A significant number of projects from TCH were anticipated and taken into account in the 2013-2014 DSM Plan Update. These projects were expected to have substantial savings contributions. However, these projects have been delayed due to funding cutbacks, increased analysis requirements and additional approvals necessary for implementation. Management and decision-making process changes within TCH over the last two years continue to have an impact on Low Income DSM program results in both the single family and multi-residential segments. The need for additional reviews prior to project execution and the finalization of decisions and implementation across the TCH housing portfolio have significantly slowed results. Specifically, TCH has currently suspended capital improvement projects in Part 3 buildings. In addition, no Part 9 buildings participated in the 2014 Winterproofing offer.

An announcement from the OPA regarding the early termination of the “social housing adder”, where LDCs are providing financial incentives of up to 50% of the project cost for social housing CDM projects, left housing providers prioritizing CDM-related projects over natural gas energy efficiency measures. Projects were required to be submitted for a mandatory pre-approval in July 2014 for completion by the end of 2015 to access this rich incentive offer.

GLOBE/Housing Services Corporation, as Enbridge's program delivery agent for the social housing sector, experienced significant internal organizational and operational challenges that impacted its ability to deliver on its performance targets for the year. New staff came on board, and new processes were introduced during the year. With changes in strategic direction and with a change in program focus on behalf of Enbridge to pursue the private market, the partnership with GLOBE has evolved from being a program delivery agent to a strategic communication channel partner for Enbridge.

Single Family (Part 9)

Home Winterproofing (formerly Low Income Weatherization) and Prescriptive Measures

Objectives	The goal of the Single Family Low Income offer is to capture energy savings through the reduction of hot water use and space heating demand in low income single family households through the installation of thermal envelope improvements, space heating and water saving measures.
Target Customer	This offer targets Rate 1 homeowners and tenants living in low-rise homes within the Enbridge franchise area who need assistance with their energy costs. Eligible customers must meet the following criteria: • Income is at or below 135% of Statistics Canada's Low Income Cut-Off (LICO); • Occupants of single detached and low-rise multi-family (3 stories or less); • Private homeowner or tenant who pays their own gas bills; or • Tenants residing in social and assisted housing, regardless of who pays the gas bills. Income verification is required to participate in this offer.

Metrics	The primary metric is cumulative cubic meter (CCM) savings.
Tracking Methodology	In the case of Home Winterproofing, reports are submitted from delivery agents summarizing installation site information (e.g., address, ownership, housing type) and natural gas savings (m^3) calculated based on the results of customized energy audits conducted by energy auditors. Participation also is tracked by type of tenancy (i.e., social housing or privately-owned dwellings). Similarly, monthly reporting is provided by delivery agents and summarizes savings per unit installed for each prescriptive measures installed, if any. Monthly reports are compiled by the Tracking and Reporting team, utilizing EGD’s sales tracking software.
Offer Description	The Low Income Home Winterproofing offer is available for: • qualified Part 9 buildings (three stories or less); • private homeowners and residential tenants within the EGD franchise who meet the established income eligibility criteria; • residents of social housing; and • recipients of social assistance benefits. For each Part 9 single family home, Enbridge aims to comprehensively treat all cost-effective opportunities, provided that the customer accepts all such measures. Basic prescriptive measures including showerheads, aerators, programmable thermostats and heat reflector panels are offered. The Winterproofing offer provides low income customers with a free home energy audit and upgrades that may include: attic, wall and/or basement insulation, door and window caulking and draft-proofing.

	Enbridge's main approach to delivering the Winterproofing offer is to work with experienced and reliable delivery agents who perform the energy audits and install measures. Upgrades are determined by a free home energy audit performed by a Certified Energy Auditor to determine which cost-effective measures are most appropriate for each home. Basic measures, as defined above, are offered as part of the screening process. Once the measures are installed, a second home energy audit is conducted to verify the gas savings realized. EnviroCentre, Green Communities, GLOBE (Green Light on a Better Environment) and GreenSaver continued as the four primary service providers contracted by Enbridge to market and deliver the offer. These delivery agents have extensive experience in energy efficiency audit and retrofit delivery activities and are well established in their communities with recognized connections to low income constituents throughout the franchise area. The strategy of delivering the offer in partnership with community-based organizations with strong links to social service agencies has continued throughout the three-year multi-year plan. It has proven to be an effective way of connecting with a hard-to-reach customer segment. Where possible, delivery agents also refer participants to the local electric utility's conservation weatherization program.
Cost-Effectiveness	Low Income programs are often among the most expensive to deliver. As per the Guidelines, the Low Income program screening threshold is 0.70, the Low Income program was cost-effective as supported by the TRC screening above 1.0 (see Table 9 in Section 6). Gas savings for the Part 9 sector were achieved at a cost of $0.1751/CCM, as summarized in Table 22.

2014 Results	Single Family (Part 9) results were solid in 2014. Actual cumulative savings were 25.67 million CCM, as outlined in Table 22 below. These results exceeded the middle (100%) target 23.6 million CCM set out in the DSM Plan. The Enbridge Home Winterproofing offer reached 1,107 low income households in 2014. Many of these homes also received basic prescriptive measures including showerheads and aerators. An additional 147 homes benefitted from the installation of heat reflector panels (included in the prescriptive measures available in 2014).

Table 22. 2014 Single Family (Part 9) Low Income Results

Low Income Component	CCM Target (100%)	Actual CCM	$/CCM	Participants [2]	Units Installed [1]
Single Family (Part 9)	23,598,260	25,673,482	$0.1751	1,107	557

1. Units Installed refers to the number of units for prescriptive offers.
2. Participants refers to the number of unique addresses for Home Winterproofing.

Table 23. 2012-2014 Multi-Year Part 9 Results

Low Income Component	Actual CCM 2014	Actual CCM 2013	Actual CCM 2012
Single Family (Part 9)	25,673,482	32,904,684	24,708,220

2014 Highlights and Lessons Learned:

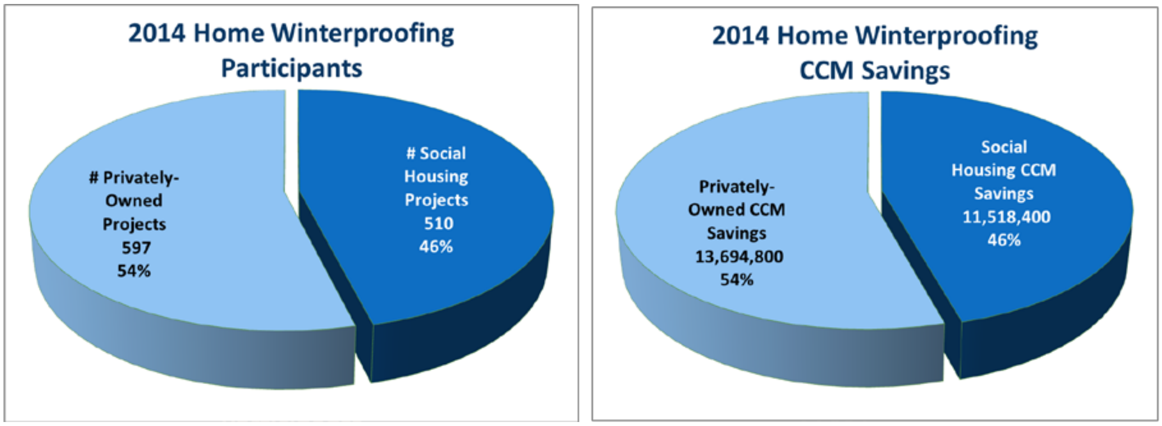
★ As summarized in Table 24, the analysis of projects completed in 2014 shows that average annual gas savings from the 510 social housing properties completed were 903 m^3 and the 597 privately-owned homes had an average annual gas savings of 918 m^3.

Table 24. Home Winterproofing – Average Project Savings

2014 Home Winterproofing Average Project Savings	Average Annual Gas Savings (m3)	Total Participants
Average Annual Gas Savings/Home - Social Housing	903	510
Average Annual Gas Savings/Home - Privately-Owned	918	597
Average/Total - All Projects	**911**	**1107**

- ★ In terms of both the number of projects completed and the CCM savings, social housing projects accounted for 46% of results and privately-owned projects accounted for 54%.

Table 25. Home Winterproofing–Social Housing and Privately-Owned



- ★ Notwithstanding the lack of gas savings expected from the Toronto social housing sector, significant savings were driven by the participation of other social housing providers as well as through delivery efforts to the privately-owned low income housing customer base.
- ★ Following a series of comprehensive interviews with key external stakeholders of the program, it became apparent that the lack of understanding regarding the service and the terminology being used was posing a significant barrier to participation in the offer. Customers in this market simply do not understand what “weatherization” is or what it means.

- ★ As a result, there was a significant improvement made to the Single Family Low Income effort in 2014, with the complete rebranding of the former Weatherization offer. Home Winterproofing was introduced early in 2014 and involved a full repositioning of outreach, marketing support materials and communication campaigns. Obvious financial barriers, challenging housing conditions, competing priorities and core needs as well as low customer awareness require customized outreach activities and well-designed marketing approaches.

- ★ The new name, brand and materials were developed to focus messaging on “warmth and comfort”. A logo was developed to deliver a recognizable and welcoming image for the offer. The logo depicts the home enveloped with a toque on the roof and a scarf to support the concept and goal of warming and increasing comfort in the home.

- ★ Specific new marketing efforts in 2014 included:
    - o A new brochure including fresh illustration-style graphics to represent homes “avoiding” the cold in a simple and memorable way. The brochure also incorporated the customer application form in one document for simplicity.

Stay comfortable and save energy all winter.

How do I qualify?

If you answer "yes" to all these questions, your home may qualify.

1. Is your home heated by natural gas?
2. Are you a customer of Enbridge Gas Distribution?
3. Do you pay your own natural gas bill?

And you also qualify if you participate in one of the following government assistance programs:

- Ontario Works
- Guaranteed Income Supplement
- National Child Benefit Supplement
- Allowance for Seniors
- Allowance for Survivors
- Ontario Disability Support Program
- Electric Utility HAP Program
- Healthy Smiles Ontario Child Dental Program

Or your household income is no more than the amounts on the following chart.

(Before tax income of all household members 18 years or older).

Household Size	Maximum Gross Annual Income
One (1) Occupant	$31,923
Two (2) Occupants	$39,744
Three (3) Occupants	$48,861
Four (4) Occupants	$59,322
Five (5) Occupants	$67,283
Six (6) Occupants	$75,882
Seven (7) or More Occupants	$84,484

Apply now and you will start saving.

How do I apply?

1. Mail or fax the application to the Enbridge Program Delivery Agent in your area or Enbridge Gas Distribution by December 31, 2014. The addresses are on the back of this brochure.

OR

2. Call the Enbridge Program Delivery Agent in your area. Numbers are listed on the back. They may be able to pre-qualify your home over the phone. You will need to provide a signed application, proof of income, and:
   - The account number on your gas bill
   - A copy of your last income tax assessment or benefit statement.

Why should I participate?

- **Save money.** The program can cut your energy use by 30% and lower your energy bills.
- **Be more comfortable.** An energy-efficient home has fewer drafts, and lets you control the temperature.
- **Get healthier.** Fewer drafts mean a more comfortable home for you and your family.
- **Increase the value of your home.** Buyers and tenants like energy-efficient homes.
- **Protect the environment.** The less energy you use, the cleaner the air.

- Campaigns encouraged customers to sign up for the program ahead of the heating season and have the Winterproofing measures installed in preparation for the cold weather.

- Transit ads were included on buses travelling in and around Toronto/GTA, Niagara, Simcoe, Durham, Peterborough and Ottawa areas.

- Two seasonal campaigns – "Spring into Winter" and "Fall into Winter" were run in June and September. Campaigns encouraged customers to complete the free Home Winterproofing pre-audit with the additional incentive of $20 gift cards.

- A social media campaign was developed to promote awareness across various channels.

- Posters were developed for use within various social agencies, in particular for the Low Income Energy Assistance Program (LEAP) in-take agencies and Member of Provincial Parliament (MPP) constituency office to post on their bulletin boards in key locations. An acrylic pocket was attached to hold brochures.

★ Enbridge facilitated webinars and information sessions targeted to audiences of social agencies and community groups at a local level to promote program awareness, introduce the new program concept and outline updated marketing materials.

★ Feedback from delivery agents supported the observation that an increased number of participants in 2014 came from low income home owners who responded to the new marketing/advertising by inquiring about the offer.

A revised LEAP outbound calling campaign was new for 2014. Enbridge developed a scripted outreach approach for the Enbridge Call Center. The script supported outbound calls to LEAP participants for the purpose of providing information regarding the offer and directing them to the appropriate delivery agent to determine offer eligibility. An estimated 7% of LEAP participants who Enbridge attempted to contact were ultimately transferred to a delivery agent in their area to discuss the Home Winterproofing opportunity. Moving forward, Enbridge LEAP intake is being centralized to a single agency and efforts are underway to streamline LEAP and Home Winterproofing applications. This effort should improve the uptake for the offer resulting from follow up calls to LEAP participants.

★ The Low Income offer included the small-scale introduction of an additional prescriptive measure for the Single Family segment to improve energy savings results and/or program delivery efficiencies. In collaboration with PEEL Living, heat reflector panels were incorporated into the screening process and, where applicable, were offered to customers for installation. GreenSaver was trained on the installation of the measure. The heat reflector panels are PVC panels with an aluminized surface designed to reflect radiant heat. They are installed in between the hot water heating units (radiator/convector) and the wall to reduce heat loss and reflect heat back into a room. In 2015, Enbridge will facilitate further training sessions with the manufacturer and other delivery agents to expand this effort.

- ★ With a focus on ongoing program improvement efforts, training and quality control improvements directed to delivery agents continued in 2014. Data collection protocols, outlines and checklists to support work plan documentation and reporting requirements were reviewed to support continuous improvement for effective tracking and reporting.

- ★ Enbridge continues to encourage delivery agents to cross-promote Ontario Power Authority's (OPA) funded saveONenergy Home Assistance Program (HAP) aimed at electricity focused energy efficiency while concurrently delivering the Home Winterproofing offer. This approach serves to benefit the customer by encouraging participation in both offers and maximizing potential energy savings. Enbridge will continue to explore opportunities for collaboration with electric utilities for efficiencies in delivering offers for low income customers.

- ★ Enbridge will expand its work with the Ontario Non-Profit Housing Association (ONPHA) in 2015 to create increased awareness, visibility and education about the Company's Low Income initiatives in addition to its usual participation at ONPHA's regional meetings and annual conference.

- ★ The Low Income program will continue to be a priority for Enbridge in 2015. The program will focus on uncovering energy savings in a market that benefits from resulting cost savings as well as through other non-energy related societal benefits. Obvious financial barriers, challenging housing conditions, competing priorities and core needs as well as low customer awareness will continue to require customized outreach activities.

Multi-Residential (Part 3)

Custom Projects and Prescriptive Measures

Objectives	The goal of the Multi-Residential Low Income offer is to capture energy savings through the reduction of space heating demand and hot water use in low income multi-residential buildings through the installation of thermal envelope improvements, space heating and water saving measures.

Target Customer	This offer targets Rate 6 multi-residential social housing providers and managers. In addition, the offer was extended in 2014 to include Rate 6 eligible owners and property managers of privately-owned multi-unit residential buildings (MURBs), which provide housing to a market that includes low income customers and families based on screening criteria established in collaboration with Enbridge's Low Income Consultative Working Group.
Metrics	The primary metric is cumulative cubic meter (CCM) savings.
Tracking Methodology	As with Commercial custom projects, the savings for each custom project are calculated on an individual basis. Additionally, savings per unit installed for each type of prescriptive measure are tracked and totalled. Results are recorded and summarized through a monthly tracking process utilizing EGD's sales tracking software.
Offer Description	Low Income Multi-Residential (Part 3) efforts help social housing providers and MURB managers improve the energy efficiency of aging buildings by offering the direct installation of basic energy savings measures. The offer alos provides financial support for custom retrofit and operational improvement projects - equipment replacement, thermal envelope improvements and controls. The Low Income Multi-Residential Custom offer takes a "building as a system approach" to energy efficiency. It targets housing providers, building operators and tenants with a range of measures and includes enhanced financial incentives, technical information services, building assessments/audits, education and project facilitation. Financial barriers inherent in the Low Income sector related to limited capital availability are addressed by

	providing an increased financial incentive relative to the standard custom offer, which provides \$0.10/ m^3 saved. Retrofits targeted at the Low Income sector are incented based on \$0.40/m^3 of gas saved (up from \$0.30 in 2013) for custom measures including building envelope, fans, boilers, heat recovery/economizers and make-up air units. Incentives are based on annual natural gas savings up to 50% of project cost. Prescriptive equipment replacement is incented at a set dollar amount depending on efficiency levels. These measures include specific condensing/high efficiency boilers, energy recovery ventilation systems and heat recovery ventilation systems. A free direct install showerhead installation program is also available. Technical issues are addressed by engaging sector experts to provide a suite of services including benchmarking, energy audits, technical assistance and project facilitation. Energy audits are incented as follows: 50% off up to \$5,000 per building or \$0.01 per m^3 gas consumed. For 2014, GLOBE, a subsidiary of the Housing Services Corporation (HSC), was engaged to provide program management and delivery services for the social housing Multi-Residential Low Income offers. The one exception is Toronto Community Housing, which is the largest single social housing provider in the country. TCH requires dedicated account management services from Enbridge, therefore the Company works directly with TCH on its multi-residential energy efficiency projects. Low-flow showerheads and heat reflector panels are provided on a direct install basis to eligible buildings.

Cost-Effectiveness	As per the Guidelines, the Low Income program TRC screening threshold is 0.70. The Low Income program was cost-effective as supported by the TRC screening above 1.0 (see Table 9 in Section 6). Gas savings for the Part 3 sector were achieved at a cost of $0.0648/CCM, as summarized in Table 26 below.
Evaluation Activities	Following internal verification review of all Low Income Multi-Residential custom projects by the DSM technical group, a further verification of Low Income custom projects is undertaken as part of the Commercial Custom Project Savings Verification (CPSV) process. An independent third-party engineering review, the Commercial Custom Project Savings Verification (CPSV), is conducted annually. The scope of work for this review is set out in a Terms of Reference established by the Technical Evaluation Committee (included as Appendix A). This verification study consists of a detailed review of the savings calculations for a statistically representative sample of Commercial sector custom projects (including Low Income Multi-Residential) claimed in 2014. The Commercial CPSV is summarized in Appendix B, and the prescribed sampling methodology followed to establish the selected projects is referenced in Appendix I. Reported results incorporate adjustments recommended by the engineering review followed by the determination of a realization rate adjustment as outlined in Appendix D.
2014 Results	The Multi-Residential offer faced significant challenges in meeting aggressive savings targets established for 2014. CCM natural gas savings were 29.8 million CCM, below the lower target metric.

Table 26. 2014 Multi-Residential (Part 3) Low Income Results

Low Income Component	CCM Target (100%)	Actual CCM	$/CCM	Participants [2]	Units Installed [1]
Multi-Residential (Part 3)	64,255,160	29,801,158	$0.0648	66	3,043

1. Units installed refers to the number of units for prescriptive offers.
2. Participants refers to the number of unique addresses for custom projects.

Table 27. 2012-2014 Multi-Year Part 3 Results

Low Income Component	Actual CCM 2014	Actual CCM 2013	Actual CCM 2012
Multi-Residential (Part 3)	29,801,158	27,314,154	43,407,789

2014 Highlights and Lessons Learned:

- ★ As the largest social housing provider in the country, TCH is a significantly large customer in Enbridge's low income customer group. Internal management changes, operational challenges and funding shortfalls as well as changing representation in the municipal government following elections have meant no resolution regarding the re-evaluation of initiatives and the re-prioritization of multi-residential energy efficiency projects. This scenario has continued in 2014, as in 2013, to have a significant negative impact on Part 3 results. Enbridge remains committed to assisting TCH by providing the much-needed technical support to better understand their portfolio and provide the direction to identify the opportunities that align with their priorities.

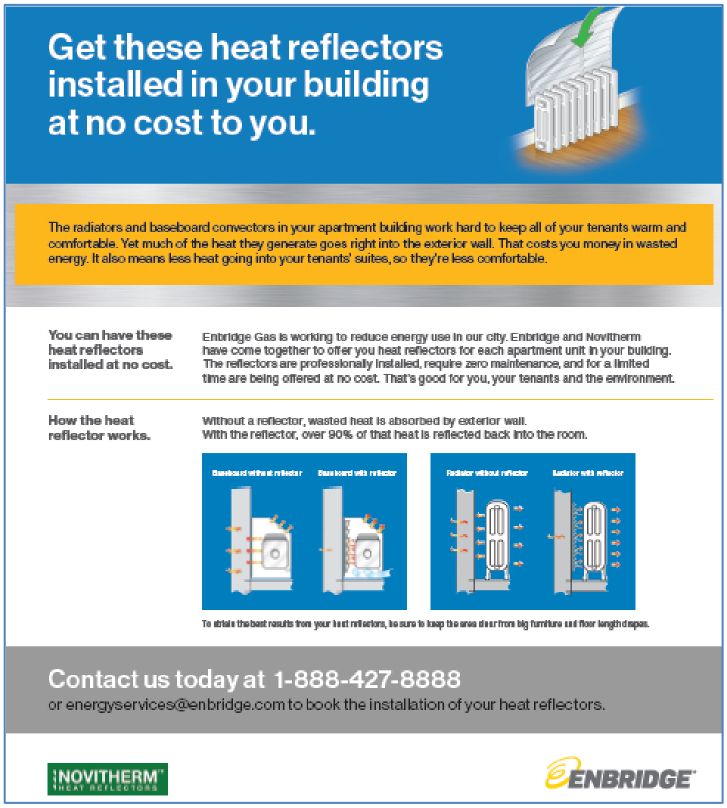
- ★ As in 2013, the offer continued to be directed to social housing providers elsewhere in the Enbridge franchise area. The offer involved direct engagement between EGD and social housing management groups as well as third-party delivery channels. No significant changes were made in 2014 to the process for capturing, calculating and tracking savings.

- ★ Retrofit fatigue in the social housing sector persists with the lingering effects of the Social Housing Renovation and Retrofit Program (SHRRP) and the Renewable Energy Initiative (REI) in the past five years and, most recently, with the accelerated application deadline for social housing projects under saveONenergy. These concurrent programs have created an additional challenge to engage housing providers to work with Enbridge for additional or deeper energy saving opportunities.

- ★ Enbridge and the Low Income Consultative Working Group continued to work collaboratively in 2014, with additional resources as necessary, to develop protocols for including privately-owned multi-residential buildings in the Low Income program within the City of Toronto based on available data specific to this municipality. The protocols are based on the following established principles:

    - o Eligibility: To be eligible to participate in the Low Income program, it should be established that privately-owned multi-residential buildings have a high proportion of low income tenants.
    - o Screening for eligibility: Screening will be based on the data available within a given region in consultation with the Low Income Consultation subgroup.
    - o Impact on Rents: Participation of privately-owned multi-residential buildings through building owner or management participation should not result in a rent increase to building tenants.
    - o Benefits to Tenants: Participation of multi-residential privately-owned buildings in the Low Income program should include measures that will result in direct benefit to tenants, e.g., in-suite measures that increase comfort and health.

- ★ As a result of the efforts mentioned above, the Low Income Part 3 offer was expanded in the fall of 2014 to include privately-owned Part 3 multi-residential buildings in the City of Toronto. Delivery to this target group of customers involved the assistance of EGD ESCs in identifying projects. The offer included the direct install of heat reflector panels targeted to privately-owned multi-residential buildings in Toronto.



Get these heat reflectors installed in your building at no cost to you.

The radiators and baseboard convectors in your apartment building work hard to keep all of your tenants warm and comfortable. Yet much of the heat they generate goes right into the exterior wall. That costs you money in wasted energy. It also means less heat going into your tenants' suites, so they're less comfortable.

You can have these heat reflectors installed at no cost.

Enbridge Gas is working to reduce energy use in our city. Enbridge and Novitherm have come together to offer you heat reflectors for each apartment unit in your building. The reflectors are professionally installed, require zero maintenance, and for a limited time are being offered at no cost. That's good for you, your tenants and the environment.

How the heat reflector works.

Without a reflector, wasted heat is absorbed by exterior wall.
With the reflector, over 90% of that heat is reflected back into the room.

To obtain the best results from your heat reflectors, be sure to keep the area clear from big furniture and floor length drapes.

Contact us today at 1-888-427-8888
or energyservices@enbridge.com to book the installation of your heat reflectors.

NOVITHERM HEAT REFLECTORS
ENBRIDGE

- Moving forward, Enbridge will work with the Low Income Consultative sub-group to develop protocols for additional municipalities based on the data and information available in those areas on a case-by-case basis.

- In partnership with the City of Toronto's Tower Renewal Office, Enbridge's campaign leveraged the extensive work the City has done to understand the building towers, residents and social planning needs of communities. These efforts are part of the continuing collaborative work Enbridge undertook with the United Way Toronto (UWT) in the 2013 private multi-residential demonstration program. Enbridge utilized the City of Toronto Tower Renewal Office where census tract information showed 40% and above of residents are low income persons (using the Low Income Measure (LIM) as the primary indicator) living in buildings eight stories or greater and where the buildings are located in City-determined communities with high social needs, i.e. Neighborhood Improvement Areas.

- With the Federation of Rental Property Owners (FRPO) as part of the Low Income Working Group, Enbridge is engaging FRPO as the largest organization representing private rental housing providers to promote the program to its membership.

Is the Multi-Residential Program right for my organization?

Enbridge fixed dollar and custom incentives offer a great opportunity to upgrade equipment.

They enable you to offset the costs of retrofits and to benefit from on-going energy efficiency savings that also help shorten the payback period.

Save money on capital improvements that reduce energy use and improve resident comfort

Energy Incentives for the Social Housing Sector

Offered by Enbridge Gas Distribution and Delivered by GLOBE

Incentives & Benefits

Enbridge Gas Distribution's Multi-Residential Incentive Program offers financial incentives to social housing providers (owners and property managers) who undertake energy audits or make capital improvements that result in reduced gas consumption.

Energy Audits

If you conduct an energy audit, you're eligible to receive either half the cost of the energy audit up to $5,000 or $0.01/m³ of gas consumed in the most recent calendar year.

Capital Improvements[A]

Replacing heating and ventilation systems or equipment

Fixed dollar incentives that start at $1,000 are available for smaller-sized condensing or high-efficiency boilers, energy recovery ventilation and heat recovery ventilation systems.[B C]

Larger, energy-saving capital improvements

'Custom' incentives for retrofits such as boilers, make-up air units, and building envelope upgrades, incentives are calculated on projected first year's natural gas savings at the rate of $0.40/m³ saved up to a $100,000 limit.[B C]

Low-flow showerhead replacements

Covers the supply and installation of energy-efficient showerheads (manufacturer-specified flow rate of 1.5 gallons per minute or less) to replace standard showerheads (flow rate of 2.5 gallons per minute or greater).[B]

Enbridge Custom Incentives reward your efficiency gains

- The Company will continue to engage multiple levels of management within municipal housing providers – from operational, “on-the-ground” staff to senior strategic-level management – to help in addressing barriers and facilitate decisions. This engagement will be particularly important in propelling efforts to implement energy efficiency projects for housing providers such as Toronto Community Housing.

- In the affordable housing building community, resident engagement has become a critical and influential factor in decision-making, successful project implementation and ensuring the sustainability of savings. Therefore, Enbridge will need to continue to co-ordinate its efforts with the understanding that resident input to the budgeting considerations of housing providers is commonplace in the project planning process.

Low Income Building Performance Management (LIBPM) [17]

Objectives	This initiative is designed to provide participants with detailed energy and water consumption information and benchmarking reports at no cost. The goal is to raise the level of awareness on energy usage. In addition, coaching is provided on possible areas of improvement, energy efficiency tips and energy efficiency opportunities.
Target Customer	Rate 6 multi-residential social housing providers and managers.
Metrics	The metric for this offer is based on the percentage of Part 3 buildings enrolled in the current year. Building owners or managers who have “enrolled” in Low Income Building Performance Management are counted towards the metric. The formula for calculating the percentage of Part 3 buildings enrolled in the current-year Low Income Building Performance Management offer is as follows: $\% \text{ LIBPM} = \dfrac{(x + y)}{(x + y + z)}$ where: x = Number of new LIBPM buildings in the current year that have participated in another aspect of the Low Income program in a previous year of the 2012-2014 plan; y = Number of new LIBPM buildings participating in current year that have not previously participated in the Low Income program; and, z = Number of buildings in the current year that have implemented custom projects other than LIBPM.
Tracking Methodology	Participating buildings are required to complete an Enrollment and Participation form. Copies of these forms

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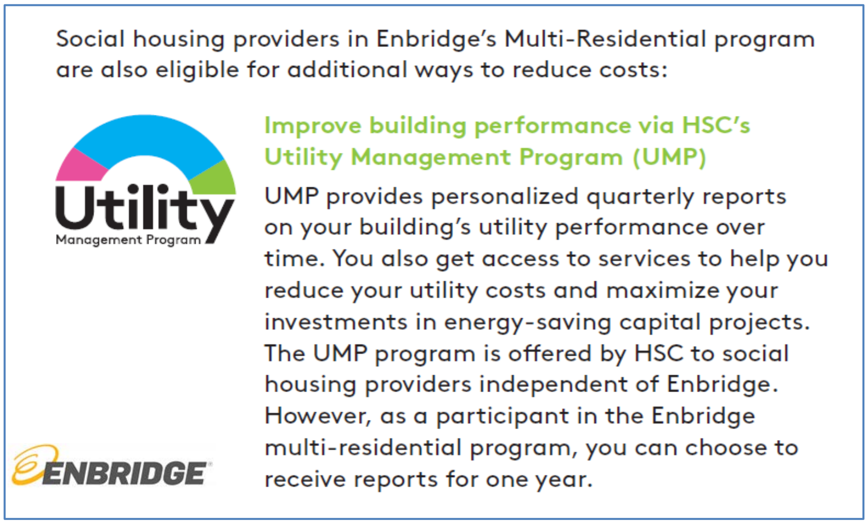
[17] Low Income Building Performance Management is the Low Income offering complement to the Commercial Run it Right (RiR) offering.

	are tracked along with copies of quarterly reports delivered by GLOBE and sent to participants as well as annual reports summarizing natural gas savings for each participant. The offer undergoes monthly tracking by the Tracking and Reporting team, utilizing EGD's sales tracking software.
Offer Description	As outlined in the 2013-2014 Update (EB-2012-0394) and in recognition of the need for a Building Performance Management offer directed at the Low Income sector, the concept of the Commercial Run it Right activity was modified to reflect the needs of social housing providers and the characteristics of social housing buildings. The Low Income Building Performance Management initiative (LIBPM) has been simplified to include: • benchmarking specifically developed for the social housing sector; • analysis of historical consumption data; • development of recommendations for reducing consumption; and • assessment of resulting changes in consumption 12 months later based on changes in actual gas usage. In line with the Low Income delivery strategy of leveraging and/or enhancing existing sector and delivery agents' networks, Enbridge entered into an agreement with GLOBE/HSC. Initially developed as a one-year trial program, GLOBE secured funding from the OPA to pilot an electricity-focused benchmarking initiative. Enbridge engaged GLOBE to enhance and expand the building subscription of its Utility Management Program (UMP) to include gas benchmarking and consumption analysis.

	Through this initiative, the energy consumption of participating buildings is tracked over a twelve-month period. Quarterly reports are generated for each building. Follow-up calls are made by GLOBE/HSC to “underperformers” based on the benchmarks established, to provide coaching and identify pathways to energy savings – from improved operational practices to energy savings incentives. The quarterly report is also used to generate program awareness and as a means to identify potential projects for custom or prescriptive offers.
2014 Results	The 2014 year saw continued good interest in the marketplace for this offer, and Enbridge reached a significant number of buildings. There were 183 properties that participated in the LIBPM offer in 2014. Based on the calculation outlined for the metric, this resulted in a score of 74% for this metric, well above the upper target for this initiative.

2014 Highlights and Lessons Learned:

- ★ The partnership with Enbridge has allowed GLOBE to continue expanding the UMP initiative well beyond its initial efforts in 2012 and make the necessary enhancements to improve usability and functionality of the tool for housing providers.



Social housing providers in Enbridge’s Multi-Residential program are also eligible for additional ways to reduce costs:

Improve building performance via HSC’s Utility Management Program (UMP)

UMP provides personalized quarterly reports on your building’s utility performance over time. You also get access to services to help you reduce your utility costs and maximize your investments in energy-saving capital projects. The UMP program is offered by HSC to social housing providers independent of Enbridge. However, as a participant in the Enbridge multi-residential program, you can choose to receive reports for one year.

- ★ Enbridge's will continue its support for UMP as it serves as a lead generator for retrofit and other energy savings opportunities.

- ★ The initiative has been well-received by housing providers and service managers over the last two years; Enbridge will continue its partnership with HSC in supporting UMP through the LIBPM initiative into 2015.

Market Transformation Program

As defined in the Board's DSM Guidelines, "market transformation programs are focused on facilitating fundamental changes that lead to greater market shares of energy efficient products and services, and on influencing consumer behaviour and attitudes that support reduction in natural gas consumption. They are designed to make a permanent change in the marketplace over a long period of time."[18] Enbridge's Market Transformation program comprises offers for both new construction sectors (Commercial and Residential) as well as an offer directed to the existing residential sector.

Enbridge is pleased to report that 2014 was a successful year with respect to the performance of the Market Transformation (MT) program. Each of the Company's three offers in this program has seen increasing recognition in the marketplace from the respective target market groups that each was intended to educate and influence in support of reducing natural gas consumption. On a weighted scorecard basis, all three of the offers met or exceeded their upper performance targets.

Savings by Design Residential and Savings by Design Commercial are designed to influence the new construction sector and were introduced in 2012 in conjunction with the current multi-year plan. These offers were developed to play a role, both through education and influence, in demonstrating to builders/developers ways of building to standards above the current building code requirements and achieve energy performance savings.

The Home Labelling (Rating) offer was developed to influence the home re-sale marketplace by helping individuals to understand what a home rating represents and the value it brings to homebuyers and sellers.

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[18] *"Demand Side Management Guidelines for Natural Gas Utilities"* (EB-2008-0346), OEB, June 30, 2011, page 10.

New Construction

Residential Savings by Design (SBD)

SBD Residential Charrette

Objectives	The goal of the Residential Savings by Design program is to use the Integrated Design Process (IDP) to demonstrate to builders the potential for achieving higher levels of energy and environmental performance through the application of alternative design approaches. In order to realize the potential that the IDP demonstrates to the builder, performance incentives are provided. These incentives encourage the construction of new homes to an energy efficiency standard 25% above the level prescribed in the 2012 Ontario Building Code, ("OBC"). EGD expects that Residential SBD will help builders see the value of the IDP approach, striving to encourage adoption on an ongoing basis.
Target Customer	The offer targets builders and designers of new, Part 9 residential low-rise houses (towns, semis and detached homes) in the Enbridge franchise territory. The intent is to engage builders who construct multiple homes in any given year.

Metrics	There were two metrics for SBD Residential in 2014. The first metric tracks the number of previously non-participating eligible builders that enroll and take part in the IDP; the second metric tracks the number of homes built to the SBD specifications over the course of the year.
Tracking Methodology	This offer requires a commitment from builders to construct within a three-year time frame following the completion of the IDP. In order to follow up on the builder commitment, the Channel Consultants maintain regular contact with builders to ensure proper submission procedures are followed for the builders to receive incentives.
Offer Description	The SBD Residential offer has been developed to address lost opportunities in the Residential new construction sector. The offer focuses on engaging building industry stakeholders and leveraging industry capabilities to encourage builders to make informed decisions that realize potential energy savings. By educating builders on how to build more energy efficient buildings, along with providing a building incentive, the Company influences these builders to first “design it right”, then “build it right” and, finally, “sell it right”. SBD is designed to provide a variety of support activities for builders of new homes from the early design phase through to construction. Savings by Design is a process-based approach involving: • Visioning Session – to define the builder’s sustainability priorities and opportunities; • Integrated Design Process Session – to identify and evaluate strategies to meet the builder’s sustainability goals and the SBD energy reduction target of 25% beyond code through application of energy modelling; • Building Energy Modelling – to evaluate energy performance baselines and proposed improvements.

	This consultation involves connecting participating design teams with leading industry experts and other stakeholders as they consider alternative approaches to energy and environmental performance. Through this process, the team works with the builder to explore opportunities to achieve higher energy performance. Starting with the building envelope (windows, wall structure, insulation) and moving inward with HVAC mechanicals and lighting, the Savings by Design team guides the builder through a design process to achieve a modelled building that performs to at least 25% better than 2012 OBC. In addition, depending on the specific priorities identified during the visioning session, experts from fields such as lighting, storm water management, sustainable land-use planning or renewable energy can be engaged to provide further value to the IDP. In order to receive the incentive, builders must agree to allow a third-party service provider to provide testing and verification services to ensure that constructed homes are built with 25% greater energy efficiency than required under the current OBC.
2014 Results	As illustrated in Table 28, in the third year for this offer, Residential SBD was successful in enrolling 23 new builders who completed the IDP process in 2014. The result exceeds the upper target for this metric. In addition, there were 1,059 new homes built in relation to the completed units metric. In other words, for builders who have enrolled and completed the IDP process since 2012, these were the homes constructed through the initiative that had features consistent with SBD standards of 25% above OBC (as illustrated in the builder's IDP). This result exceeded the middle target for completed units in 2014.

Table 28. 2014 Residential Savings by Design Scorecard

Component	**Metric**	**Targets**				**2014 Actual Result**
		Weight	**Lower**	**Middle**	**Upper**	
Residential Savings by Design	*Completed Units*	***40%***	750	1000	1,250	**1059**
	Previously Non-Participating Builders Enrolled [1]	***60%***	12	16	20	**23**

1. Eligible builders based on a minimum of 50 homes built in the prior year.

Table 29. SBD Residential 2012-2014 Results

Component	**Metric**	**2014 Actual Results**	**2013 Actual Results**	**2012 Actual Results**
Residential Savings by Design	*Completed Units* [1]	**1,059**	**967**	**N/A**
	Previously Non-Participating Builders Enrolled [2]	**23**	**18**	**12**

1. Metric not applicable in 2012.
2. Eligible builders based on a minimum of 50 homes built in the prior year.

2014 Highlights and Lessons Learned:

- ★ In 2014, SBD Residential has continued to successfully expose additional builders to the IDP initiative while also working with previous attendees to assist them in building homes to the improved standards set out in the offer.

- ★ SBD Residential is a relationship-based effort. Success with the offer is reliant on the efforts of EGD Channel Consultants in recruiting key decision makers of building companies to reassess their approach to building design as it relates to their energy efficiency considerations; and as a means of preventing lost opportunities and realizing deep energy savings.

- ★ Feedback from builders that have participated in an IDP indicates that they recognize the potential of alternative planning and design approaches as a means to achieving improved energy and environmental performance in their projects.

- ★ Drawing on the experience, expertise and interests of all stakeholders, the offer has provided a forum for enhanced relationship development between Enbridge, builders, municipalities and other industry participants.

- ★ Enbridge ensured that participants were made aware of other energy efficiency programs available, including the Ontario Power Authority (OPA) funded saveONenergy Residential New Construction program aimed at electricity focused energy efficiency, in an effort to ensure the builder could take advantage of other potential energy savings.

- ★ Enbridge has gained further insight into the sales and marketing challenges facing builders, and is continuing to develop and evolve consumer-facing marketing collateral to support builder efforts to sell energy efficiency. These materials will be enhanced on a regular basis as more learning from builders and their customers continue to drive marketing innovation.

Your Guide to SBD Sales Collateral

Live SAVINGS BY DESIGN™

Use these marketing materials to help educate homebuyers on the advantages of owning a Savings by Design (SBD) home. All pieces will be co-branded with your own company logo (see reverse for how to supply your logo to us).

① live.savingsbydesign.ca Website

This website has detailed information on what makes a Savings by Design home a smart choice. The URL appears on all collateral, along with a QR code that consumers can scan with their smartphone to be brought to the site immediately. Your team can also refer to the site on screen to help explain the SBD home features.

② Consumer Benefits Banner

This self-supporting banner should be displayed somewhere near the entrance of your sales centre. Its purpose is to quickly educate consumers on the four main benefits of owning a Savings by Design home, and drive them to visit the website or scan the QR code to learn more.

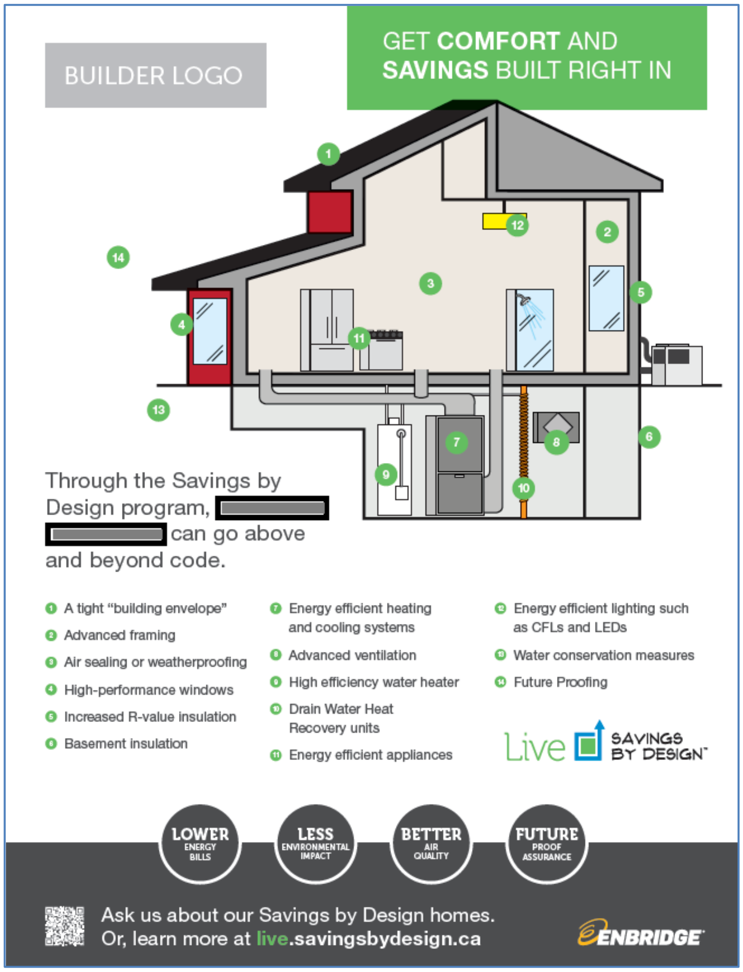
Size: 31.5"x78"
Quantity: 1 of your choice of 3 versions
Price: $350 (first supply is courtesy of Enbridge)

③ SBD Home Features Poster

This poster should be displayed prominently in your sales centre. Its purpose is to show consumers the key energy efficient upgrades that would be included in a Savings by Design home, and also to work as a reference for your team as they explain some of the upgrades.

Size: 18"x24"
Quantity: 1
Price: $50 (first supply is courtesy of Enbridge)

- ★ As part of the IDP charrette, a sales and marketing module was added to address a builder-identified barrier in upselling energy efficiency homes to prospective buyers.
- ★ Builders continue to face external challenges to achieving their targets for construction of new energy efficient homes due to lack of consumer demand, land access issues and market fluctuations.



BUILDER LOGO

GET **COMFORT** AND
SAVINGS BUILT RIGHT IN

Through the Savings by Design program, [redacted] [redacted] can go above and beyond code.

① A tight "building envelope"
② Advanced framing
③ Air sealing or weatherproofing
④ High-performance windows
⑤ Increased R-value insulation
⑥ Basement insulation
⑦ Energy efficient heating and cooling systems
⑧ Advanced ventilation
⑨ High efficiency water heater
⑩ Drain Water Heat Recovery units
⑪ Energy efficient appliances
⑫ Energy efficient lighting such as CFLs and LEDs
⑬ Water conservation measures
⑭ Future Proofing

Live SAVINGS BY DESIGN™

LOWER ENERGY BILLS

LESS ENVIRONMENTAL IMPACT

BETTER AIR QUALITY

FUTURE PROOF ASSURANCE

Ask us about our Savings by Design homes.
Or, learn more at **live.savingsbydesign.ca**

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★ Builders continue to express a desire to participate in multiple charrettes due to the heterogeneous nature of the disparate developments. EGD has recognized the value in this idea, specifically as it relates to the impact that multiple IDP participations could have on builder culture.

★ Builders have responded that, given the opportunity, they would benefit from going through the design process for subsequent projects since each development is unique in terms of housing and environmental impacts.

★ Participation in the offer includes a commitment from builders to construct within a three-year time frame following the completion of the IDP. The number of incentivized homes built and the associated incentive payable was not realized in the 2014 offer year. The offer continues to have an outstanding incentive commitment to these participants over the multi-year period.

★ The current DSM framework and planning process, including the budget timeframe, is structured to address programs in one-year “windows”. The SBD Residential offer currently provides builders a three-year horizon in which to complete the homes that are eligible to be incented through the offer. Enbridge has identified some concerns from a forecasting perspective such that managing commitments made to participants over a multi-year period is proving challenging with annual (one-year) budgets. In Enbridge’s 2015-2020 Multi-Year DSM Plan (EB-2015-0049), the Company has proposed the use of a deferral account to address this challenge.

Commercial Savings by Design (SBD)

SBD Commercial Charrette

Objectives	The goal of the Commercial Savings by Design offer is to use the Integrated Design Process to demonstrate to builders the potential for achieving higher levels of energy and environmental performance through the application of alternative design approaches. The offer is intended to support this demonstration and awareness with incentives that encourage builders to use the knowledge gained in the IDP to design and build buildings that are more energy efficient. EGD expects that Commercial SBD will help builders see the value of the IDP approach, striving to encourage adoption on an ongoing basis.
Target Customer	This offer is targeted at builders and designers of new, Part 3 commercial buildings in the Enbridge franchise territory. Enbridge targets its promotional activity to owners, builders and developers, design teams including architects, design engineers and energy modelers.

Metrics	Builders and developers who enroll in the offer and complete the IDP process are eligible to be counted towards performance targets. As per EB-2012-0394, metrics are based on the number of projects to which a developer commits, i.e. "the same developer with different clients and different kinds of projects may be counted multiple times. A minimum 100,000 square feet requirement applies to each project. A project is defined as either a single building or multiples of the same building by the same company that add up to 100,000 square feet."[19]
Tracking Methodology	Enrollment entails a signed memorandum of understanding with a builder or developer containing a commitment to participate in the Commercial Savings by Design offer and participate in the IDP process. The builder commits to constructing building(s) to the IDP standard within five years in order to receive performance incentives. EGD Channel Consultants maintain regular contact with builders to track project status to project completion. Charrette reports for each IDP are maintained to provide a record of information on preliminary estimated savings for each project.
Offer Description	Enbridge has provided commercial new construction programming since 1999, beginning with the Design Assistance Program ("DAP"), which was developed to engage the new building design community to design and model new construction buildings to higher levels of energy efficiency. The Commercial Savings by Design offer was designed and developed for delivery beginning in 2012 to encourage developers to build/construct Part 3 buildings to 25% above 2012 OBC. The offer includes the following

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[19] EB-2012-0394, Exhibit B, Tab 1, Schedule 3, page 17 of 20.

	types of activities: • Improving sizing and design; • Optimization of passive solar, day lighting and natural ventilation; • Integration of high efficiency lighting and HVAC systems; • Integration of lighting and HVAC controls in response to occupant loads; • Reduction and/or optimization of internal loads; • Improving thermal characteristics of the building envelope; and • Managing environmental impacts. In addition to the facilitation of the IDP, which brings together industry experts, conservation authorities, and municipalities, the offer provides incentives that include financial support to cover costs associated with the IDP and additional incentives tied to the achievement of gas savings above code.
2014 Results	Enbridge was successful in enrolling 19 new developments in 2014 that met the eligibility requirements and completed the IDP process. This result reached the upper scorecard target.

Table 30. 2014 Commercial Savings by Design Scorecard

Component	Metric		Targets			2014 Actual Result
		Weight	Lower	Middle	Upper	
Commercial Savings by Design	*New Developments Enrolled*	***100%***	8	12	19	**19**

Table 31. SBD Commercial 2012-2014 Results

Component	Metric	2014 Actual Results	2013 Actual Results	2012 Actual Results
Commercial Savings by Design	*New Developments Enrolled*	**19**	**16**	**9**

2014 Highlights and Lessons Learned:

- ★ As with the Residential offer, SBD Commercial continues to receive positive reviews from those taking part in the process. In addition to the primary focus of influencing builders to construct their building(s) to 25% above the current OBC in the new construction market, the overall education component of the design charrette is also helping to prepare builders for the upcoming building code update in 2017.

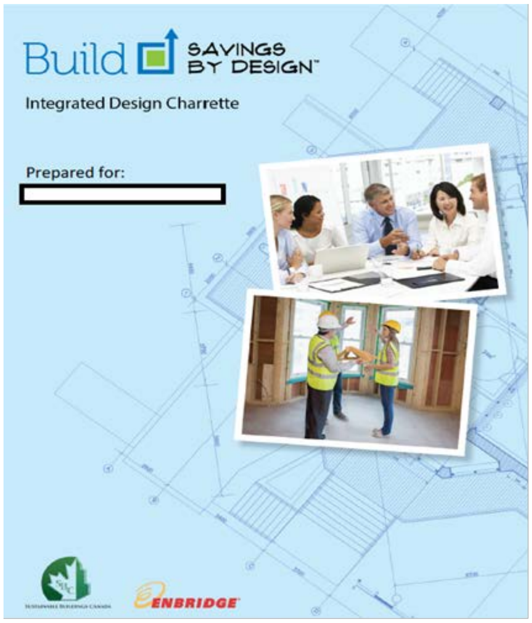
- ★ The 2014 year saw increased enrollments following good success in 2012 and 2013 in engaging builders to participate in the design charrettes.

- ★ In some cases, participants continue to wrestle with the view that building “green” is an expense rather than an investment. The commercial builder is price sensitive, and an additional cost for energy efficiency considerations is not always viewed as providing enough of a positive differentiator to offset a price increase to the end customer. With this in mind, Enbridge explored how to incorporate a cost estimation element to the IDP process to provide additional value in consideration of the client’s cost/benefit analysis.

- ★ In investigating this idea, Enbridge recognized that the pricing structure for products varies from builder to builder based on such factors as relationships with suppliers or the builder’s ability to benefit from bulk purchasing. As a result, Enbridge took a different approach. The IDP now incorporates guidance in estimating potential incremental costs for design considerations and improvements, by providing relative increases on a percentage basis, across the spectrum of technologies proposed.

★ Not surprisingly, many of the developments being reviewed in the offer have been buildings being contemplated from around the Greater Toronto and Ottawa areas, as these urban centers would be expected to be home to these larger buildings.

★ Though it is anticipated that the new condo construction market will slow in Toronto over the next number of years, with the recent strength of the condo development market in Toronto in the last few years, many of the projects partaking in the process since 2012 have been condo projects.

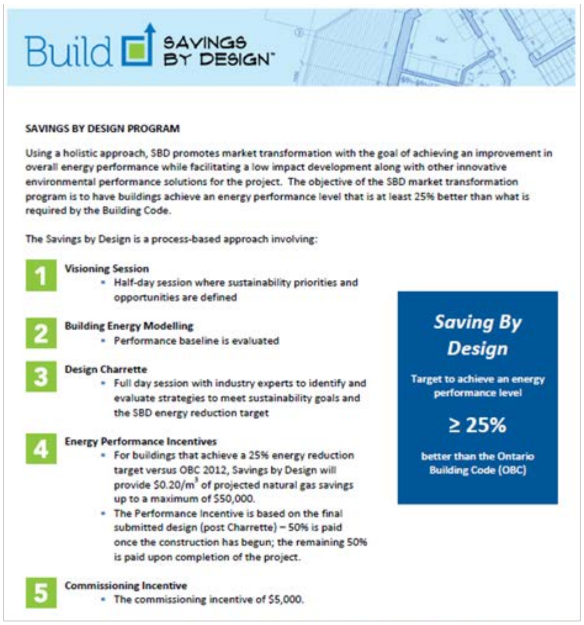


Build SAVINGS BY DESIGN™

Integrated Design Charrette

Prepared for:

ENBRIDGE



Build SAVINGS BY DESIGN™

SAVINGS BY DESIGN PROGRAM

Using a holistic approach, SBD promotes market transformation with the goal of achieving an improvement in overall energy performance while facilitating a low impact development along with other innovative environmental performance solutions for the project. The objective of the SBD market transformation program is to have buildings achieve an energy performance level that is at least 25% better than what is required by the Building Code.

The Savings by Design is a process-based approach involving:

1 **Visioning Session**
- Half-day session where sustainability priorities and opportunities are defined

2 **Building Energy Modelling**
- Performance baseline is evaluated

3 **Design Charrette**
- Full day session with industry experts to identify and evaluate strategies to meet sustainability goals and the SBD energy reduction target

4 **Energy Performance Incentives**
- For buildings that achieve a 25% energy reduction target versus OBC 2012, Savings by Design will provide $0.20/m^3 of projected natural gas savings up to a maximum of $50,000.
- The Performance Incentive is based on the final submitted design (post Charrette) – 50% is paid once the construction has begun; the remaining 50% is paid upon completion of the project.

5 **Commissioning Incentive**
- The commissioning incentive of $5,000.

Saving By Design

Target to achieve an energy performance level

≥ 25%

better than the Ontario Building Code (OBC)

	Heating	Cooling	Interior Lighting	Exterior Lighting	Fans	Pumps	DHW	Process
■ Baseline	37,242	13,477	19,990	1,968	40,080	2,497	1,786	25,500
■ Reference	60,604	14,217	21,446	1,968	45,415	3,472	2,128	25,500

★ Savings by Design Commercial is still a relatively new offer and efforts will continue to focus on building awareness and leveraging on the success demonstrated thus far. Strategic involvement in conferences and events that provide an opportunity to showcase the offer and market the approach will be ongoing. Opportunities to engage architects, developers and construction industry manufacturers will be explored, for example the Canada Green Building Council and the Green Building Festival as well as municipal stakeholder events.

Savings by Design.

Design it right. Build it right. Run it right.

The Savings by Design program supports you with expertise and rewards you with performance incentives through the three primary stages of your project.

ENBRIDGE
Life Takes Energy™

1 Integrated Design Process (IDP)

The process begins with a visioning session to help define your project requirements and sustainability priorities, and establish a baseline energy model. Next, during an Integrated Design Charrette, you'll work with a multidisciplinary team of experts to explore possible building design improvements. You'll receive a final charrette report outlining the recommendations and final energy modelling results.

IDP incentive – up to $25,000.

Savings by Design covers all costs of the IDP, up to a $25,000 value, including:

- Visioning session and report
- Preliminary energy model and charrette energy model
- Integrated Design Charrette logistics, catering facilitation and design expert fees
- Final charrette report

2 Energy Performance

The IDP identifies the optimal mix of design elements and technologies to maximize energy and environmental performance. Implementing these recommendations can help you achieve significant energy savings and qualify you for valuable incentives.

Performance incentive – $15,000.

For buildings that achieve a 25% energy reduction target versus OBC 2012 with SB-10, Savings by Design will provide a $15,000 incentive once the energy performance target has been met.

3 Commissioning

Commissioning is a process of confirming that design, construction and system operations meet the project requirements. This benefits energy efficiency by ensuring that the optimal size of equipment is specified and building systems are installed and operating as predicted.

Commissioning incentive – $15,000.

For builders that surpass the energy performance target of 25% better than OBC with SB-10 and submit the Final As-Built Energy Model along with the final Commissioning Report will be entitled to receive a $15,000 incentive.

★ Enbridge has developed strong relationships with builders and is now connected with some high profile buildings. Having the Savings by Design name associated with these projects will help support the value of the offer and increase the overall market acceptance of the approach. This exposure will not only help to increase awareness but will also help to demonstrate to other developers – the benefits of the offer, the value of the Savings by Design process and what can be accomplished.

★ A focus for 2015 will be to explore more opportunities to impact school and long term care facilities projects as both the Ministry of Health and the

Ministry of Education have approved incremental funds from the province for building in these sectors.

★ Even with changes that were made to the 2013 and 2014 offers during the consultation process to update the 2012-2014 multi-year plan that allowed for the inclusion of developments in cases where the proponent can show aggregate potential for the construction of multiple, similar buildings, to meet the square footage threshold -- there continue to be lost opportunities resulting from projects that are disallowed to participate because they do not meet the minimum aggregate size requirement. In Enbridge's 2015-2020 Multi-Year DSM Plan (EB-2015-0049), the Company has proposed a revision to the eligibility criteria to capture these opportunities.

Existing Residential

Home Labelling (Rating)

Objectives	The primary objective of the Home Labelling offer is to achieve widespread adoption of a voluntary home labelling system in the residential home resale marketplace. This initiative is aimed at educating the Residential market (realtors and homeowners) to better understand the concept of home energy rating and the value it brings in the resale market. Ultimately, the goal is to transform the re-sale market so that a home's energy performance rating becomes a standard condition of sale, similar to home inspections.
Target Customer	The immediate target market to support the deployment of a home rating system is realtors and their various real estate brokerages. To achieve this aim, collaboration with brokerages willing to commit to promoting Home Labelling and educating real estate agents is a key component for effective delivery. The ultimate market is residential (Rate 1) customers and real estate agents / brokerages who are listing homes for sale.
Metrics	The first metric requires Enbridge to secure new commitments from realtors collectively responsible for more than 5,000 (middle target) or 10,000 (upper target) home listings per year. The 2013 scorecard introduced a second metric, which counts the number of ratings performed by buyers and/or sellers. The rating must either be included in a listing or related marketing materials by the seller or made a condition of sale by the buyer.
Tracking Methodology	Track commitment letters from new realtors not counted towards a previous year's metric and home ratings included in Multiple Listing Service (MLS) listings or related marketing materials.

Offer Description	The Home Labelling offer is designed to influence the re-sale marketplace in understanding what a home rating represents and the value it can provide to both homebuyers and purchasers at the time of sale or purchase. The offer also aims to motivate realtors to include energy ratings in marketing material (e.g., MLS).
2014 Results	In 2014, 34 brokerages committed to participate. As illustrated in Table 32, these brokerages are collectively responsible for 40,040 home listings. This result exceeded the upper target established for this metric. The number of home ratings marketed in 2014 was 662. This result fell short of the lower target for the second metric specified for this offer.

Table 32. 2014 Home Labelling Scorecard

Component	Metric	Targets				2014 Actual Result
		Weight	Lower	Middle	Upper	
Home Labelling	*Number of Committed Realtors* [1, 2]	***70%***	N/A	5,000	10,000	**40,040**
	Ratings performed	***30%***	750	1500	2250	**662**

1. Commitments to make provision for a data field to show home energy ratings for all homes listed by participating realtors (industry-wide commitment to include such a field on MLS or similar listing service and/or realtors' commitment to do so with all the homes they list on their own websites, handouts and other consumer material).

2. Commitment from realtors collectively responsible for more than 5,000 (middle target) or 10,000 (upper target) listings/year.

Table 33. Home Labelling 2012-2014 Results

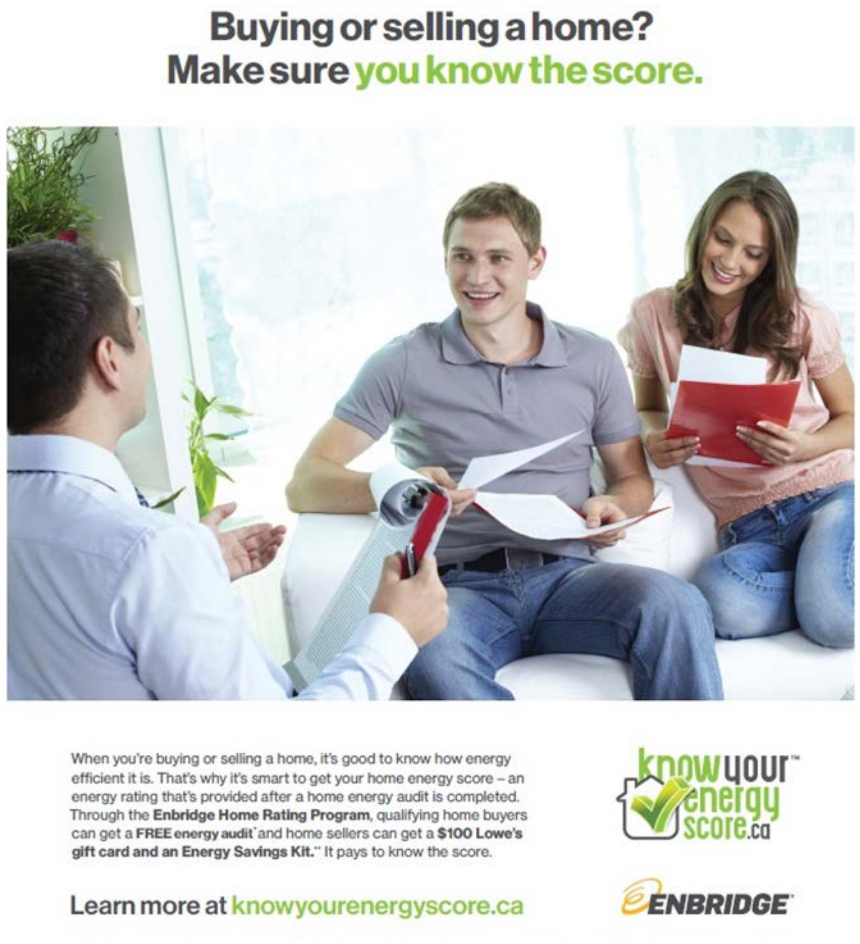
Component	Metric	2014 Actual Results	2013 Actual Results	2012 Actual Results
Home Labelling	*Number of Committed Realtors* [1, 2]	**40,040**	**78,000**	**8,600**
	Ratings performed [2]	**662**	**138**	**N/A**

1. Commitments to make provision for a data field to show home energy ratings for all homes listed by participating realtors (industry-wide commitment to include such a field on MLS or similar listing service and/or realtors' commitment to do so with all the homes they list on their own websites, handouts and other consumer material).

2. Metric not applicable in 2012.

2014 Highlights and Lessons Learned:

- ★ Though the Green Energy and Green Economy Act in 2009 originally included a proposal to mandate a home labelling system for all re-sale homes in Ontario, implementation did not follow. Given this outcome and the anticipated continuation of opposition from realtors to a government-enforced program, a voluntary system designed to gain acceptance in the marketplace continues to be suitable.



When you're buying or selling a home, it's good to know how energy efficient it is. That's why it's smart to get your home energy score – an energy rating that's provided after a home energy audit is completed. Through the **Enbridge Home Rating Program**, qualifying home buyers can get a **FREE energy audit*** and home sellers can get a **$100 Lowe's gift card and an Energy Savings Kit.**** It pays to know the score.

Learn more at knowyourenergyscore.ca

- ★ The approach leverages existing infrastructure to achieve voluntary adoption as a standard practice in the resale marketplace, in much the same way as offers to purchase are made under the provision of a home inspection.

- In May 2014, Channel Consultants participated in the annual Realtor Quest conference in Toronto – the largest gathering of Toronto Real Estate Board members. In the process, they presented and exhibited Enbridge's Home Labelling offer and initiated follow-up sessions to discuss the value of the offer and the benefits to potential buyers and/or sellers.

- Enbridge Channel Consultants reached out to real estate brokerages to discuss the value of understanding home labelling/rating in the resale market, explain the offer parameters as well as to provide education, training workshops and incentives.

- Efforts continued, as in the prior year, to focus on engaging individual brokerages with customized incentive support to better address the varied brokerage/realtor relationships and partnership models and maximize the value of participation.

- Current home buyers typically do not ask if a house has been energy labelled or rated although most value the importance of purchasing an energy efficient home. Challenges identified in this regard are related to a variety of contributing factors which include:
  - an overall lack of knowledge and understanding from realtors;

  - a perception that energy labels are confusing and don't depict true operating costs;
  - cost implications for energy audits and upgrades;
  - real estate agents' focus on closing the sale of a home with minimal delays or barriers; and
  - a belief that an energy rating will weaken the re-sale value and, therefore, there is no benefit for agents to promote.

★ The offer will continue in 2015. Activities focused on securing commitments from brokerages; creating awareness and educating realtors on the value of home energy ratings will not change.

★ Enbridge has had success with the offer to date as the Company has demonstrated good results in influencing realtors to participate; however, the Company is not seeing the actual number of homes labelled increase in the marketplace.

★ Beyond 2015, the Company will need to reposition given that there are a limited number of brokerages to involve with the offer and appreciating that there are a finite number of potential listings in the franchise area each year.

★ In the 2015-2020 Multi-Year DSM Plan (EB-2015-0049), Enbridge proposes to refocus efforts to promote energy audits as a means to educate homeowners and, in turn, increase demand to have home ratings performed before the purchase of a resale home is completed. Enbridge has proposed a greater emphasis on mass market outreach to homeowners and direct marketing to select realtors and home inspectors. In tandem, the Company will look at expanding marketing initiatives in the sector by working with key stakeholders including energy auditors, financial institutions, mortgage brokers, HVAC contractors and municipalities who heavily influence the sector and can promote the concept to customers.

★ Enbridge will continue to lead the market in building understanding of the value of a home energy rating with the end goal of encouraging mandatory labelling.

8. DSM Incentive Deferral Account (DSMIDA)

The Guidelines call for targets for each of the three programs: Resource Acquisition, Low Income and Market Transformation – to be included on their respective balanced scorecards. The Guidelines indicate that there should be three levels of achievement.[20] The scorecards for each program offered in 2014 were developed in consultation with the intervenors and approved by the Board in the Update to the 2012 to 2014 Demand Side Management Plan (EB-2012-0394).

The Guidelines also state that "an incentive payment should be available to the natural gas utilities to encourage them to aggressively pursue DSM savings and recognize exemplary performance."[21] The DSM Incentive (DSMI) provides that incentive to the Company for its DSM activities.

Further to approved amounts in EB-2012-0394, Table 34 summarizes how the maximum incentive available in 2014 is allocated across each program.

Table 34. 2014 DSM Maximum Incentive Allocation

Program	Program Budget	Overheads	Total Budget	% of Total	Maximum Incentive Available
Resource Acquisition	$14,160,578	$4,638,711	$18,799,289	58%	$6,355,631
Low Income	$6,729,500	$507,831	$7,237,331	23%	$2,446,785
Market Transformation	$4,795,000	$1,327,144	$6,122,144	19%	$2,069,764
Total	**$25,685,078**	**$6,473,686**	**$32,158,764**	**100%**	**$10,872,180**

The Guidelines explain that "the purpose of the DSMIDA is to record the shareholder incentive amount earned by a natural gas utility as a result of its DSM Programs." It further details that "the natural gas utilities should apply annually for disposition of the balance in their DSMIDA, together with carrying charges, after the completion of the annual third party audit," and that "incentive amounts paid to the natural gas utilities should be allocated

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[20] *Demand Side Management Guidelines for Natural Gas Utilities* (EB 2008-0346), OEB, June 30, 2011, page 30.

[21] Ibid, page 31.

to rate classes in proportion to the amount actually spent on DSM activities on each rate class."[22]

Scorecard Targets and DSMI Calculations

Scorecard results and the corresponding DSMI earned for each program is detailed in the following tables:

Table 35. Resource Acquisition Scorecard & DSMI

Resource Acquisition						
Component	**Metric**		**Targets**			**Actual Result**
		Weight	**Lower**	**Middle**	**Upper**	
Volumes	*Cumulative Savings (million m^3)*	**92%**	729.46	972.61	1,215.76	**664.37**
Residential Deep Savings	*Number of Houses*	**8%**	549	732	915	**5,213**
					Max. DSMIDA	$6,355,631
					DSMIDA Achieved	**$5,202,419**

Table 36. Low Income Scorecard & DSMI

Low Income						
Component	**Metric**		**Targets**			**Actual Result**
		Weight	**Lower**	**Middle**	**Upper**	
Single Family (Part 9)	*Cumulative Savings (million m^3)*	**50%**	17.3	23.1	28.8	**25.67**
Multi-residential (Part 3)	*Cumulative Savings (million m^3)*	**45%**	45	60	75	**29.80**
Multi-residential (Part 3) LIBPM	*Percent of Part 3 Participants Enrolled*	**5%**	30%	40%	50%	**74%**
					Max. DSMIDA	$2,446,785
					DSMIDA Achieved	**$375,059**

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[22] *Demand Side Management Guidelines for Natural Gas Utilities* (EB-2008-0346), OEB, June 30, 2011, page 35-36.

Table 37. Market Transformation – Residential SBD Scorecard & DSMI

Market Transformation

Component	Metric			Targets		Actual Result
		Weight	Lower	Middle	Upper	
Residential Savings by Design	*Previously Non-Participating Builders*	**60%**	11	14	18	**23**
	Completed Units	**40%**	675	900	1,125	**1059**
					Max. DSMIDA	$1,055,385
					DSMIDA Achieved	**$1,055,385**

Table 38. Market Transformation – Commercial SBD Scorecard & DSMI

Market Transformation

Component	Metric			Targets		Actual Result
		Weight	Lower	Middle	Upper	
Commercial Savings by Design	*New Developments Enrolled*	**100%**	6	8	15	**19**
					Max. DSMIDA	$410,068
					DSMIDA Achieved	**$410,068**

Table 39. Market Transformation – Home Labelling Scorecard & DSMI

Market Transformation

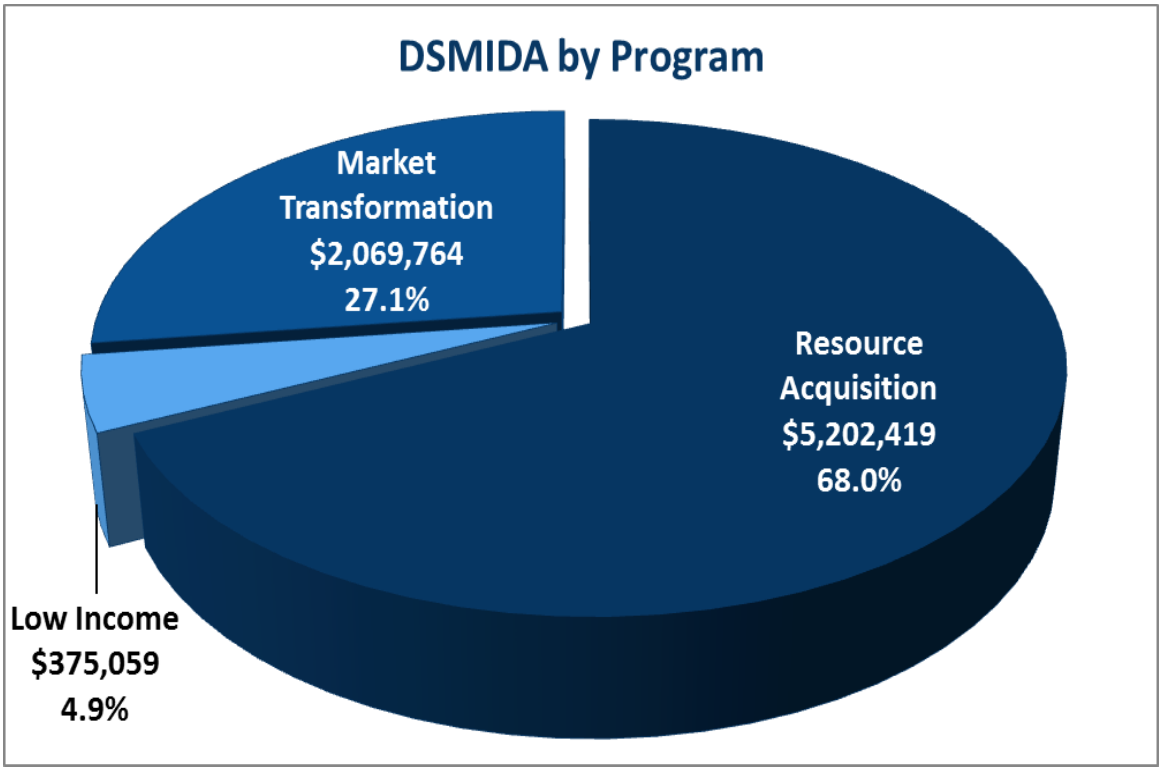
Component	Metric			Targets		Actual Result
		Weight	Lower	Middle	Upper	
Home Labelling	*Number of Committed Realtors*	**70%**	N/A	5,000	10,000	**40,040**
	Ratings performed	**30%**	250	500	750	**662**
					Max. DSMIDA	$604,311
					DSMIDA Achieved	**$604,311**

DSMIDA Summary

Table 40. 2014 DSMIDA Summary Statement

Program	DSMIDA $	DSMIDA %
Resource Acquisition	$5,202,419	68.0%
Low Income	$375,059	4.9%
Market Transformation	$2,069,764	27.1%
TOTAL	**$7,647,242**	**100%**

Table 41. 2014 Program Contribution to DSMIDA



9. Demand Side Management Variance Account (DSMVA)

In accordance with the Guidelines, the Demand Side Management Variance Account "should be used to track the variance between actual DSM spending by rate class versus the budgeted amount included in rates by rate class. A natural gas utility may record in the DSMVA in any one year, a variance amount of no more than 15% above its DSM budget for that year."[23] Further, "if spending is less than what was built into rates, ratepayers shall be reimbursed for the full amount. If more is spent than was built into rates, the natural gas utility may be reimbursed up to a maximum of 15% of its DSM budget for the year." [24]

The OEB approved budget for 2014 is $32,158,764. The same amount of $32,511,266 was built into rates. Total spending in relation to 2014, however, is $32,511,266 resulting in a variance of $352,502 over budget, to be recovered from ratepayers. These amounts are summarized in Table 42.

Table 42. 2014 DSMVA

	OEB Approved Budget (Built Into Rates)	2014 Actual Spending	2014 Variance (DSMVA)
Total	**$32,158,764**	**$32,511,266**	**$352,502**

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[23] *Demand Side Management Guidelines for Natural Gas Utilities* (EB-2008-0346), OEB, June 30, 2011, page 34.

[24] Ibid, page 34.

10. Lost Revenue Adjustment Mechanism Statement (LRAM)

The LRAM is a mechanism to adjust for margins the utility loses (gains) if its DSM program is more (less) successful in the period after rates are set than was planned in setting the rates. As outlined in the Guidelines, "the LRAM amount is a retrospective adjustment and may be an amount refundable to or receivable from the utility's customers, depending respectively on whether the actual natural gas savings resulting from the natural gas utility's DSM activities are less than or greater than what was included in the forecast for rate-setting purposes."[25]

Table 43. LRAM Statement

2014 LRAM Calculation

Based on 57,036,910 FE m3 built into rates

Rate Class	Budget Net Partially Effective	Actual Net Partially Effective	Volume Variance	Distribution Margin	LRAM Allocation $	LRAM Allocation %
Rate 110	2,065,678	1,237,361	(828,317)	1.4276	($11,825)	11%
Rate 115	1,314,523	846,042	(468,480)	0.7900	($3,701)	6%
Rate 135	0	51,608	51,608	1.2753	$658	-1%
Rate 145	2,428,288	467,549	(1,960,740)	1.5397	($30,189)	26%
Rate 170	4,942,907	707,329	(4,235,578)	0.4789	($20,282)	57%
Totals	10,751,396	3,309,889	-7,441,507		($65,339)	100%
		Amount to be paid back to Ratepayers			($65,339)	

** Rate 1 and Rate 6 are not included in the LRAM amount for clearance above as these rate classes are covered under the Average Use True-Up Variance Account (AUTUVA)*

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[25] *Demand Side Management Guidelines for Natural Gas Utilities* (EB-2008-0346), OEB, June 30, 2011, page 33.

11. DSM Rate Allocation and Impact

Table 44 illustrates the allocation to rate classes of the DSM Variance Accounts as prescribed in the Guidelines.[26]

Table 44. Rate Allocation

2014 Rate Allocation

Rate Class	DSMIDA	LRAM	DSMVA	TOTAL
Rate 1**	$4,476,362	N/A**	$6,968,595	$11,444,957
Rate 6**	$2,647,166	N/A**	-$3,576,246	-$929,080
Rate 9*	$326	$0	-$93	$234
Rate 110	$228,800	-$11,825	-$307,460	-$90,486
Rate 115	$108,728	-$3,701	-$488,902	-$383,875
Rate 125*	$12,230	$0	-$3,488	$8,741
Rate 135	$23,438	$658	-$86,721	-$62,625
Rate 145	$54,091	-$30,189	-$934,532	-$910,629
Rate 170	$91,047	-$20,282	-$1,217,209	-$1,146,445
Rate 200*	$4,240	$0	-$1,209	$3,030
Rate 300*	$815	$0	-$233	$582
Total	$7,647,242	-$65,339	$352,502	$7,934,405

**Rates 9, 125, 200 & 300 will not have any LRAM component included in the rate allocation since customers in these rates classes are not eligible for DSM programs. These rate classes will however, be subject to rate allocations for DSMVA and applicable DSMIDA related to the Low Income Program.*

** Rate 1 and Rate 6 are not included in the LRAM amount for clearance above as these rate classes are covered under the Average Use True-Up Variance Account (AUTUVA)

Note: Numbers may not add up due to rounding

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[26] Page 26 of the *Guidelines*, Section 8.3 Budget for Low Income Programs states that: "The Board is of the view that the low-income DSM budget should be funded from all rate classes, to be consistent with the electricity conservation and demand management framework, as well as the LEAP Emergency Financial Assistance program." Allocation for the LEAP fund was outlined in EB-2008-0150 Report of the Board: Low Income Energy Assistance Program on page 11 Section 5.1.1 Funding LEAP.

Table 45 provides the estimated impact of the 2014 Clearance of DSM Variance Accounts on a typical customer's bill in each of the rate classes affected.

Table 45. Estimated Impact of DSM Clearance on a Typical Customer

Rate Class	Annual Volume for Typical Customer (m^3)	Annual Bill for Typical Customer[1] ($)	DSM Amount for Recovery[2] ($)	Estimated % of Annual Bill
Rate 1 - Heating & Water Heating	3,064	$871	$7	0.7%
Rate 6 - Commercial, Heating & Other Uses	22,606	$6,543	($4)	-0.1%
Rate 9 - Container Service[3,5]			$233	0.0%
Rate 100 - Industrial, small size	339,188	$81,601	$0	0.0%
Rate 110 - Industrial, small size, 50% Load Factor	598,568	$131,614	($103)	-0.1%
Rate 110 - Industrial, avg. size, 75% Load Factor	9,976,120	$2,032,402	($1,708)	-0.1%
Rate 115 - Industrial, small size, 80% Load Factor	4,471,609	$895,944	($3,182)	-0.4%
Rate 125 - Extra Large Firm Distribution[4,5]			$1,748	
Rate 135 - Industrial, Seasonal firm	598,567	$115,351	($598)	-0.5%
Rate 145 - Commercial, avg. size	598,568	$125,734	($3,848)	-3.2%
Rate 170 - Industrial, avg. size, 75% LF	9,976,120	$1,814,358	($25,145)	-1.4%
Rate 200 - Wholesale Service[3,5]			$3,031	
Rate 300 - Firm or Interruptible Distribution[4,5]			$291	

1. Annual bills based on October 1, 2015 rates.

2. DSM amounts for Recovery do not include interest amounts that will apply at the time of clearing.

3. Information is for the total amount for DSM recovery

4. DSM amounts for recovery for Rate 125 and Rate 300 are for average customers in each rate class

5. Rates 9, 125, 200, & 300 do not have any LRAM Allocations since customers are not eligible for DSM programs

12. Status Update –2013 Auditor and Audit Committee Recommendations

The following is an overview of the recommendations made by the Auditor in the 2013 DSM Audit.

Also summarized are the responses to each recommendation put forward by Enbridge and in turn, the 2013 Audit Committee (Intervenor Members) respectively. Finally, the current status pertaining to each recommendation where applicable is provided[27].

1. Recommendation:

Select an independent third-party engineering firm to review the ETools software for consistency with acceptable engineering practice. The CPSV TEs are directed to perform independent analyses to confirm or revise the saving estimates calculated by Enbridge or engineering contractors. In many cases, these savings estimates are generated by Enbridge's proprietary ETools analysis software. Instead of performing independent savings estimates each year, Optimal recommends that a third-party engineering contractor--one with significant experience with Excel and the VBA-based tools used to develop ETools—be retained to perform a thorough audit of all of the ETools software modules. Once the validity of the methodologies embedded in the ETools software is independently verified, the CPSV TE review of projects employing ETools can focus on determining:

- Whether the methodology used by ETools is appropriate for the specific project.
- Whether the inputs used in the ETools calculations are reasonable. As ETools is typically updated on a semi-annual basis, an independent annual review of any modifications to the ETools software should be incorporated in the annual audit process.

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[27] Unless otherwise indicated, the Audit Committee (AC) refers to the entire Audit Committee - which includes three intervenor members and one utility representative - as outlined in the *Joint Terms of Reference for Stakeholder Engagement*, Exhibit B, Tab 2, Schedule 9, Appendix A, Page 13 of 21.

Enbridge Response:

Enbridge agrees with selecting an independent third-party firm to review the Commercial boiler seasonal efficiency module of the Etools software for consistency with acceptable engineering practice, as soon as feasible. Enbridge's agreement is contingent on the TEC's endorsement to update the CPSV TOR to reflect that the CPSV firms can utilize the utilities' software for project reviews. Enbridge's agreement is also based on the AC's support that, barring a change in the market, in industry understanding of savings estimation, in the OEB's DSM guidelines or other factors that might affect commercial boiler savings estimates, such a change in the CPSV TOR should remain in place until at least the mid-term review of the next multi-year plan.

AC (Intervenor Members) Response:

The AC (Intervenors Members) endorses this response.

Status Update:

Enbridge has engaged an independent third party contractor to review the boiler component of ETools. This work will verify through inspection the ETools algorithms to ensure that there are no mathematical errors and/or Excel spreadsheet computational errors (e.g., errors with macros, links, lookups), and testing to ensure that the cascading effect of various algorithms are operating correctly. Secondly, through the TEC, Enbridge is proceeding with a joint review of commercial boiler seasonal efficiency through an RFP for a third party independent study as well as an RFP to review boiler baseline. Upon completion of these reviews, the ETools boiler module will be independently reviewed to ensure all updated findings are properly reflected in determining savings estimates.

2. Recommendation:

Develop a standardized report template for use by the CPSV TEs. Providing a report template would assist the CPSV TEs in developing more consistent reports that provide all of the information required to validate their review. The template should stress the importance of including all relevant project assumptions, inputs, and calculation methodologies. The inclusion of all relevant project information in a consistent format and level of detail will allow the Auditor to perform their task without having to request the full project file from Enbridge. Auditor review of Enbridge project files for clarification or to obtain missing data is a redundant and inefficient effort. The template will also allow the Auditor to easily locate data and information within each CPSV TE project write-up leading to a more streamlined CPSV audit review process.

Enbridge Response:

This Audit Recommendation will be directed to the TEC, as it potentially impacts the CPSV TOR. The 2013 CPSV reports, which underwent substantial revision in response to the Auditor's feedback, could be a starting point for discussion.

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Status Update:

The auditor provided a proposed template draft. Using this draft as a starting point, Enbridge worked with the TEC to develop a standardized CPSV coversheet template. The template was endorsed by the TEC for use in the 2014 CPSV review process and was included with the CPSV Terms of Reference.

3. Recommendation:

Request that the CPSV TEs estimate the remaining useful life of the existing equipment in cases where the energy efficiency measure is an “add-on” to existing equipment for both the commercial and industrial sectors. For example, if the measure is an efficiency control on an existing boiler, the CPSV TE should determine if the existing boiler will be in place for the entire measure life of the efficiency control. If not, then a baseline (or measure life) adjustment should be made to account for the existing boiler being replaced with a more efficient boiler prior to the end of the measure life. Alternatively, develop one or more deemed measure lives for these types of projects, which are not currently included in the OEB measure life tables.

Enbridge Response:
This Audit Recommendation will be directed to the TEC, as it potentially impacts the CPSV TOR.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorse this response.

Status Update:
Language was introduced into the updated CPSV Terms of Reference to address this recommendation. The CPSV Terms of Reference was reviewed and endorsed by the TEC.

4. Recommendation:
Document the custom project realization rate calculation methodology. The 2012 Audit provided guidance on the correct process to calculate realization rates, but there is no formal stand-alone document that lists all the agreed upon steps. The method employed by Enbridge's realization rate contractor for 2013 contained process errors that Optimal needed to correct as part of its audit review.

Enbridge Response:
This Audit Recommendation will be directed to the TEC as it potentially impacts the current, TEC endorsed, sampling methodology.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

Status Update:
The TEC reviewed the Sampling Methodology and updated language to make clear the realization rate methodology. The Sampling Methodology reference document was revised accordingly by Navigant Consulting (referenced in Appendix I). The revised document was endorsed by the TEC in November 2014.

5. Recommendation:
Undertake a baseline boiler study. For replacement projects, the base case is a code compliant boiler with 80.5% thermal efficiency. In many other

jurisdictions, higher efficiency boilers are often code or standard practice. Standard practice might also include additional boiler control efficiency measures. A boiler baseline study was completed three years ago. However, given the importance of this measure and the reality that these markets change quickly, it is important to update this work. An updated study will determine if the standard practice in Enbridge's service area is actually above code, which would indicate a need for a revised baseline.

Enbridge Response:
This Audit Recommendation will be directed to the TEC for completion in 2015. Further to the Auditor's report, this study will focus on the commercial sector.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

Status Update:
A boiler baseline study is currently underway through the TEC.

6. Recommendation:
Provide clear instructions to the CPSV TEs to focus on evaluation of annual gas savings and measure lives, the inputs used to determine CCM. The sole DSMIDA metric for custom projects is CCM. Given tight timelines and the need to use ratepayer funds efficiently, the CPSV TEs should not spend time reviewing non-gas savings values or measure cost data.

Enbridge Response:
This Audit Recommendation will be directed to the TEC, as it potentially impacts the CPSV TOR.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

Status Update:
Language was introduced into the updated CPSV Terms of Reference to address this recommendation. The CPSV Terms of Reference was reviewed and endorsed by the TEC.

7. Recommendation:

For projects modeled using eQUEST, consider using IPMVP protocols for New Construction projects with adequate calibration of both the baseline and as-built models. In addition, each project file should contain the final model used to support the project savings claim. If necessary, any secondary calculations to overcome shortcomings of the modeling tools should also be saved in the file.

Enbridge Response:

As was the case during discussions and agreement in the 2012 Audit process last year, it is anticipated that the 2014 CCM results for legacy projects (captured under Resource Acquisition) will be minimal, therefore this recommendation would not be an effective use of resources and budget dollars. For additional clarity, with the exception of legacy projects, all 2014 Commercial New Construction projects will be claimed via the Savings by Design Market Transformation offer, which is not based on CCM.

AC (Intervenor Members) Response:

Requiring calibration of simulation models, as required by IMPVP is undoubtedly industry best practice. However, such calibration would require waiting perhaps 18 months after the building was completed before claiming savings (perhaps 6 months to allow for transition to full occupancy and another 12 months of consumption data across all seasons of the year). That is consistent with a recommendation by the 2012 Auditor. If Enbridge was to continue to claim savings from commercial new construction projects in the future, the AC would endorse such recommendations from both Auditors. However, given that (1) any new construction projects on which the Company began work since 2012 are being addressed only through its market transformation program (i.e. no resource acquisition savings claims), (2) there are no more than a few pre-2012 "legacy" projects for which the Company is expected to claim savings in 2014,and (3) savings goals for the 2012-2014 period were set without the expectation that the Company would have to wait 18 months after completion to claim savings from legacy new construction projects, the AC can accept not changing practices for 2014.

8. Recommendation:

Proper IPMVP protocols should be followed to verify project savings. While most projects employ sound measurement and verification methodologies, it was not always clear that CPSV contractors followed proper IPMVP protocols. Access and schedule issues as well as budget limitations may prevent CPSV contractors from performing the level of on-site measurement necessary to comply with IPMVP guidelines. Future CPSV contractors should endeavor to clearly identify which IPMVP option was employed and provide a thorough description of how that option was implemented. For example, if “Option A. Retrofit Isolation: Key Parameter Measurement” is determined to be the best option for a given project, the contractor should clearly establish which parameters are measured, which are estimated, and the methodology used to calculate savings. Presenting the verification results within the framework of IPMVP would lead to more justifiable savings estimates and facilitate review by future Auditors.

Enbridge Response:

This Audit Recommendation will be directed to the TEC, as it potentially impacts the CPSV TOR.

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Status Update:

Language was introduced into the updated CPSV Terms of Reference to address this recommendation. The CPSV Terms of Reference was reviewed and endorsed by the TEC.

9. Recommendation:

Enbridge should develop site-specific destratification factors based on the building site, ceiling height, fan diameter, and speed. For custom industrial destratification fan projects, Enbridge assumes that the contractor/vendor will design and install the project to destratify the entire space. Enbridge then applies a blanket factor of 0.85 to de-rate the destratification savings to be conservative. Developing site-specific destratification would result in a more rigorous savings estimate.

Enbridge Response:
Enbridge will calculate the actual percentage of destratified coverage area for a specific project, based on best available information.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

Run It Right

10. Recommendation:
Establish a free rider rate for the Run It Right program. Currently, there is no OEB approved free rider rate for this program. As part of this audit process, Enbridge proposed a free rider rate. Optimal conducted an informal review of free rider rates for gas retro-commissioning programs in other jurisdictions and recommended adoption of Enbridge's requested rate for purposes of this audit. Enbridge should formally establish a free rider rate that is subsequently filed and approved by the OEB.

Enbridge Response:
This Audit Recommendation will be directed to the TEC, as Union has indicated that they have a similar program. As such, there may be value in developing a free ridership rate for both utilities through the TEC. If it is determined that this is not the case, Enbridge will proceed with establishing its own free ridership rate for the RIR offer.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

Status Update:
The 2014 AC agreed that Enbridge would proceed on its own to undertake work to confirm the free ridership rate for 2014 RIR results. The AC further agreed that a free ridership rate for the RiR offer should be included as part of the Net-to-Gross Study through the TEC.

11. <u>Recommendation:</u>

Survey Run It Right participants. Ideally, Enbridge or its evaluator should survey participants prior to any billing regression analysis. This would ensure better data and avoid noted problems with ex-post adjustments to the sample that resulted from exogenous factors affecting gas usage. The importance of conducting a survey prior to the analysis is that all data is treated equally, and any obvious outliers or other problem data can be removed or adjusted without bias. In addition, this process will allow for removal of any obviously bad or incomplete data. Surveys should accomplish the following:

- Determine whether the participant implemented the measures recommended in the timeframe indicated.
- Determine whether the participant made any significant changes to the facility, its operations, or equipment outside of the Run It Right Program. If changes were made, determine whether changes can be attributed to Run It Right spillover savings, are completely independent of the Program, or were already counted in another Enbridge program.
- Collect basic participant characteristics, including building type, occupancy load, usage, and size.

Based on this information, the analyst can remove or adjust all data in a consistent fashion. For example, if a major piece of equipment was replaced with a more efficient one, it may be appropriate to adjust the ex-post data to subtract the expected additional savings. Further, if building usage or operations have changed significantly, the data can be adjusted if the impacts of these changes can be estimated with relative certainty. In some cases, it may be more appropriate to simply remove a participant from the sample.

Enbridge Response:

Enbridge agrees that completing a survey with a random sample of participants would be more appropriate in order to gain further insight into results. The random sample would be conducted in a manner similar to the CPSV process. A survey of all participants would be cost prohibitive (this is in line with recommendation #13).

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Status Update:

Enbridge discussed this recommendation with the 2014 AC and the Auditor and proceeded to engage a third party consultant to complete a survey of participants included in 2014 results with input from the AC and the Auditor.

12. Recommendation:

Include a “comparison group” of similar customers that did not participate in the Run It Right program. A comparison group of customers that are matched to the participant group (in terms of building type, major end-uses, size, and consumption) should be included in the analysis. Typically this would be done with a “dummy variable” that indicates whether the customer was a participant or not. The biggest benefit of including a comparison group is that it can more explicitly control for weather and other variations over time. Because all sites will have been exposed to the same weather, the analysis inherently controls for weather without the need to identify balance temperature points for each facility. It also avoids introducing uncertainty from determining a building specific relationship between weather and gas usage. This will significantly simplify the analysis and result in a more accurate isolation of weather effects. A comparison group also can adjust for unknown variables that may be important but are difficult to identify and control for. For example, there may be natural growth in existing buildings’ gas usage that would mask some of the true program savings. Comparing participants with similarly situated non-participants would automatically control for any such effects.

Enbridge Response:

Enbridge's proposal for recommendation #11 appropriately addresses the need for increased accuracy and information, without unduly increasing the cost and complexity of the offer.

AC (Intervenor Members) Response:

The AC agrees that the revisions associated with Auditor recommendation #11 are a good next step in the evolution of the evaluation of this program, and that the addition of a control group is not necessary at this point in time. However, that decision should be revisited in the future as more experience with the program (and its evaluation) is gained, particularly if the program grows substantially in size.

13. Recommendation:

Consider sampling approaches that balance required resources with level of importance. When performing the analysis and incorporating the two previous recommendations, we recognize that this approach may add additional program costs related to surveying participants and using comparison groups. We also understand that Enbridge intends for this program to expand and hopefully have more participants in the future. As a result, it may be appropriate to analyze a sample of participants rather than a full census of participants. This is appropriate, particularly if the number of participants grows significantly. We recommend that the sample of participants first be stratified by size. The largest usage customers will tend to have a disproportionately high impact on overall savings. As a result, we recommend developing size strata and oversampling the largest stratum (depending on range of usage and number of participants, it may make sense to oversample more than one large stratum). Often, the very largest stratum might only have a few participants, who would all be included in the sample. This approach of devoting more resources to the largest projects will enhance the overall precision of the sample without the need to actually increase the numbers of participants sampled. Once the strata cut points are selected, the samples should be drawn in a randomized way (except for any strata where a full census is used). Similarly, the comparison group should align with the same strata and also be randomly selected.

Enbridge Response:

Please refer to the response to recommendation #11.

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Audit Process

14. Recommendation:

Produce an audit guidelines document for the Auditor. Currently, each Auditor establishes its own detailed process to meet the overall requirements stated in the audit RFP. This can lead to inconsistencies over time. A clear, detailed set of guidelines would result in more consistent audit results from year-to-year.

Enbridge Response:

Although this recommendation may result in consistency, it may impact the level of independence that exists for each Audit year, therefore the Auditor should independently establish their own detailed process to meet the overall requirements. To aid in this activity, Enbridge will engage the 2014 AC to ensure that the Auditor is provided with a reasonable level of orientation to the process as a whole.

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Status Update:

The 2014 AC and the Auditor discussed this recommendation and agreed that there was no need to implement this recommendation at this time.

15. Recommendation:

Clarify Audit Committee role. The AC should have a written charter that spells out its decision-making process, purpose, duties, and powers. While the “Union Gas Limited – 2012-2014 Demand Side Management Plan Settlement Agreement on Terms of Reference for Stakeholder Engagement” provides high level guidance on the function and operation of the AC, it would be useful to have a more detailed, stand-alone charter that is provided to the Auditor. This would add clarity to the AC role for the Auditor and generally make for a more efficient audit process.

Enbridge Response:

Enbridge notes that the document the Auditor is referring to is the "Joint Terms of Reference on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc. and Union Gas Limited". Enbridge will discuss this recommendation with the 2014 AC early in the Audit process.

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Status Update:

The role of the AC was discussed with the Auditor at the audit kick-off meeting on December 8th, 2014.

16. Recommendation:

Award the audit contract earlier in the process. Optimal received its audit contract on March 5, 2014. OEB rules require that the final audit report be submitted by June 30 of each year. Optimal was able to quickly shift its other workloads to allow its audit staff to devote the necessary effort needed to produce rigorous audit results over this short timeframe. For example, in order to provide timely feedback on the CPSV draft Wave 1 reports, Optimal staff had to devote more than a full time effort at the outset of its contract period. Fortunately, Optimal was able to shift other work to accommodate this initial, quick turn-around. Because subsequent Auditors may not be able to adjust so rapidly, issuing the audit contract earlier will better ensure a robust and thorough audit report within the necessary timeframe. This recommendation is not intended to suggest that Optimal did not have sufficient time to produce a high quality and rigorous audit. Optimal did indeed have ample time. Rather, it is meant to address potential challenges that may arise if future audit firms are unable to re-deploy staff resources as readily.

Enbridge Response:

Enbridge agrees that it would be beneficial to have the Auditor's contract awarded earlier. This recommendation will be brought forward to the 2014 AC.

AC (Intervenor Members) Response:

The AC (Intervenor Members) endorses this response.

Status Update:

This recommendation was discussed with the 2014 AC and the Auditor was retained on November 12th, 2014.

17. Recommendation:

Seek written comments and feedback from the Audit Committee as one unified document as opposed to individual documents from each AC member. Currently, the Auditor has to respond to and sort through multiple documents. Having a single document from the AC for each set of comments would simplify the Auditor’s work flow.

Enbridge Response:

Enbridge will support the decision made by the 2013 AC on this issue.

AC (Intervenor Members) Response:

The AC appreciates that compliance with the Auditor's recommendation would make life a little simpler for the Auditor. However, the most that we could say is that the AC should do this whenever possible, with the understanding that it often won't be. Given the very tight timelines for review of draft materials, there often just isn't enough time to get everyone together, explain and discuss each comment, debate conflicting comments, document a consolidated set of comments, send it to everyone so that they agree the consolidated document represents everyone's perspective accurately and then send to the Auditor.

Other Recommendations

18. Recommendation:

Produce a single document that pulls in all of the current year final OEB approved metrics, DSMIDA amounts and calculation procedures with appropriate citations back to the OEB regulatory filings. This document would be provided to the Auditor at the start of their work plan. Currently, all of this data is buried in hundreds of pages of OEB regulatory filings and exhibits. For someone not familiar with these proceedings, it is time consuming and not efficient to dig through all of these documents. In addition, it is sometimes difficult to determine the final approved values given the various revisions and updates.

Enbridge Response:
Enbridge will work with the 2014 AC and Auditor to determine what is useful and appropriate.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

Status Update:
At the audit kick-off meeting on December 8th, 2014, it was agreed that this audit recommendation need not be implemented.

19. Recommendation:
Provide enhanced quality control procedures for the data provided to the CPSV TE and the CPSV sampling and realization rate firm(s). In its audit review, Optimal identified minor data entry errors in data sets provided by Enbridge to its sampling and realization rate contractor and the CPSV TEs. Project level savings data were not always consistent between the realization rate contractor and the CPSV TEs. We suspect that as Enbridge records and updates the data in its DSM tracking system, it is not also ensuring that all the various firms performing audit and verification tasks receive updated data sets.

Enbridge Response:
Enbridge will review current processes to ensure accuracy of data not only internally, but with external contractors. Subsequent process changes will be shared with the 2014 AC.

AC (Intervenor Members) Response:
The AC (Intervenor Members) endorses this response.

13. Other Evaluation Research

As outlined in the Joint Terms of Reference for Stakeholder Engagement on DSM Activities, “the goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario.” [28] Further, the Joint Terms of Reference outlines the TEC’s work as follows:

- The TEC will make recommendations to the OEB on the annual Technical Reference Manual (TRM) Update.
- The TEC has accountability to:
    - produce and maintain a prioritized annual work list (by consensus);
    - establish evaluation priorities and specify future evaluation studies to be undertaken – execution of all work defined by the TEC is subject to the utilities’ resource constraints (such as funding, personnel resources, time limitations); and
    - review and reach consensus on the design and implementation of evaluation studies to be carried out including determination of whether the work is done by utility staff, the TEC technical consultant or third party firms.

In 2014, the TEC pursued evaluation priorities set out in the prior year, focusing on responding to recommendations made by the utilities’ respective auditors and two evaluation projects – a Custom Net-to-Gross (Free Ridership and Participant Spillover) Research Study and a Technical Reference Manual (TRM).

Technical Reference Manual

Throughout 2014, the TEC continued to work with a third-party consultant (ERS Inc.) to update existing measure assumptions and create substantiation documents for new technologies using best available information. The TRM is intended to provide an up-to-date reference for

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[28] *Joint Terms of Reference on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution and Union Gas Limited*, November 4, 2011, page 9.

both utilities and the public, providing transparency and clarity regarding measure assumptions.

Net-to-Gross Study

In February of 2014, DNV GL was selected by consensus by the TEC to develop and implement a survey of a sample group of Enbridge and Union Gas commercial and industrial customers in order to assist the TEC in developing Net-to-Gross factors to be applied to each utility's Custom Commercial and Industrial offers.

The TEC worked with DNV GL to identify and resolve a number of methodological questions relating to the survey process and scoring of responses. The project was temporarily postponed in mid-2014 due to unresolved discussions involving the type of Net-to-Gross ratio measured by the study. Additional clarity was not provided as anticipated in the draft OEB guidelines released in September 2014, and the project remained on hold for the remainder of 2014 pending the final DSM Framework and Guidelines.

Appendix A: CPSV Terms of Reference

The following pages include the CPSV Terms of Reference and the CPSV Project Cover Sheet Template. These documents were reviewed and endorsed by the TEC in November 2014 to outline the scope of work for the CPSV engineering firms in their review of the 2014 program year custom projects.

2014 Custom Project Savings Verification
Terms of Reference

A. Background

Utility Specific

B. Requirements / Scope of Work

This verification study will consist of a detailed estimate of gas savings, for comparison to the utility's estimates, for a representative sample of custom projects in 2014.

a) Sampling

A random sample of custom projects will be selected by an independent third party (other than the proponent selected). The 2014 CPSV will be conducted in two parts. Wave 1 will be selected from custom projects tracked during Q1-Q3 of 2014. These projects will be reviewed immediately. Wave 2 will be selected from custom projects completed during Q1-Q4 of 2014. These projects will be reviewed during Q1 of 2015.

b) Environment Health & Safety

Utility Specific

c) Assessment Methodology

The consultant will conduct on-site visits that will involve:

1. **An interview with the customer to validate installation of equipment and confirm operating conditions**. The consultant should provide to the customer the list of the data that they would like to see as well as an overview of the types of questions that will be asked of the customer prior to the interview. In addition, this information will also be provided to the Audit Committee, the Auditor, and the utility.

2. **Direct measurement of key site, equipment and/or operating characteristics whenever such measurements could be expected to appreciably improve the accuracy of the savings verification and does not overly burden the customer**. Direct measurement could involve both instantaneous measurement and short duration measurement that might require revisiting the site to collect data and devices left on-site. In cases in which the consultant determines that either adequate onsite measurement has already been conducted, or there would be an undue burden on the customer, or the cost of additional onsite measurement would be disproportionately high relative to the benefits, the consultant could choose not to conduct the measurement but is expected to provide the rationale for not doing so.

The utility's 2014 DSM incentive is based on the achievement of a targeted level of cumulative gas savings (CCM). CCM is calculated by multiplying the net annual gas savings of a measure and its measure life (the consultant is not tasked with addressing free ridership assumptions). The consultant should focus on gas savings, but provide an assessment of the reasonableness of non-gas savings estimates found to be noteworthy (water savings, electric savings, maintenance savings, space savings, time savings, etc.).

There may be cases in which the consultant believes that no increase in the accuracy/confidence of its savings estimates would reasonably be expected from a site visit. In such cases (which are expected to be rare), the consultant may complete the assessment without a site visit provided that it clearly documents the rationale for not having a site visit.

In addition to conducting site visits, the consultant will interview vendors whenever useful for informing the savings verification process.

Using information collected during site-visits and interviews as well as its own expertise, the consultant will develop its own independent estimate of the savings for the project. The independent estimate should be based on the consultant's own tools, calculations and assumptions. Note that the utility's savings goals are expressed as total lifetime savings. Thus, the consultant's work must address both the reasonableness of estimates of annual savings and the reasonableness of estimates of the life of those savings. The consultant's basis for assumptions made in developing the independent estimates of lifetime savings (both first year savings and measure life) must be, to the extent practical, documented with appropriate references and/or other forms of substantiation. If the consultant cannot identify a reference, the consultant must provide a rationale for their assumption.

During the review, the consultant will work with the respective utility to address any issues requiring clarification or additional documentation. The consultant will also be expected to work with an independent auditor that will be hired by the utility's 2014 "Audit Committee", a body comprised of several stakeholders to assess the reasonableness of the Company's 2014 savings claim (looking at all savings, of which custom project savings are just a part). The auditor will be charged, among other things, with providing input to and ultimately passing judgment on the reasonableness of the consultant's work and conclusions.

The consultant is encouraged to propose, either in their initial proposal, or during the review process, alternative or additional methods of verification of results that are expected to increase the accuracy level or confidence of the review results. Any such proposal should include an analysis of the additional benefits versus the incremental costs and any impact on both the customer and project schedule.

C. Deliverables

The project deliverables include the following:

- A Draft Report: In addition to the points outlined below, the Draft Report will also note the date of the interview and the names of individual(s) interviewed.
- A report showing the findings for each custom project review undertaken. A coversheet template will be provided by the Utility to ensure consistency and the inclusion of all relevant project assumptions, inputs, and calculation methodologies for each project addressed in the report. The consultant should also indicate which IPMVP Option it followed in its review of each CPSV project. Where the consultant deviates from the Option it selected, it should provide an explanation.
- The review of savings will include the following items in the report for each project:
    - Description of the project
    - Date of installation of equipment;
    - Type of building, building segment or process;
    - Description of the base case scenario used in utility's savings estimate; the reasonableness of the designation of advancement where applicable (i.e. did the utility's program cause old inefficient equipment to be replaced before it otherwise would have been) or replacement (i.e. should savings be based on the efficiency of new standard equipment because the equipment would have been replaced even in the absence of the utility's program) of the claimed base case used in the savings calculation – both for annual savings and measure life;

- Discussion of any base case adjustments applied by the consultant, if applicable;
- Description of on-site data collection or measurement that was used in developing savings estimates;
- Description of other aspects of the approach used by the consultant to estimate savings for the project, including references;
- Discussion of the difference between the utility's savings estimate and the consultant's estimate, including a discussion of the relative merits of the methodologies used by both the utility and the consultant and differences in key assumptions used by each;
- Regarding measure life, commentary on the reasonableness of the measure life applied to the specific project. Also provide commentary on the reasonableness of the remaining useful life of the existing equipment in cases where the energy efficiency measure is an "add-on" to the existing equipment. Where appropriate, comment on future changes to the OEB filed measure lives for custom projects. Where the project has multiple measures, the measure life should be a savings weighted average of the lives of the measures;
- Discussion of the reasonableness of the results (i.e. gas m^3/yr.);
- Where proprietary modeling software is used, the consultant must identify the model and provide support to demonstrate its use as an appropriate and accurate tool for this application. When possible, the consultant should make available to the utility and the auditor for review, the underlying algorithms for any proprietary models used by the consultant to validate the savings calculation. When not possible, the consultant should supply model inputs and assumptions, so that if desired by others, they can compare the proprietary model results to other models or approaches; and
- Complete documentation of the reviewer's calculations.

The report will also include:

- Any additional data or information collected through the verification process;
- Report on any discrepancies between the equipment as described in the utility's savings estimates and the equipment as installed;
- Discussion of changes in the size or use of the building or process that alter the baseline model; and the assumptions that were made to account for these changes;
- Total claimed and evaluated lifetime gas savings;
- Recommendations on steps which could be taken to provide higher level of accuracy/confidence for future reviews;
- Recommendations on what could have been done earlier in the process to improve the confidence and accuracy of verification results;
- To the extent that any measurements were taken on-site, list what was actually measured. (The raw data will be made available to the Auditor, Audit Committee and the utility. Any raw data that is commercially sensitive will be identified as having been used but will be kept confidential and not included in the report.); and
- Identify areas of greatest confidence and areas with the greatest level of uncertainty.

The report will also include a section recommending any refinements for future savings calculations for custom projects.

For privacy reasons, the names and addresses of the customers and any specific data or information indicating the type of industry, which could allow the reader to infer the identity of customer, must not be published in any of the reports. Therefore, the consultant will be required to provide their report with that information included, for internal use, and with that information redacted for public use.

The consultant will be involved in discussions with an Auditor regarding the report during their investigations and after the release of their final report.

D. Schedule

Deadlines for deliverables will be strictly adhered to. The utility may impose penalties for failure to meet deadlines, up to 10% of the total cost of the project.

E. Proposal Requirements

Utility Specific

F. Proposal Deadline

Utility Specific

G. Project Contact

Utility Specific

2014 Custom Project Savings Verification Coversheet Template

Date:
Wave:
Utility Project Number:

#	Required Information	Value to be entered
Project Basics		
1	Sector	text
2	Type of building, building segment or process	text
3	Efficiency Measure(s) Description	text
4	Date Measure(s) Operational	Date, text
5	Site Visit	yes/no + text
6	Justification of why site visit not required	text
7	Advancement Project?	yes/no
8	Agreement with Advancement Designation?	text
Baseline		
9	Utility Claimed Base Case	text
10	Agreement with Base Case	yes/no
11	Where item 10 is 'no': CPSV Recommended Base Case	text
Annual Savings Estimate		
12	Utility Claimed Gross Natural Gas Savings (for each measure)	m^3
13	Agreement with Utility Claimed Gross Natural Gas Savings (for each measure)	yes/no
14	Where item 13 is 'no': CPSV Recommended Gross Natural Gas Savings (for each measure)	m^3
15	Utility Claimed Gross Electricity Savings	kWh
16	Utility Claimed Gross Water Savings	L
Measure Life		
17	CPSV Recommended Measure Life (for each measure)	years
18	Measure Life as per OEB Measure Life Guide	years
19	Measure Life Conforms with filed OEB Measure Life Guide?	yes/no
20	Justification of CPSV Firm's alternate measure life being used	text
Results		
21	Proprietary modelling software	yes/no + text
22	Were any measures add-ons?	yes/no
23	Where item 22 applies, provide commentary of reasonableness of remaining useful life.	text
24	% Difference Between CPSV Independently Calculated Gross Natural Gas Savings vs. Utility Gross Natural Gas Savings	%
25	CPSV Firm Independently Calculated Annual Gross Natural Gas Savings	m^3
26	CPSV Firm Final Recommended Gross Cumulative Cubic Meters (CCM)	m^3
27	CPSV Justification for Final Recommendation	text
28	CPSV Firm IPMVP option identified	yes/no + text
29	CPSV Firm Final Assessed Electricity Savings (if noteworthy)	kWh
30	CPSV Firm Final Assessed Water Savings (if noteworthy)	L

Appendix B: Commercial / Low Income Custom Project Savings Verification Study (CPSV) Summary

As part of its annual evaluation and DSM audit process, a third-party firm is selected to undertake engineering reviews of a random sample of custom projects in each of the Commercial and Industrial sectors.

In consultation with the 2014 Audit Committee, in November 2014, EGD retained MMM Group Limited (MMM) to conduct the engineering review (Custom Project Savings Verification Study (CPSV)) [29] of the savings claim for the 2014 Commercial custom projects.

Purpose of the Study

The purpose of the CPSV is to provide an independent opinion of the reasonableness of the energy savings claimed by the Commercial sector and Low Income Multi-Residential sector custom projects in 2014 through a review of a statistically representative sample of projects.

Methodology

Using a sampling methodology developed for Enbridge and Union Gas by Navigant Consulting in 2012, revised in 2014 and endorsed by the TEC (attached as Appendix I), Ipsos Loyalty was contracted as an independent third party to randomly select a representative sample of Commercial custom and Low Income Multi-Residential custom projects claimed in 2014. In 2014, there were 567 Commercial custom and Low Income Multi-Residential custom projects completed, of which 27 were randomly selected by Ipsos Loyalty for the CPSV.

A detailed Terms of Reference for the CPSV was updated and endorsed by the TEC and provided to the CPSV consultant at the outset of the review.

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[29] The Commercial CPSV includes both the Commercial custom and the Low Income Multi-Residential custom projects.

Specific details regarding the scope of work and deliverables associated with the study are outlined in the CPSV Terms of Reference (included in Appendix A).

Results of the engineering review are shown in the next table, with the claimed and revised CCM savings as recommended by MMM.

2014 Commercial Custom Project Verification Results

Table 46. Commercial CPSV Result

2014 Commercial Engineering Review Results	Enbridge Claim	CPSV Recommendation	% Difference
Total CCM Savings	74,412,932	65,185,597	-12.4%

Appendix C. Industrial Custom Project Savings Verification Study (CPSV) Summary

As part of its annual evaluation and DSM audit process, a third-party firm is selected to undertake engineering reviews of a random sample of custom projects in each of the Commercial and Industrial sectors.

In consultation with the 2014 Audit Committee, in November 2014, EGD retained Cole Engineering (Cole) to conduct the engineering review (Custom Project Savings Verification Study (CPSV)) of the savings claim for the 2014 Industrial custom projects.

Purpose of the Study

The purpose of the CPSV is to provide an independent opinion of the reasonableness of the energy savings claimed by the Industrial sector custom projects in 2014, through a review of a statistically representative sample of projects.

Methodology

Using a sampling methodology developed for Enbridge and Union Gas by Navigant Consulting in 2012, revised in 2014 and endorsed by the TEC (attached as Appendix I), Ipsos Loyalty was contracted as an independent third party to randomly select a representative sample of Industrial custom projects claimed in 2014. In 2014, there were 128 Industrial custom projects completed, of which 19 were randomly selected by Ipsos Loyalty for the CPSV.

A detailed Terms of Reference for the CPSV was updated and endorsed by the TEC and provided to the CPSV consultant at the outset of the review. Specific details regarding the scope of work and deliverables associated with the study are outlined in the CPSV Terms of Reference (included in Appendix A).

Results of the engineering review are summarized below, with the Enbridge claimed and CPSV revised CCM as recommended by Cole Engineering.

2014 Industrial Custom Project Verification Results

Table 47. Industrial CPSV Result

2014 Industrial Engineering Review Results	Enbridge Claim	CPSV Recommendation	% Difference
Total CCM Savings	8,279,071	9,001,386	+8.7%

Appendix D. CPSV Realization Rates

The Custom Project Savings Verification ("CPSV") process ultimately facilitates the determination of project and portfolio specific realization rates. The realization rate is the ratio that compares the CPSV firm recommended savings to the savings originally claimed by Enbridge.

The realization rate extrapolates verified savings from a sample of projects representative of the project portfolio and applies this calculation to the underlying project portfolio. More specifically, realization rates are calculated for each stratum sample, and a weighted realization rate is determined.

The methodology for determining the random sample and calculating realization rates was established by Navigant Consulting in 2012, revised in 2014 and endorsed by the TEC (see Appendix I). This approach ensures the sample of projects to be verified is statistically representative of the custom project population for each of the Commercial/Low Income (Multi-Residential) and Industrial custom project portfolios.

As detailed below, two separate realization rates were calculated by the Auditor (Optimal Energy, Inc.) for cumulative gas savings results.

Commercial/Low Income CPSV

Ipsos Loyalty was retained to select a statistically relevant set of sample projects, following the prescribed methodology, representative of Enbridge's 2014 Commercial custom & Low Income Multi-Residential custom projects to be reviewed in the Custom Project Savings Verification (CPSV).

For the purposes of the 2014 Commercial/Low Income CPSV, 27 projects were independently selected for verification.

The CCM values recommended by MMM in their Final CPSV Report were utilized to calculate a Realization Rate. This calculation was completed by the 2014 auditor, Optimal Energy, Inc. This adjustment factor was applied to all 2014 Commercial custom and Low Income Multi-Residential custom project results.

The Realization Rate for the 2014 Commercial/Low income Multi-Residential custom projects is 80.8%. based on the CPSV firm recommended adjustments.

The CCM values recommended by MMM in their Final CPSV Report were reviewed by the auditor through the audit process and final auditor recommended values were then utilized to determine the audit adjusted Realization Rate. This calculation was completed by the 2014 auditor, Optimal Energy, Inc.

The final post-audit Realization Rate for the Commercial/Low income Multi-Residential custom projects is 83.7%.

Industrial CPSV

Ipsos Loyalty was retained to select a statistically relevant set of sample projects, following the prescribed methodology, representative of Enbridge's 2014 Industrial custom projects to be reviewed in the Custom Project Savings Verification (CPSV).

For the purposes of the 2014 Industrial CPSV, 19 projects were independently selected for verification.

The CCM values recommended by Cole Engineering in their Final CPSV Report were utilized to calculate a Realization Rate. This calculation was completed by the 2014 auditor, Optimal Energy, Inc. This adjustment factor was then applied to all 2014 Industrial custom project results.

The Realization Rate for the 2014 Industrial custom projects is 103.3% based on the CPSV firm recommended adjustments..

The CCM values recommended by Genivar in their Final CPSV Report were reviewed by the auditor through the audit process and final auditor recommended values were then utilized to determine the audit adjusted Realization Rate. This calculation was completed by the 2014 auditor, Optimal Energy, Inc.

The final post-audit Realization Rate for the Industrial custom projects is 103.5%.

Appendix E. Breakdown of 2014 Results

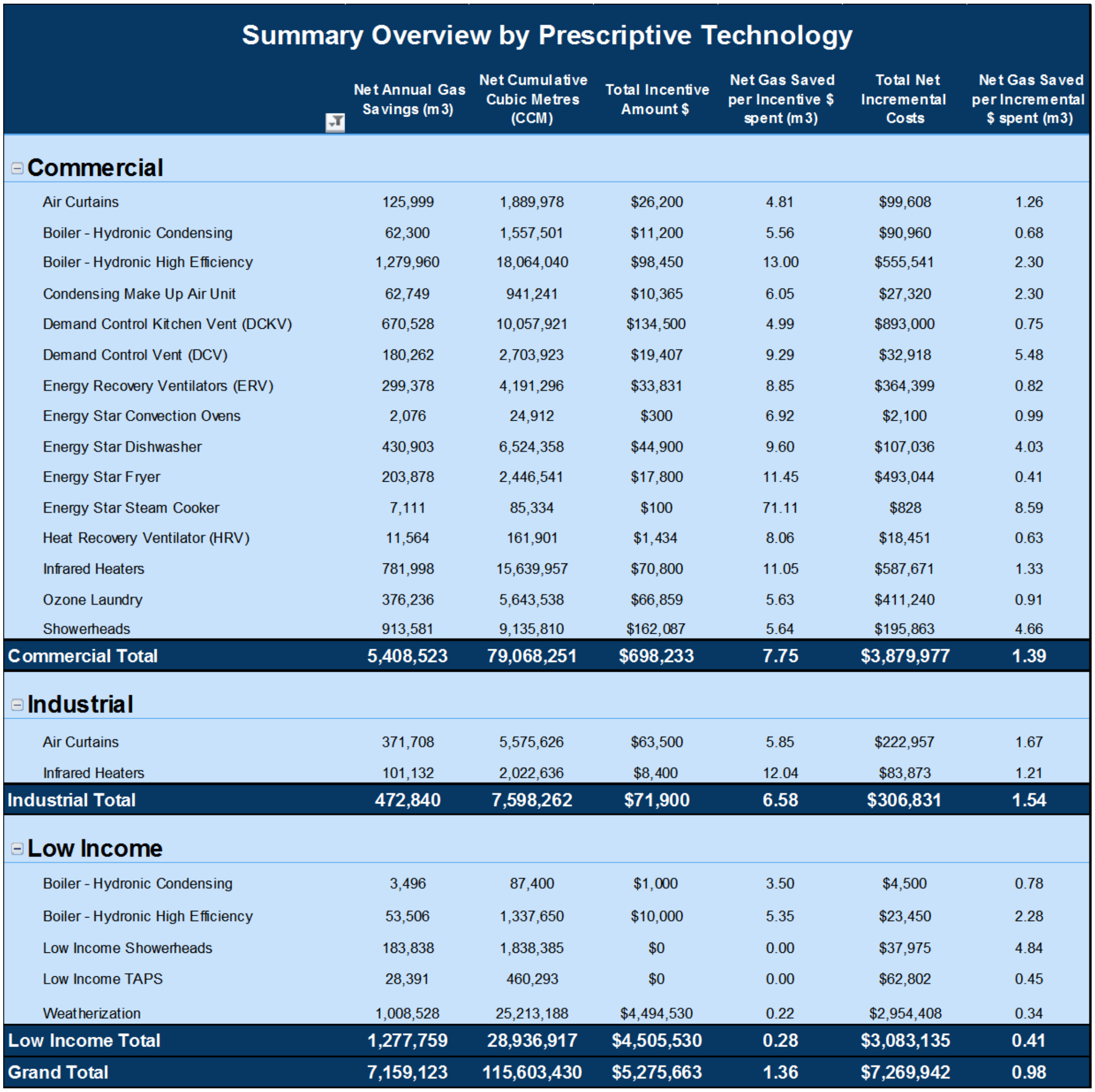
This appendix provides additional detail regarding the 2014 DSM results. Separate tables are presented for prescriptive and custom technologies.

The following three tables summarize results as follows:

- by technology for prescriptive offers
- summarized by type of custom project
- custom projects by sub-sector.

These tables are presented for illustrative purposes only.

Table 48. Overview by Prescriptive Technology



Summary Overview by Prescriptive Technology

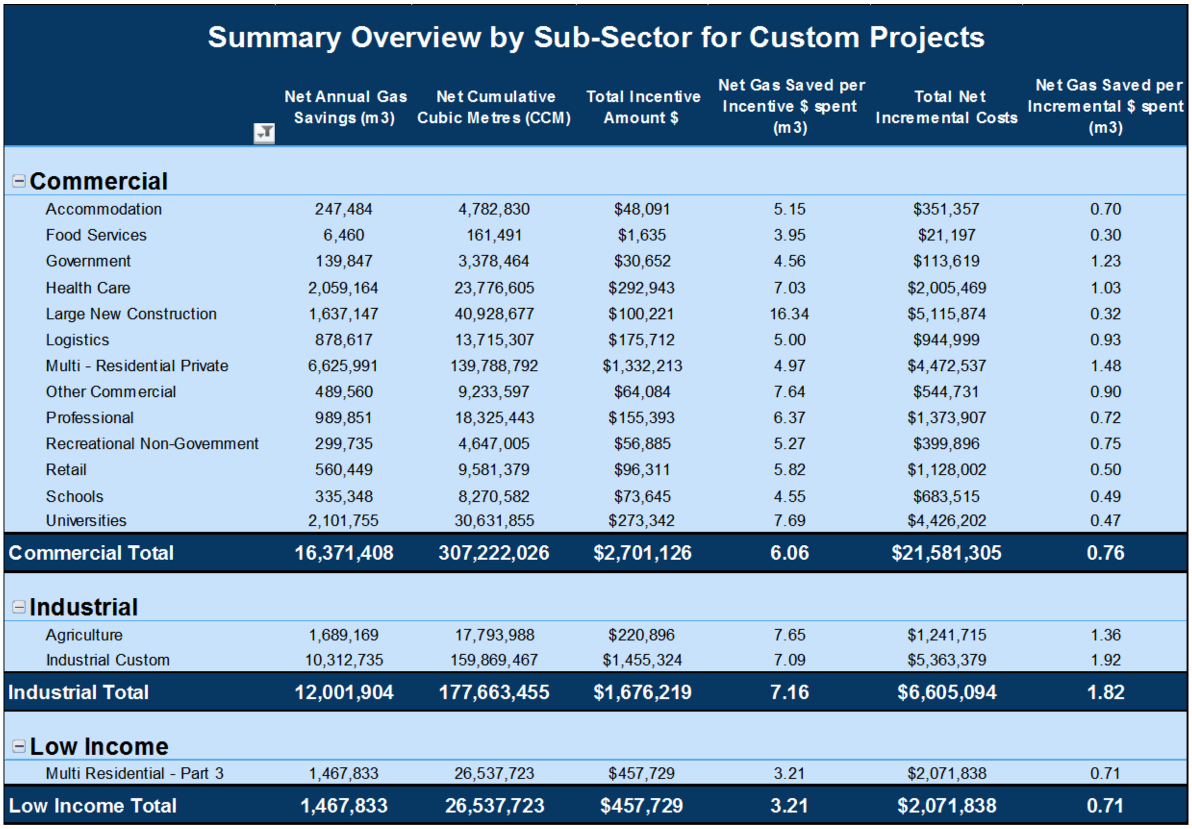
	Net Annual Gas Savings (m3)	Net Cumulative Cubic Metres (CCM)	Total Incentive Amount $	Net Gas Saved per Incentive $ spent (m3)	Total Net Incremental Costs	Net Gas Saved per Incremental $ spent (m3)
Commercial						
Air Curtains	125,999	1,889,978	$26,200	4.81	$99,608	1.26
Boiler - Hydronic Condensing	62,300	1,557,501	$11,200	5.56	$90,960	0.68
Boiler - Hydronic High Efficiency	1,279,960	18,064,040	$98,450	13.00	$555,541	2.30
Condensing Make Up Air Unit	62,749	941,241	$10,365	6.05	$27,320	2.30
Demand Control Kitchen Vent (DCKV)	670,528	10,057,921	$134,500	4.99	$893,000	0.75
Demand Control Vent (DCV)	180,262	2,703,923	$19,407	9.29	$32,918	5.48
Energy Recovery Ventilators (ERV)	299,378	4,191,296	$33,831	8.85	$364,399	0.82
Energy Star Convection Ovens	2,076	24,912	$300	6.92	$2,100	0.99
Energy Star Dishwasher	430,903	6,524,358	$44,900	9.60	$107,036	4.03
Energy Star Fryer	203,878	2,446,541	$17,800	11.45	$493,044	0.41
Energy Star Steam Cooker	7,111	85,334	$100	71.11	$828	8.59
Heat Recovery Ventilator (HRV)	11,564	161,901	$1,434	8.06	$18,451	0.63
Infrared Heaters	781,998	15,639,957	$70,800	11.05	$587,671	1.33
Ozone Laundry	376,236	5,643,538	$66,859	5.63	$411,240	0.91
Showerheads	913,581	9,135,810	$162,087	5.64	$195,863	4.66
Commercial Total	**5,408,523**	**79,068,251**	**$698,233**	**7.75**	**$3,879,977**	**1.39**
Industrial						
Air Curtains	371,708	5,575,626	$63,500	5.85	$222,957	1.67
Infrared Heaters	101,132	2,022,636	$8,400	12.04	$83,873	1.21
Industrial Total	**472,840**	**7,598,262**	**$71,900**	**6.58**	**$306,831**	**1.54**
Low Income						
Boiler - Hydronic Condensing	3,496	87,400	$1,000	3.50	$4,500	0.78
Boiler - Hydronic High Efficiency	53,506	1,337,650	$10,000	5.35	$23,450	2.28
Low Income Showerheads	183,838	1,838,385	$0	0.00	$37,975	4.84
Low Income TAPS	28,391	460,293	$0	0.00	$62,802	0.45
Weatherization	1,008,528	25,213,188	$4,494,530	0.22	$2,954,408	0.34
Low Income Total	**1,277,759**	**28,936,917**	**$4,505,530**	**0.28**	**$3,083,135**	**0.41**
Grand Total	**7,159,123**	**115,603,430**	**$5,275,663**	**1.36**	**$7,269,942**	**0.98**

Table 49. Overview by Custom Technology

Summary Overview by Custom Technology

	Net Annual Gas Savings (m3)	Net Cumulative Cubic Metres (CCM)	Total Incentive Amount $	Net Gas Saved per Incentive $ spent (m3)	Total Net Incremental Costs	Net Gas Saved per Incremental $ spent (m3)
Commercial						
20 Year Space	328,588	6,571,750	$44,611	7.37	$2,215,286	0.15
5 Year Space	44,570	222,850	$5,923	7.53	$23,544	1.89
Air Curtain	123,107	1,846,599	$17,399	7.08	$66,475	1.85
Air Handling Unit	28,957	434,357	$7,506	3.86	$2,259	12.82
Boiler - Hydronic Condensing	2,882,421	71,632,301	$685,940	4.20	$2,885,112	1.00
Boiler - Hydronic High Efficiency	4,899,115	119,864,650	$791,595	6.19	$7,505,274	0.65
Boiler - Steam	55,193	1,379,816	$7,494	7.36	$224,177	0.25
Building Envelope	49,334	1,233,351	$6,698	7.37	$324,433	0.15
Controls	4,556,468	68,347,026	$634,395	7.18	$5,221,898	0.87
DCV 15 yr	310,291	4,654,371	$42,127	7.37	$300,626	1.03
Dehumidification	35,799	536,985	$4,860	7.37	$69,960	0.51
Destratification	798,144	11,972,157	$181,362	4.40	$785,647	1.02
Drain Water Heat Recovery	5,924	148,104	$804	7.37	$6,325	0.94
Heat Recovery/Economizer	279,988	4,199,817	$38,990	7.18	$554,266	0.51
High Extraction Washer	59,081	590,810	$8,610	6.86	$212,634	0.28
Insulation/Caulking/Sealing	134,473	2,017,094	$18,477	7.28	$93,310	1.44
Operational Improvements	693,551	3,467,754	$89,820	7.72	$300,467	2.31
Pipe Insulation	11,390	170,855	$1,682	6.77	$9,804	1.16
Re-Commissioning	166,659	833,296	$22,627	7.37	$48,664	3.42
Reflective Panel	87,843	1,317,642	$14,289	6.15	$108,575	0.81
Roof Top Unit	8,499	127,487	$1,154	7.36	$19,888	0.43
Steam Condensate Recovery	28,450	426,755	$3,862	7.37	$34,685	0.82
Steam Pipe Insulation	43,099	646,486	$6,103	7.06	$70,048	0.62
Steam Trap	658,358	3,291,790	$53,261	12.36	$107,865	6.10
Tank Less/Instantaneous	18,778	338,001	$2,549	7.37	$21,816	0.86
VFD	63,328	949,920	$8,988	7.05	$368,265	0.17
Commercial Total	**16,371,408**	**307,222,026**	**$2,701,126**	**6.06**	**$21,581,305**	**0.76**
Industrial						
10 Year Industrial	1,098,718	10,987,182	$85,520	12.85	$88,983	12.35
5 Year Industrial	482,979	2,414,893	$2,801	172.41	$2,801	172.41
Air Handling Unit	8,499	127,484	$3,285	2.59	$5,596	1.52
Boiler - Hydronic Condensing	103,936	2,598,399	$23,803	4.37	$185,406	0.56
Boiler - Steam	96,814	2,420,360	$24,354	3.98	$249,164	0.39
Boiler - Watertube	30,472	457,079	$10,444	2.92	$26,750	1.14
Building Envelope	498,185	12,454,634	$119,239	4.18	$233,079	2.14
Condensate Recovery	140,939	2,114,078	$21,117	6.67	$27,575	5.11
Condensing Economizer	308,628	4,629,415	$48,845	6.32	$142,482	2.17
Controls	387,620	5,814,307	$54,328	7.13	$236,043	1.64
Furnace	232,303	4,181,448	$48,993	4.74	$280,661	0.83
Greenhouse Curtains	1,617,741	16,177,405	$200,274	8.08	$1,171,791	1.38
Heat Recovery	222,047	3,330,702	$21,674	10.25	$298,732	0.74
Heat Recovery/Economizer	116,202	1,743,029	$40,522	2.87	$65,452	1.78
Industrial Equipment	4,234,975	84,699,494	$693,159	6.11	$2,783,301	1.52
Infrared	269,149	5,382,973	$48,505	5.55	$542,041	0.50
Insulation	576,518	8,647,767	$90,770	6.35	$119,103	4.84
Linkageless Control	97,871	1,468,067	$8,550	11.45	$12,150	8.06
Oven	28,410	426,146	$9,750	2.91	$9,750	2.91
Pipe Insulation	24,851	372,763	$1,916	12.97	$1,916	12.97
Roof Insulation	4,529	113,229	$1,750	2.59	$2,350	1.93
Steam Trap	1,420,520	7,102,602	$116,621	12.18	$119,967	11.84
Industrial Total	**12,001,904**	**177,663,455**	**$1,676,219**	**7.16**	**$6,605,094**	**1.82**
Low Income						
Boiler - Hydronic Condensing	198,069	4,951,734	$118,498	1.67	$423,632	0.47
Boiler - Hydronic High Efficiency	291,113	6,906,231	$145,544	2.00	$410,779	0.71
Controls	36,685	550,273	$22,886	1.60	$66,983	0.55
Heat Recovery/Economizer	9,129	136,937	$5,249	1.74	$43,200	0.21
Make Up Air Unit	263,929	3,958,930	$164,968	1.60	$439,299	0.60
Reflective Panel	667,685	10,015,274	$0	0.00	$668,945	1.00
Tank Type Water Heater	1,223	18,343	$584	2.09	$19,000	0.06
Low Income Total	**1,467,833**	**26,537,723**	**$457,729**	**3.21**	**$2,071,838**	**0.71**
Grand Total	**29,841,145**	**511,423,205**	**$4,835,075**	**6.17**	**$30,258,236**	**0.99**

Table 50. Custom Project Overview by Sub-Sector



Summary Overview by Sub-Sector for Custom Projects

	Net Annual Gas Savings (m3)	Net Cumulative Cubic Metres (CCM)	Total Incentive Amount $	Net Gas Saved per Incentive $ spent (m3)	Total Net Incremental Costs	Net Gas Saved per Incremental $ spent (m3)
⊟ Commercial						
Accommodation	247,484	4,782,830	$48,091	5.15	$351,357	0.70
Food Services	6,460	161,491	$1,635	3.95	$21,197	0.30
Government	139,847	3,378,464	$30,652	4.56	$113,619	1.23
Health Care	2,059,164	23,776,605	$292,943	7.03	$2,005,469	1.03
Large New Construction	1,637,147	40,928,677	$100,221	16.34	$5,115,874	0.32
Logistics	878,617	13,715,307	$175,712	5.00	$944,999	0.93
Multi - Residential Private	6,625,991	139,788,792	$1,332,213	4.97	$4,472,537	1.48
Other Commercial	489,560	9,233,597	$64,084	7.64	$544,731	0.90
Professional	989,851	18,325,443	$155,393	6.37	$1,373,907	0.72
Recreational Non-Government	299,735	4,647,005	$56,885	5.27	$399,896	0.75
Retail	560,449	9,581,379	$96,311	5.82	$1,128,002	0.50
Schools	335,348	8,270,582	$73,645	4.55	$683,515	0.49
Universities	2,101,755	30,631,855	$273,342	7.69	$4,426,202	0.47
Commercial Total	**16,371,408**	**307,222,026**	**$2,701,126**	**6.06**	**$21,581,305**	**0.76**
⊟ Industrial						
Agriculture	1,689,169	17,793,988	$220,896	7.65	$1,241,715	1.36
Industrial Custom	10,312,735	159,869,467	$1,455,324	7.09	$5,363,379	1.92
Industrial Total	**12,001,904**	**177,663,455**	**$1,676,219**	**7.16**	**$6,605,094**	**1.82**
⊟ Low Income						
Multi Residential - Part 3	1,467,833	26,537,723	$457,729	3.21	$2,071,838	0.71
Low Income Total	**1,467,833**	**26,537,723**	**$457,729**	**3.21**	**$2,071,838**	**0.71**

Appendix F. 2012-2014 DSM Plan – Multi-Year Results

Table 51. 2012-2014 DSM Plan Multi-Year Results

	Component	Metric	2014 Actual Results	2013 Actual Results	2012 Actual Results
Resource Acquisition	**Volumes**	*Cumulative Savings (million m^3)*	**664.37**	**766.69**	**970.05**
	Residential Deep Savings	*Number of Houses* [1]	**5,213**	**1,649**	**271**
Low Income	**Single Family (Part 9)**	*Cumulative Savings (million m^3)*	**25.7**	**32.9**	**24.7**
	Multi-residential (Part 3)	*Cumulative Savings (million m^3)*	**29.8**	**27.3**	**43.4**
	Multi-residential (Part 3) LIBPM [2]	*Percent of Part 3 Participants Enrolled* [3]	**74%**	**85%**	**N/A**[7]
Market Transformation	**Drain Water Heat Recovery**	*# of Units Installed*	**N/A**[8]	**6,465**	**5,047**
	Residential Savings by Design	*Completed Units*	**1,059**	**967**	**N/A**[7]
		Builders Enrolled [4]	**23**	**18**	**12**
	Commercial Savings by Design	*New Developments Enrolled*	**19**	**16**	**9**
	Home Labelling	*Number Committed Realtors* [5,6]	**40,040**	**78,000**	**8,600**
		Ratings performed	**662**	**138**	**N/A**[7]

1. Number of houses with at least two major measures and where average annual gas savings across all participants is at least 25% of combined baseline space heating and water heating usage.
2. LIBPM - Low Income Building Performance Management is the Low Income offer complement to the Commercial Run It Right (RIR) offer.
3. Low Income Building Performance Management (LIBPM) percentage of Part 3 buildings enrolled in current year program = (x+y)/(x+y+z):

   x = # of new LIBPM buildings in the current year that have participated in another aspect of the Low Income program in a previous year of 2012-2014 plan; y = # of new LIBPM buildings participating in current year that have not previously participated in the Low Income program; z = # of buildings in the current year that have implemented custom projects other than LIBPM.
4. Eligible builders based on a minimum of 50 homes built in the prior year.
5. Commitments to make provision for a data field to show home energy ratings for all homes listed by participating realtors (industry-wide commitment to include such a field on MLS or similar listing service and/or realtors' commitment to do so with all the homes they list on their own websites, handouts and other consumer material).
6. Commitment from realtors collectively responsible for more than 5,000 (middle target) or 10,000 (upper target) listings/year.
7. Metric did not apply in this year.
8. Program ended in 2013.

Appendix G. New and Updated DSM Measures

On March 27, 2015, Enbridge Gas Distribution Inc. and Union Gas Ltd. submitted a joint application which sought approval from the Ontario Energy Board for new and updated Demand Side Management measures. The Board assigned this matter file number EB-2014-0354. On July 23, 2015 Enbridge and Union Gas were granted approval of the new and updated DSM measures and input assumptions as set out in the joint application, EB-2014-0354.

Below is the link to the OEB website to access the filing:

http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/search/rec&sm_udf10=eb-2014-0354&sortd1=rs_dateregistered&rows=200

Appendix H. Avoided Costs

	2014 Gas Avoided Costs							
	Water Heating		Space Heating		Combined Space & Water Heating		Industrial	
Year	Baseload ($/m3)		Baseload ($/m3)		Baseload ($/m3)		Baseload ($/m3)	
	Rate	NPV	Rate	NPV	Rate	NPV	Rate	NPV
1	0.15488	$0.15	0.16267	$0.16	0.16145	$0.16	0.15536	$0.16
2	0.16264	$0.31	0.17227	$0.32	0.17071	$0.32	0.16339	$0.31
3	0.18316	$0.47	0.19229	$0.49	0.19061	$0.49	0.18428	$0.47
4	0.20437	$0.63	0.21450	$0.67	0.21262	$0.66	0.20578	$0.64
5	0.22945	$0.81	0.24138	$0.85	0.23906	$0.84	0.23083	$0.81
6	0.25834	$0.99	0.29654	$1.06	0.29129	$1.05	0.26060	$1.00
7	0.25101	$1.16	0.26761	$1.24	0.26470	$1.23	0.25280	$1.17
8	0.24938	$1.32	0.26588	$1.41	0.26299	$1.39	0.25116	$1.32
9	0.25036	$1.46	0.26692	$1.56	0.26402	$1.54	0.25214	$1.47
10	0.24321	$1.59	0.25930	$1.70	0.25648	$1.68	0.24495	$1.60
11	0.24807	$1.72	0.26448	$1.84	0.26161	$1.82	0.24984	$1.73
12	0.25303	$1.84	0.26977	$1.97	0.26684	$1.94	0.25484	$1.85
13	0.25810	$1.95	0.27517	$2.09	0.27218	$2.07	0.25994	$1.97
14	0.26326	$2.06	0.28067	$2.20	0.27762	$2.18	0.26514	$2.08
15	0.26852	$2.17	0.28628	$2.31	0.28317	$2.29	0.27044	$2.18
16	0.27389	$2.27	0.29201	$2.42	0.28884	$2.39	0.27585	$2.28
17	0.27937	$2.36	0.29785	$2.52	0.29461	$2.49	0.28137	$2.38
18	0.28496	$2.45	0.30381	$2.62	0.30051	$2.59	0.28699	$2.47
19	0.29066	$2.54	0.30988	$2.71	0.30652	$2.68	0.29273	$2.55
20	0.29647	$2.62	0.31608	$2.80	0.31265	$2.77	0.29859	$2.64
21	0.30240	$2.70	0.32240	$2.88	0.31890	$2.85	0.30456	$2.72
22	0.30845	$2.77	0.32885	$2.96	0.32528	$2.93	0.31065	$2.79
23	0.31462	$2.84	0.33543	$3.04	0.33178	$3.00	0.31686	$2.86
24	0.32091	$2.91	0.34214	$3.11	0.33842	$3.07	0.32320	$2.93
25	0.32733	$2.98	0.34898	$3.18	0.34519	$3.14	0.32966	$3.00
26	0.33387	$3.04	0.35596	$3.24	0.35209	$3.21	0.33626	$3.06
27	0.34055	$3.10	0.36308	$3.30	0.35913	$3.27	0.34298	$3.12
28	0.34736	$3.15	0.37034	$3.36	0.36631	$3.33	0.34984	$3.17
29	0.35431	$3.21	0.37775	$3.42	0.37364	$3.38	0.35684	$3.23
30	0.36140	$3.26	0.38530	$3.47	0.38111	$3.44	0.36398	$3.28

The Nominal Inflation Rate used in the table is 2.0%
The Discount factor used in the table is 7.0%

	2014 Water and Electricity Avoided Costs															
	Water Heating				Space Heating				Combined Space & Water Heating				Industrial			
Year	Electricity (¢/Kwh)		Water ($/1000 litre)		Electricity (¢/Kwh)		Water ($/1000 litre)		Electricity (¢/Kwh)		Water ($/1000 litre)		Electricity (¢/Kwh)		Water ($/1000 litre)	
	Rate	NPV	Rate	NPV	Rate	NPV	Rate	NPV	Rate	NPV	Rate	NPV	Rate	NPV	Rate	NPV
1	0.10770	$0.11	2.59480	$2.59	0.10770	$0.11	2.59480	$2.59	0.10770	$0.11	2.59480	$2.59	0.10770	$0.11	2.59480	$2.59
2	0.11000	$0.21	2.65017	$5.07	0.11000	$0.21	2.65017	$5.07	0.11000	$0.21	2.65017	$5.07	0.11000	$0.21	2.65017	$5.07
3	0.11221	$0.31	2.70347	$7.43	0.11221	$0.31	2.70347	$7.43	0.11221	$0.31	2.70347	$7.43	0.11221	$0.31	2.70347	$7.43
4	0.11446	$0.40	2.75772	$9.68	0.11446	$0.40	2.75772	$9.68	0.11446	$0.40	2.75772	$9.68	0.11446	$0.40	2.75772	$9.68
5	0.11677	$0.49	2.81335	$11.83	0.11677	$0.49	2.81335	$11.83	0.11677	$0.49	2.81335	$11.83	0.11677	$0.49	2.81335	$11.83
6	0.11916	$0.58	2.87101	$13.88	0.11916	$0.58	2.87101	$13.88	0.11916	$0.58	2.87101	$13.88	0.11916	$0.58	2.87101	$13.88
7	0.12161	$0.66	2.92995	$15.83	0.12161	$0.66	2.92995	$15.83	0.12161	$0.66	2.92995	$15.83	0.12161	$0.66	2.92995	$15.83
8	0.12403	$0.73	2.98829	$17.69	0.12403	$0.73	2.98829	$17.69	0.12403	$0.73	2.98829	$17.69	0.12403	$0.73	2.98829	$17.69
9	0.12644	$0.81	3.04640	$19.46	0.12644	$0.81	3.04640	$19.46	0.12644	$0.81	3.04640	$19.46	0.12644	$0.81	3.04640	$19.46
10	0.12897	$0.88	3.10728	$21.15	0.12897	$0.88	3.10728	$21.15	0.12897	$0.88	3.10728	$21.15	0.12897	$0.88	3.10728	$21.15
11	0.13153	$0.94	3.16899	$22.76	0.13153	$0.94	3.16899	$22.76	0.13153	$0.94	3.16899	$22.76	0.13153	$0.94	3.16899	$22.76
12	0.13416	$1.01	3.23224	$24.30	0.13416	$1.01	3.23224	$24.30	0.13416	$1.01	3.23224	$24.30	0.13416	$1.01	3.23224	$24.30
13	0.13684	$1.07	3.29678	$25.76	0.13684	$1.07	3.29678	$25.76	0.13684	$1.07	3.29678	$25.76	0.13684	$1.07	3.29678	$25.76
14	0.13956	$1.13	3.36228	$27.16	0.13956	$1.13	3.36228	$27.16	0.13956	$1.13	3.36228	$27.16	0.13956	$1.13	3.36228	$27.16
15	0.14233	$1.18	3.42923	$28.49	0.14233	$1.18	3.42923	$28.49	0.14233	$1.18	3.42923	$28.49	0.14233	$1.18	3.42923	$28.49
16	0.14518	$1.24	3.49788	$29.76	0.14518	$1.24	3.49788	$29.76	0.14518	$1.24	3.49788	$29.76	0.14518	$1.24	3.49788	$29.76
17	0.14808	$1.29	3.56777	$30.97	0.14808	$1.29	3.56777	$30.97	0.14808	$1.29	3.56777	$30.97	0.14808	$1.29	3.56777	$30.97
18	0.15105	$1.33	3.63924	$32.12	0.15105	$1.33	3.63924	$32.12	0.15105	$1.33	3.63924	$32.12	0.15105	$1.33	3.63924	$32.12
19	0.15406	$1.38	3.71167	$33.22	0.15406	$1.38	3.71167	$33.22	0.15406	$1.38	3.71167	$33.22	0.15406	$1.38	3.71167	$33.22
20	0.15712	$1.42	3.78553	$34.26	0.15712	$1.42	3.78553	$34.26	0.15712	$1.42	3.78553	$34.26	0.15712	$1.42	3.78553	$34.26
21	0.16025	$1.46	3.86086	$35.26	0.16025	$1.46	3.86086	$35.26	0.16025	$1.46	3.86086	$35.26	0.16025	$1.46	3.86086	$35.26
22	0.16345	$1.50	3.93807	$36.21	0.16345	$1.50	3.93807	$36.21	0.16345	$1.50	3.93807	$36.21	0.16345	$1.50	3.93807	$36.21
23	0.16672	$1.54	4.01683	$37.12	0.16672	$1.54	4.01683	$37.12	0.16672	$1.54	4.01683	$37.12	0.16672	$1.54	4.01683	$37.12
24	0.17006	$1.58	4.09717	$37.98	0.17006	$1.58	4.09717	$37.98	0.17006	$1.58	4.09717	$37.98	0.17006	$1.58	4.09717	$37.98
25	0.17346	$1.61	4.17911	$38.81	0.17346	$1.61	4.17911	$38.81	0.17346	$1.61	4.17911	$38.81	0.17346	$1.61	4.17911	$38.81
26	0.17693	$1.64	4.26270	$39.59	0.17693	$1.64	4.26270	$39.59	0.17693	$1.64	4.26270	$39.59	0.17693	$1.64	4.26270	$39.59
27	0.18047	$1.67	4.34795	$40.34	0.18047	$1.67	4.34795	$40.34	0.18047	$1.67	4.34795	$40.34	0.18047	$1.67	4.34795	$40.34
28	0.18408	$1.70	4.43491	$41.05	0.18408	$1.70	4.43491	$41.05	0.18408	$1.70	4.43491	$41.05	0.18408	$1.70	4.43491	$41.05
29	0.18776	$1.73	4.52361	$41.73	0.18776	$1.73	4.52361	$41.73	0.18776	$1.73	4.52361	$41.73	0.18776	$1.73	4.52361	$41.73
30	0.19151	$1.76	4.61408	$42.38	0.19151	$1.76	4.61408	$42.38	0.19151	$1.76	4.61408	$42.38	0.19151	$1.76	4.61408	$42.38

The Nominal Inflation Rate used in the table is 2.0%
The Discount factor used in the table is 7.0%

Appendix I. Sampling Methodology for Custom C&I Programs

NAVIGANT

A Sampling Methodology for Custom C&I Programs

Prepared for:
Sub-Committee of the

Technical Evaluation Committee

unionogas
A Spectra Energy Company

ENBRIDGE

November 12, 2012
Revised: October 28, 2014

Prepared by:
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Table of Contents

1. Introduction

This report presents a sampling methodology intended for use in the evaluation of custom demand side management (DSM) programs delivered in commercial and industrial (C&I) sectors. The report provides a technical explanation of issues that have been raised in the evaluation processes. It also provides justification for the approaches recommended herein.

Past evaluation studies of Union Gas Limited (Union) and Enbridge Gas Distribution (Enbridge) custom programs have undergone third-party audits where the sample design and realization rate calculations are examined. The processes and judgments applied in these evaluation studies are audited to ensure that the analyses are transparent and accurate. The recommendations in this report along with the technical discussions are intended to better frame the issues for the third-party audit reviews and streamline the overall audit process.

The sample design methodology recommendations are presented in Section 5. The realization rate and achieved precision methodology recommendations are presented in Section 6. The report also contains three technical appendices discussing key issues and presenting the calculations required to develop statistical program estimates.

1.1 Background

Union and Enbridge have delivered DSM initiatives since 1997 and 1995, respectively. Union and Enbridge operate DSM programs, including programs that involve custom projects in the industrial, commercial, multi-residential, and new construction sectors. Custom projects cover opportunities where savings are linked to unique building and manufacturing specifications, end uses, and technologies. Each project is assessed individually for participation in the program. The DSM portfolio for both utilities includes several hundred custom projects annually.

Union and Enbridge DSM activities are regulated by the Ontario Energy Board (OEB) and adhere to the requirements as laid out in DSM Guidelines for Natural Gas Utilities.[1] For custom projects, the resource savings are determined through engineering calculations that are determined at the design stage of each project. There is a need to verify the resource savings through a third-party C&I engineering review.

A sampling methodology for custom projects was developed in 2008.[2,3] This methodology was intended to be used to evaluate future custom program impacts while the programs retained

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[1] "Demand Side Management Guidelines for Natural Gas Utilities." EB-2008-0346. Ontario Energy Board. June 30, 2011.

[2] "Sampling Methodology for Engineering Review of Custom Projects." Enbridge Gas Distribution Inc. and Union Gas Limited. Prepared by Summit Blue Consulting. April 3, 2008.

roughly the same distribution of projects in terms of size and segment. There have been some changes to the custom programs and Union and Enbridge are now preparing for the engineering review of custom projects for 2012. As a result, there is a need to update the sampling methodology. Both utilities seek a harmonized approach to evaluating custom programs that involves on-site reviews of selected custom projects within a representative sample of the respective utility project populations.

In 2012, both utilities entered into a new regulatory framework in Ontario that established a new intervener process with the creation of a common Technical Evaluation Committee (TEC) for both utilities. The goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario. The TEC will make recommendations to the OEB on annual Technical Reference Manual (TRM) updates, establish evaluation priorities, and reach consensus on the design and implementation of evaluation studies.

1.2 OEB Requirements for Evaluating Custom Projects

The OEB's DSM Guidelines for Natural Gas Utilities draws special attention to custom projects. The Guidelines define custom projects:[4]

> *Custom projects are those projects that involve customized design and engineering, and where a natural gas utility facilitates the implementation of specialized equipment or technology not identified in the Board approved list of input assumptions. Projects that simply include a combination of several measures provided in the list of input assumptions are not considered to be custom projects.* (p.5)

The Guidelines go on to prescribe an evaluation approach for custom projects:

> *For custom resource acquisition projects, which usually involve specialized equipment, savings estimates should be assessed on a case by case basis. It is expected that each custom project will incorporate a professional engineering assessment of the savings. This assessment would serve as the primary documentation for the savings claimed.*
>
> *A special assessment program should be implemented for custom projects. The assessment should be conducted on a random sample consisting of 10% of the large custom projects; and the projects should represent at least 10% of the total volume savings of all custom projects. The minimum number of projects to be assessed should be 5. Where less than 5 custom projects have been undertaken, all projects should be assessed. The assessment should focus on verifying the equipment installation, estimated savings and equipment costs.*

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[3] "Update Memorandum: Proposed Sampling Method for Custom Projects." Summit Blue Consulting. October 31, 2008.

[4] "Demand Side Management Guidelines for Natural Gas Utilities." EB-2008-0346.Ontario Energy Board. June 30, 2011.

> *All program result evaluations should be conducted by the natural gas utilities' third-party evaluator(s). If possible, the natural gas utilities' third-party evaluator(s) should be selected from the [Ontario Power Authority's] OPA's third-party vendor of record list. The natural gas utilities' third-party evaluators should seek to follow the OPA's evaluation, measurement and verification protocols,[5] where applicable and relevant to the natural gas sector.* (p.39)

The recommended sample methodology contained in Sections 5 and 6 of this report conforms to the Guidelines for custom projects. Appendix B presents the detailed equations necessary to implement the recommended methodology.

1.3 Report Objective

The objective of this report is to develop a methodology for designing a sample and for calculating achieved realization rates and sample confidence and precision using the observed results from the sample. The recommended methodology must meet OEB requirements as well as address the technical and programmatic needs of Union and Enbridge custom programs. The steps taken to achieve this objective include the following:

- Understand the composition of Union and Enbridge custom programs (Sections 2 and 3)
- Review and analyze sample methodologies in selected jurisdictions (Section 4)
- Recommend a methodology for designing and selecting samples (Section 5)
- Recommend a methodology for calculating the achieved program realization rates and sample confidence and precision (Section 6)

The recommended statistical methodology can be described as two-stage stratified ratio estimation. A step-by-step approach to implementing the methodology for sample design is presented in Section 5.4.

The recommended sample methodology is intended to provide sufficient flexibility to allow Union and Enbridge to efficiently meet sample precision needs while the composition, participation, and impacts of their custom programs resemble the current 2011/2012 programs. If the nature of the custom programs changes, adjustments to the recommended methodology may be warranted.

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[5] "EM&V Protocols and Requirements: 2011-2014." Ontario Power Authority. March 2011. (see page 129)

2. Overview of Union Custom Programs

Union's T1/R100 and commercial/industrial (C/I) custom programs are aligned under one brand platform, the *EnerSmart* program. This ensures a seamless, recognizable brand throughout Union's franchise. The program scorecards are divided based on rate class.[6] The T1/R100 program consists of T1 rate customers in Union's Southern delivery zone whose annual consumption is over 5M m^3 and R100 rate customers in Union's other delivery zones whose annual consumption is over 25.6M m^3. The C/I program consists of Union customers in all other rate classes. The methodology in this report pertains only to the custom measures in these programs. Additionally, Union is adding a new Low Income custom segment for the 2012 program year.[7]

Figure 1 outlines the rate class divisions of Union's custom projects. The number of projects in the C/I program is more than twice the number of the projects in the T1/R100 program but represents less than half of the savings of that program.

Figure 1. Union 2011 Custom Projects Overview

Union Custom Sector	# of Custom Projects	Gas Savings	% of Custom Portfolio
T1/R100	200	98,702,955	68.3%
Commercial/Industrial	459	45,472,108	31.5%
Low Income*	13	348,525	0.2%
Total	**672**	**144,523,588**	**100%**

*Low Income values are forecast for 2012 as this is a new segment for Union in 2012.

Source: Union Gas Limited

Custom projects are highly heterogeneous, with most projects tied directly to unique processes or technology requirements. Each project is validated on a stand-alone basis by a comprehensive professional engineering review and the overall programs are required to pass a Total Resource Cost (TRC) screening process. The EnerSmart program was designed to achieve savings in process-specific energy applications, as well as space heating, water heating, and the building envelope. Given the customized nature by which tracking database savings estimates are generated, Union conducts a third-party, on-site engineering study to verify the results of a representative project sample.

Account managers market the program directly to customers for T1/R100 and a combination of directly and indirectly through trade allies, channel partners, energy service companies, engineering firms, and equipment manufacturers to all other rate classes. Account managers work to cost-effectively promote energy efficiency within Union's C&I customer base.

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[6] Historically, the Union custom C&I program was divided based on whether the customer purchased gas under a firm distribution contract or through a general service contract.

[7] Low income includes commercial and industrial general service customers.

3. Overview of Enbridge Custom Programs

Enbridge offers custom programs for the C&I sectors. A variety of incentive-based initiatives are offered to C&I sector customers. These initiatives include custom project incentives and a suite of prescriptive offerings aimed at promoting specific measures. Given the myriad of building types, end uses, ownership structures, and leasing arrangements, the C&I sector is a complex and variable segment in which to market and deliver energy efficiency.

Enbridge's Continuous Energy Improvement (CEI) initiative is focused on custom measures in the industrial segment. As part of ongoing modifications to this program, the industrial program will pursue greater targeting of small to mid-size operations and more flexibility in the incentives offered. As such, in 2012 Enbridge proposes to increase its custom incentive and expand its prescriptive offering to include more measures. Greater segment-focused marketing activities aimed at the mid-size facilities will augment the traditional marketing efforts for larger customers.

Figure 2 presents the commercial and industrial sector divisions of Enbridge custom projects in 2011. The number of projects in the commercial sector is more than six times the number of the projects in the industrial sector, but the average commercial sector project is only about one third the size of the average industrial sector project.

Figure 2. Enbridge 2011 Custom Projects Overview

Enbridge Custom Sector	# of Custom Projects	Gas Savings	% of Custom Portfolio
Commercial	780	37,470,116	68.2%
Industrial	127	17,482,847	31.8%
Total	**907**	**54,952,963**	**100%**

Source: Enbridge Gas Distribution Company

There are important differences in the Union and Enbridge custom programs. One difference is the average size of project. The average Enbridge commercial project is about 48K therms compared to about 99K therms for the Union C/I market projects. The average Enbridge industrial project is about 138K therms compared to the Union T1/R100 industrial projects, which average about 493K therms. In general terms, Enbridge's programs serve a market more dominated by commercial customers with smaller average project sizes, while Union's programs generally serve a market with more industrial customers, which results in larger projects in terms of savings. These factors need to be taken into account in an efficient sample design.

4. Analysis of Sampling Methodologies in Selected Jurisdictions

This section presents the findings from a review of sampling methodologies used in the evaluation of custom project programs in North America, including those described in annual evaluation reports of selected utilities as well as methodologies contained within evaluation protocols. The reviewed methodologies are all contained within publicly available documents. Because the reviewed documents contain varying degrees of detail and explanation, the Navigant Consulting, Inc. (Navigant) team applied its best interpretation of these documents to synthesize the available information in a consistent manner.

4.1 *Summary of Jurisdictions Reviewed*

The analysis of the reviewed methodologies accounts for factors such as fuel type, customer segment, and program design factors that might influence the design of samples for realization rate analyses.

Seventeen documents[8] were reviewed covering 12 unique jurisdictions in North America listed below:

- Illinois (Chicago) – Commonwealth Edison Company[9]
- Michigan (Detroit) – DTE Energy[10]
- Massachusetts – Massachusetts Energy Efficiency Advisory Council[11] covering NSTAR, National Grid, and Western Massachusetts Electric Company
- New Mexico – El Paso Electric Company,[12] New Mexico Gas Company,[13] and Public Service Company of New Mexico[14]
- Pennsylvania (Philadelphia) – PECO Energy Company[15,16]
- Ohio – AEP Ohio[17]

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[8] Not counting the review of methodologies used by Union and Enbridge in prior evaluation cycles.

[9] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[10] "Reconciliation Report for DTE Energy's 2010 Energy Optimization Programs." DTE Energy Company. Prepared by Opinion Dynamics Corporation. April 15, 2011.

[11] "Impact Evaluation of 2008 and 2009 Custom CDA Installations." Massachusetts Energy Efficiency Advisory Council. Prepared by KEMA and SBW Consulting Incorporated. June 7, 2011.

[12] "Evaluation of 2011 DSM Portfolio." El Paso Electric Company. Prepared by ADM Associates Incorporated. May 2012.

[13] "Evaluation of 2011 DSM Portfolio." New Mexico Gas Company. Prepared by ADM Associates Incorporated. June 2012.

[14] "Evaluation of 2011 DSM & Demand Response Portfolio. "Public Service Company of New Mexico. Prepared by ADM Associates Incorporated. March 2012.

[15] "Annual Report to the Pennsylvania Public Utility Commission for the Period June 2010 through May 2011." PECO Energy Company. Prepared by Navigant Consulting. November 15, 2011.

[16] "Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs. "Pennsylvania Public Utility Commission. Prepared by the PA Statewide Evaluation Team. November 4, 2011.

[17] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012.

- Maryland – EmPOWER Maryland[18] covering Baltimore Gas & Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison
- California – California Public Utilities Commission,[19,20,21]covering Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric
- Vermont – Vermont Department of Public Service[22] covering Efficiency Vermont and Burlington Electric Department
- PJM Interconnection – covering participating utilities in the Midwest and Eastern U.S.[23]
- U.S. Federally Owned Facilities – U.S. Department of Energy[24]
- International Performance Measurement and Verification Protocol (IPMVP) – Efficiency Evaluation Organization[25]

Figure 3 provides a high-level summary comparing the reviewed studies and Appendix C presents more detail on methods used in selected jurisdictions.

4.2 Key Findings – Review of Methods Used in Selected Jurisdictions

Commercial and industrial programs across North America range in type and size, and they frequently use inconsistent nomenclature. It is common to see custom C&I programs separated from prescriptive programs; however, some utilities do combine custom and prescriptive measures into a single program. Stratification approaches and confidence and precision targets are determined differently, depending on each utility's regulatory requirements and program organization.

Many publicly available evaluation reports tend not to describe sampling methodologies in much detail. These reports focus more on reporting evaluation results rather than describing methods used. Certain attributes of the sampling methodologies can be deduced from the reports, but explicit detail on the sampling approach ranges from little to none. The Navigant team applied its best interpretation in assessing utility evaluation reports.

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[18] "EmPower Maryland 2011 Evaluation Report – Chapter 4: Commercial and Industrial Custom and Re-commissioning Programs." Baltimore Gas & Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison. Prepared by Navigant Consulting, Incorporated.

[19] "Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period." California Public Utilities Commission. January 2011.

[20] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

[21] "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals." California Public Utilities Commission. Prepared by TecMarket Works. April 2006.

[22] "Verification of Efficiency Vermont's Energy Efficiency Portfolio for the ISO-NE Forward Capacity Market." Vermont Department of Public Service. Prepared by West Hill Energy and Computing Incorporated. July 29, 2010.

[23] "PJM Manual 18B: Energy Efficiency Measurement & Verification." PJM Forward Market Operations. March 1, 2010.

[24] "M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3." U.S. Department of Energy. Prepared by Nexant Incorporated. April 2008.

[25] "International Performance Measurement and Verification Protocol: Concepts for Determining Energy and Water Savings Volume 1." Efficiency Valuation Organization. January 2012.

Figure 3. Summary Comparison of Sample Methodologies in Selected Jurisdictions

N°	Service Territory or Jurisdiction	Organizations Reviewed	Year	Service Type	Timing	Precison Target	Stratify by Size	Stratify by Segment	Ratio Estimation
1	Illinois (Chicago)	Commonwealth Edison Company	2011	Electric	2-stage	90/08 (3yr utility program)	✓		✓
2	Michigan (Detroit)	DTE Energy	2010	Gas & Electric	1-stage	90/10 (utility program)		✓	✓
3	Massachusetts	Massachusetts Energy Efficiency Advisory Council (NSTAR, National Grid, Western Massachusetts Electric Company)	2009	Gas & Electric	1-stage	90/10 (statewide custom C&I)			✓
4	New Mexico	El Paso Electric Company, New Mexico Gas Company, Public Service Company of New Mexico	2011	Gas & Electric	1-stage	90/10 (utility total portfolio)	✓		✓
5	Pennsylvania (Philadelphia)	PECO Energy Company	2011	Gas & Electric	3-stage	85/15 (utility C&I total)	✓	✓	✓
6	Ohio	AEP Ohio	2011	Electric	2-stage	90/10 (utility program, RTO zone)	✓	✓	✓
7	Maryland	EmPower Maryland (Baltimore Gas & Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison)	2011	Gas & Electric	1-stage	80/20 one-sided (utility program)	✓		✓
8	California	California Public Utilities Commission (Pacific Gas & Electric Company, San Diego Gas & Electric, Southern California Edison, Southern California Gas Company)	2009	Gas & Electric	flexible	90/10 (utility program)	✓	✓	✓
9	Vermont	Vermont Department of Public Service (Efficiency Vermont and Burlington Electric Department)	2010	Electric	2-stage	80/10 (utility portfolio)	✓	✓	✓
10	PJM Interconnection (Midwest & Eastern US)	PJM Interconnection	2010	Electric	flexible	90/10 one-sided (utility program, RTO zone)	✓	✓	✓
11	US Federal Facilities	US Department of Energy	2008	not applicable	flexible	not applicable		✓	
12	General International	Efficiency Valuation Organization (IPMVP)	2012	not applicable	flexible	not applicable		✓	

Source: Navigant review of previously cited documents in selected jurisdictions

Protocols for evaluating DSM projects in specific jurisdictions tend to provide a more detailed description of sampling methodologies used than the program evaluation reports. Protocols generally allow specific sampling options such as selecting between census, simple random sampling, and stratified sampling, as well as options for determining the appropriate basis for stratification. The reviewed protocols usually offer step-by-step processes for designing samples.

Meeting Precision Targets

Confidence and precision requirements vary widely across the reviewed methodologies. Both one-sided and two-sided confidence intervals are common. Confidence requirements range from 80% to 90%, and precision requirements ranged from 8% to 20%. These confidence and precision requirements frequently differ in the level at which they are applied, which could be for the program, the customer segment, the portfolio, or the transmission zone. One methodology[26] adheres to a relatively rigorous precision target of 90/08, but the target only applies to a 3-year term rather than annually.

On-site verification and evaluation is common industry practice for evaluating larger custom program impacts. There are cases where phone and engineering algorithm verifications have been used for custom programs in some years with more in-depth evaluation work performed in other years. Phone surveys are generally reserved for process evaluation and establishing free-ridership estimates. Phone surveys are less commonly used to estimate gross program impacts. The reviewed methodologies tend to contain a rather substantial description of the evaluation techniques used to estimate project savings, often describing in detail the engineering models applied and how parameters were measured and used. Several evaluation sample design methodologies apply more rigorous techniques or aim to achieve a census for large projects that represent a high concentration of savings in order to cost-effectively increase validity and accuracy of evaluation estimates at the project and program levels.[27,28]

Ratio estimation is used in nearly all of the reviewed methodologies and has now become a standard practice in the industry. Ratio estimation is a statistical technique whereby prior information from a tracking database—"tracked savings"—is employed to reduce the overall sample requirements. If stratification is used, the resulting precision is applied to the total based on applying the realization rate measured for each stratum.

An expected variance must be assumed to create an initial sample design. This assumption is made via an error ratio or coefficient of variation (CV). The CV is defined as the standard

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[26] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[27] As a point of interest, the more rigorous evaluation approaches for selected large projects can, on occasion, produce a higher variance across the sample. This can produce the appearance of worsening sampling precision, but it is generally viewed as producing more appropriate levels of confidence and precision for the program.

[28] "EmPower Maryland 2011 Evaluation Report – Chapter 4: Commercial and Industrial Custom and Re-commissioning Programs." Prepared by Navigant Consulting, Inc.

deviation of the sample divided by the mean. In the case of ratio estimation, the CV should be based on the variance of project-specific realization rates rather than the variance of savings. Industry practice is to conservatively rely on historic evaluation results in selecting a CV for sample design. When historic data are not available, conservative assumptions are made, typically ranging from 0.5 to 1.0 depending on the expected homogeneity of the population.[29] Ratio estimation can sometimes reduce the CV to levels around 0.3; however, these levels represent "best outcomes" and should not be viewed as conservative when designing a sampling framework.

The reviewed methodologies more commonly apply Z-values[30,31] than T-values in determining sample precision. At larger sample sizes (i.e., greater than 30) the differences are insignificant. But for smaller samples, application of the Z-value fails to account for the limited degrees of freedom in the sample and can lead to overstating the confidence and precision achieved by the sample.

Use of the finite population correction (FPC) factor is not frequently discussed. However, the FPC has a valid statistical basis and should be used when evaluating smaller populations. Two of the reviewed methodologies[32,33] do not appear to use the FPC, and instead recommend a census if the calculated sample size approached or exceeded the population size. Any sample size calculation that exceeds the population is not taking into account the basic principles of sample design. This approach is not statistically valid and can lead to excessive evaluation costs. Although this topic is not frequently discussed, it is reasonable to assume that the FPC is applied whenever size-based sampling was used since application of the FPC is necessary to take advantage of the concentrations of savings in large projects.

Use of Stratification

The reviewed methodologies applied stratification in the sample design when population sizes were not sufficiently small to achieve a census. Stratification approaches vary across the reviewed methodologies and appear to be customized to fit each utility's program structure, number of projects, sizes of projects, regulatory requirements, and stakeholder concerns.

The review yielded two common approaches for stratifying based on size. The first approach defines the large stratum based on very large projects in the population. Sometimes a census is

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[29] "PJM Manual 18B: Energy Efficiency Measurement & Verification." PJM Forward Market Operations. March 1, 2010. (See page 30)

[30] "Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs." Pennsylvania Public Utility Commission. Prepared by the PA Statewide Evaluation Team. November 4, 2011.

[31] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

[32] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004. (See page 337)

[33] "Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs." Pennsylvania Public Utility Commission .Prepared by the PA Statewide Evaluation Team. November 4, 2011. (see page 75)

sought when the very large stratum contains only a few projects. The second approach divides the population into strata of roughly equal contribution to total savings.[34] In some cases, this approach seemed to follow textbook examples rather than examining the program projects to see if alternate approaches to stratification could be designed to increase precision. Simply dividing the population into three roughly equal strata may overlook more appropriate stratification designs that could yield higher precision and confidence. This approach is more applicable when project size declines smoothly from large to small projects. Some of the reviewed methodologies apply more rigorous evaluation and measurement approaches to projects in the large stratum or for strata with highly heterogeneous populations in a cost-efficient effort to improve accuracy.

Many of the reviewed methodologies stratify by segment instead of or in addition to stratifying by size. Segments used for stratification included market sector (e.g., education, multi-family, manufacturing, and other customer-type segments), geography, and project types (space heating, water heating, or industrial process). Stratification by segment can be used to increase precision for a given sample size as well as make the sample more representative of the population.

Sample Staging

Schedule requirements for reporting often necessitate a rolling sample or staged approach to sampling in order to begin evaluation efforts early enough to complete the evaluation tasks in time to report results on schedule. About half of the reviewed methodologies implement staged sampling. Most of the methodologies do not require reporting intermediate results, but rather focus only on the final population results.[35]

A two-stage approach is most common[36,37,38] where a stage one sample is drawn based on either the first two or first three quarters of the year. Single-stage sampling and three-stage sampling also occur in the reviewed methodologies. Details on the rationale underlying the calendar periods for the different stages, and the allocation of sample to the different stages, were generally not explicitly stated. In general, approaches were based on "reasonable judgment" by the evaluators.

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[34] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012. (See appendix J, page 33)

[35] Pennsylvania has a slight exception. Reporting quarterly results is required by Act 129. Although quarterly reporting has been interpreted as applying to unverified results, verified results are reported for the full year.

[36] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[37] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012. (See appendix J, page 33)

[38] "Verification of Efficiency Vermont's Energy Efficiency Portfolio for the ISO-NE Forward Capacity Market." Vermont Department of Public Service. Prepared by West Hill Energy and Computing Incorporated. July 29, 2010.

Gas & Electric Service

Major differences in evaluating savings between electric and gas utilities were not found. Differences in evaluation methods are more likely based on program size and number of years evaluating and reporting program savings. Most jurisdictions count both electric and gas savings for custom C&I measures regardless of whether the administrating utility supplies both fuel types.

Bias in Results

Industry best practices prescribe a demonstration of effort to control for common sources of bias. Once a population of projects exists, the goal of the sample design is to estimate the gross savings resulting from that population.[39] The principal concern about bias is that certain elements of the population may be over- or underrepresented in the sample. Stratification is a good approach for reducing this potential bias. Bias can also result from non-random sample selection. Finally, bias can be introduced into the analysis by anomalous observations in the sample that for some reason are unique and not representative of other members of the population. If anomalous observations are also "influential" observations, then corrective action may be necessary to provide accurate information from the realization rate calculation, and the accompanying calculations of precision and confidence. The California Evaluation Framework notes:[40,41]

> *[If] there is substantial bias, perhaps due to self-selection, non-response, deliberate substitution of sample projects, or measurement bias, then the methods presented here can be seriously misleading. For example it is misleading and counterproductive to report that the average savings has been estimated with a relative precision of 10% at the 90% level of confidence if there is a serious risk that the results might be in error by 25% due to bias.* (p. 327)

The reviewed methodologies contain little description of efforts made to minimize bias. Additionally, there is little discussion on the composition of the sample, treatment of outliers, sample replacements, missing data points, or other sample adjustments. These discussions could be addressed in project memos rather than expanding what is often a lengthy final evaluation report. However, this is an area where standard industry practice may not be on par with evaluation practices in other fields. It is not clear whether this deficiency is related only to reporting or if it reflects limitations on current evaluation practice.

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[39] Issues such as self-selection bias in recruiting program participation are not an issue for sample designs whose purpose is to estimate the gross savings from those that did participate in the program. Once the frame of participant projects is determined, the biases of concern are typically based on ensuring random samples, ensuring representativeness, addressing extreme values, and using appropriate calculations consistent with the sample cases to produced unbiased estimates of the population parameters.

[40] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

[41] The California Evaluation Framework contains a substantive discussion on accuracy and bias in chapter 12.

5. Recommended Sample Design Methodology

This section describes the recommended sample design methodology for DSM programs for Union and Enbridge. Sections 5.1–5.3 describe the key attributes of the recommended methodology and offer support for their use in evaluating Union and Enbridge custom programs. Section 5.4 presents steps for appropriate sample designs and sample selection. Sections 5.5–5.6 present examples for Union and Enbridge illustrating how the sample methodology might be implemented using representative tracking data.

Ratio estimation has become standard practice for the evaluation of large C&I programs, as it leverages information available on the population of projects with the sample. The sample design approaches discussed in this section are constructed to make full use of the ability to leverage sample data in combination with information on the population from the project tracking database. This is important given the relatively high cost of rigorously evaluating custom C&I projects. Ratio estimation has become a common industry practice in evaluation since it leverages information on the population to better interpret information from the sample. Stratification has also become a common industry practice, although its application varies, and its application may not result in strata that enhance the efficiency of the sample design. The methods presented in this section are aligned with these basic concepts of leveraging information to get the most out of the analysis.

The level of specification for sampling protocols observed in jurisdictions across North America ranges widely. An overly specified methodology may lead to incompatibilities in future evaluation efforts as the composition, participation, and distribution of impacts evolve. However, an overly general methodology may lead to sample designs that do not meet Union and Enbridge's confidence and precision requirements with cost-efficient methods. The recommended sample design methodology is intended to strike a balance between flexibility and specification to allow Union and Enbridge to best meet their evaluation needs now and in future program years.

5.1 *Stratification*

Stratification is recommended in designing samples for evaluating custom C&I programs. Stratification is the practice of disaggregating the population into sub-groups based on some criteria. Strata should be defined such that the strata sample frames are mutually exclusive (i.e., no overlap) and exhaustive (i.e., strata sample frames combine to represent the appropriate population sample frame). There are three generally accepted reasons to use stratification:

1. Sample Efficiency: To reduce the required sample size needed to achieve confidence and precision targets on an estimate. There are two common stratification practices that can increase sample efficiency:

- Stratifying by project size may reduce the overall number of required samples by taking advantage of the concentrations of savings when relatively few projects contribute to a large fraction of total impacts. This is most commonly seen in C&I evaluations, and the majority of reviewed methodologies apply this approach.
- Stratifying based on qualitative segments (e.g., project type or customer segment) can reduce the effective variance compared to combining the segments in a single stratum when segments of a population produce different results. For example, if the project-level realization rate (RR) is expected to average 0.9 for lighting projects and 0.8 for heating, ventilating, and air conditioning (HVAC) projects, then the variance of these segments combined will usually be greater than their individual variances. Separating lighting from HVAC would then allow smaller sample sizes to meet the required precision criteria for total combined savings.

  Stratification design must reduce the effective sample variance in order to produce gains in precision. The simple rule is that projects within a sample should have a smaller variance within the strata than across strata. Lohr notes:[42,]

  > *Observations within many strata tend to be more homogeneous than observations in the population as a whole, and the reduction in variance in the individual strata often leads to a reduced variance for the population estimate.* (p. 77)

- Stratification cannot make the problem worse (i.e., decrease precision). As a result, it is strongly recommended.

2. Segment Results Required: To ensure sufficient sample sizes that can answer questions pertaining to certain segments of the total population. For example, if stakeholders or interveners require results specifically for HVAC-related projects in order to improve program implementation in subsequent years, then creating strata for HVAC projects and establishing a minimum precision requirement for those strata would help ensure that sufficient data are collected to understand HVAC projects.
3. Reduced Potential for Bias by Improving the Representativeness of the Sample: For many evaluators, this is the most important reason for stratification as part of sample design. Stratification helps ensure that the sample appropriately represents the population. Since simple random sampling allows for the possibility of under-sampling certain segments, stratification can help ensure that the sample drawn provides the appropriate sample size for each segment. For example, stratifying by project type can ensure that each major project category is appropriately represented in the sample by explicitly drawing samples for each project type. Other frequently used dimensions for stratification include customer segments and site geographies. Representativeness quotas are sometimes used instead of strata to ensure representativeness.

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[42] Lohr, S. L., “Sampling: Design and Analysis,” Second Edition, 2010.

The specific stratification approach will depend on evaluation of the population data. If the distribution of project savings for a program is relatively tight[43] and there is not an easily delineated group of large projects, then stratification by project size alone may not produce sampling efficiencies. However, if the distribution of project savings is wide or there is clear group of large projects, then stratifying by project size will likely produce sampling efficiencies.

It is important to note that when sample observations are collected based on a stratified sample design, the strata weights must be applied in the estimation of the population realization rate.

The general rule for stratification is to attempt to select strata that have smaller variance within the strata than between strata. Stratifying by segment may also be appropriate when realization rates are expected to vary by segment. Judgment should be applied to segment the population on the basis of mechanisms that lead to different realization rates, rather than simply using common predefined segments used in program administration. For example, if steam projects are expected to have a different realization rate than other project types—or even more widely varied realization rates across steam projects—then a potentially useful segmentation may be by steam projects vs. other non-steam projects. It is not necessary to segment by every major project category to achieve the desired sampling efficiency, only those where this effect is believed to be sizeable and where stratification may also help increase the representativeness of the final sample across important technology categories.

5.2 *Ratio Estimation*

The application of a ratio estimation approach is recommended. Ratio estimation is the statistical technique whereby the *accuracy* of "prior" tracked estimates is applied from the sample rather than directly applying the *absolute* estimates of the sample. For DSM evaluation efforts, the sample estimator is the realization rate for each stratum rather than the sampled savings for each stratum. Ratio estimation is often used to increase the precision of estimated means and totals. It is motivated by the desire to use information about a known auxiliary quantity (i.e., tracked savings) to obtain a more accurate estimator of the population total or mean (i.e., verified savings). When applying ratio estimation within a stratified population, the separate ratio estimator approach should be used where strata are defined and analyzed before combining strata.[44]

Ratio estimation would not be possible without initial savings estimates for the population. This technique relies on establishing the variance based on the errors between the savings predicted by the stratum average realization rates for each project and the actual savings measured for each project. Ratio estimation effectively develops verified savings estimates based on measuring the accuracy of the tracked savings. Therefore, it is necessary to ensure that the tracked savings in the tracking database represent the best possible estimate based on the available information.

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[43] A "tight" project savings distribution is generally considered to be within a single order of magnitude. Size-based stratification should be considered when the distribution of savings spans multiple orders of magnitude.

[44] Lohr, S. L., "Sampling: Design and Analysis," Second Edition, 2010. (Section 4.5)

5.3 *Sample Staging*

A rolling sampling approach comprised of two sample draws (a two-stage sample approach) is recommended to ensure that spring reporting requirements can be met. Reporting schedules often do not provide sufficient time to design and evaluate a sample following the completion of the project year. This type of schedule constraint frequently occurred in the jurisdiction reviewed in Section 4. Sample staging can allow evaluation efforts to begin earlier on a preliminary sub-sample of projects completed early in the program year. Thus, staging can reduce the evaluation workload required between the end of the program year and the reporting deadline.

A two-stage sample is recommended, where the first stage takes a sample draw from projects completed in the first three quarters of the program year, and the second sample draw adds in projects completed in the fourth quarter.

The sample design for the first stage should estimate or extrapolate the numbers of projects in each stratum to the values expected at the end of the year.[45,46] Sample sizes should be determined for this preliminary sample frame as an indication of the final population. While judgment is needed to determine how much of the expected overall sample is drawn in the first stage, it is unlikely that the first stage sample would fully require three-quarters of the calculated sample sizes.[47] In general, practical considerations would support a lower split of the planned sample between the first and second stages. This would allow for a sample that adequately represents the year-end projects.

Union's and Enbridge's projects tend to come online more heavily in the fourth quarter, with roughly half to three-quarters (depending on which program) of projects completing in the last quarter. This would imply that a 50-50 split between sample stages would be reasonable, given constraints related to the calendar time needed to set up and conduct the verification studies. However, if the timing allows, Union and Enbridge might consider placing more of the sample into the fourth quarter when savings from projects completed in the fourth quarter are expected to contribute more than half of program savings. This recommendation is a compromise between the time and resources needed to perform the number of site verifications, and the need to meet program reporting deadlines. It simply is not possible for the utilities to wait until information on that year's full population of projects becomes available and then draw the sample and complete the site verifications while still meeting the program reporting deadlines.

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[45] This step is important because it will reduce the effect of finite population correction that could otherwise lead to underestimating the required sample sizes.

[46] If the final quarter of the program year is known to have very large projects in disproportion to the first three quarters, the strata weighting may be adjusted to account for this information.

[47] The sample sizes may be further reduced slightly to allow for the possibility that the assumed CV is overly conservative. If upon evaluation of the first stage, the assumed CV was not overly conservative, then additional samples may be added in the second stage.

This rolling sample or two-stage approach is often used in program evaluation (see Section 4 above) to meet timely reporting deadlines.

The sample design for the second stage should consider the population of the program year in its entirety. Sample sizes should be determined for the entire population. The first stage sample is intended to fulfill about half of the overall sample. The second stage is intended to fulfill the remainder of the sample and should be selected from projects completed in the fourth quarter.[48] If analysis of the first stage sample observations indicates insufficient sample sizes, then the first stage may be reinforced in the second stage with additional projects selected at random from the full program year population. An analysis of sample data should investigate whether differences between sample stages are significant and adjustments are needed. Again, the goal is to produce good information for making decisions regarding the custom programs for both the utilities and stakeholders. Some judgment is needed in implementing this rolling two-stage sample selection approach.

5.4 Recommended Sample Design Process—Seven Steps

The sample study should be designed to estimate the impacts of the population of projects in each program year. At the time of this report, gross *cumulative* (i.e. lifetime) gas savings measured in cubic meters (m^3) is the primary impact to be studied and should serve as the basis of the sample design.[49] The sampling and the application of population-wide realization rates should all be performed using gross cumulative savings.[50] The recommended sample design methodology contains the following steps:

Step 1: Review project tracking database for accuracy and quality.
Prior to any stratification or sampling, large gains can be made in the resulting analysis and precision by reviewing the estimates in the tracking database and making sure that the best possible initial project-based engineering estimates are contained in the tracking database. It is also important to make sure that appropriate contact information is contained in the files to avoid having to replace drawn sample projects with supplemental projects held in reserve. One of the most cost-effective ways to enhance the precision and confidence in the evaluation results is to make the appropriate investment in the tracking database. A tracking database that is accurate will typically reduce the costs of the evaluation, yield project realization rates that are closer to one, and have a smaller variance across the project realization rates. Many utilities do a

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[48] Although this approach is intended to achieve roughly equal proportions of projects for each quarter, disproportions by quarter should not be viewed as causing notable bias. Accordingly, if the first stage produces a small number of projects in excess of what is required in the second stage, these extra projects may be counted toward meeting the fourth quarter sample size requirements.

[49] This is a new basis for custom C&I evaluation studies beginning in program year 2012. The Technical Evaluation Committee may decide to change this basis in future years.

[50] Ultimately, adjusted gross savings can be converted to adjusted net savings (i.e. by applying a program net-to-gross ratio to the adjusted program gross savings). However, that would occur outside of (i.e. after) the application of the sampling work discussed in this report.

second check of the tracking database prior to the sample design and sample selection.

Identifying unique projects in the tracking database can help avoid outlier problems later in the analysis. Examples of unique projects may be those with the only instance of a certain efficient technology installed or even those with technologies whose impacts are difficult to predict. These unique projects may be treated separately from the primary population to produce more efficient samples for the vast majority of the population. Identification of unique projects can also help ensure the representativeness of the selected sample and help eliminate problems in the interpretation of the analysis such as bias in the realization rate.

Step 2: Evaluate the population and define strata.
Examine the population for ways to leverage the sample design to improve efficiencies in meeting target confidence and precision levels. This includes three activities:

- *Exclusion of extremely small projects* – Ratio estimation weights project realization rates according to project savings. Very small projects typically exert only negligible influence on estimates of the total realization rate, the total savings, and the total achieved precision. For many very small projects, a 100% difference in realized savings would produce a negligible impact on the total estimates. The cost of evaluating the impacts of these small projects exceeds the value of the information obtained from them. Additionally, including projects that contribute only small fractions of a percent to program savings in the sample frame might result in the random selection of projects that includes a disproportionate number of these very small projects, which could reduce the accuracy with which the overall realization rate is estimated for a given sample size and reduce the overall representativeness of the sample. It is therefore considered reasonable to exclude the very small projects (i.e., representing up to 5% of the total program savings as appropriate) from the sample frame. The savings of the population of very small projects may be adjusted by an appropriate realization rate[51] and added to the program savings total.
- *Identification of project size strata bounds* – Efficiencies can be gained by stratifying by project size when the distribution of project savings is wide or there is a clear group of large projects. Sorting the projects by savings size can allow easy identification of discontinuities in the project size distribution. If it is unclear whether natural project size groupings exist; visualization of the project savings in a histogram should provide a clearer indication. Typically, strata are set such that program savings within a stratum fall within an order of magnitude.[52] Set strata bounds first based on natural breaks in the distribution that result in easily delineated groupings. If natural groupings do not exist,

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[51] If the remaining population is stratified by size, then the average small stratum realization rate should be applied. Otherwise the population total realization rate should be applied. However, the savings accounted for by these projects is so small that alternative assumptions should not affect the overall program savings estimates. Some applications simply use a realization rate of 1.0 for these very small projects.

[52] One rule of thumb is to keep the expected coefficient of variation of project savings to less than 1.0 within a stratum.

other approaches may be used such as stratifying into strata of roughly equal total savings. The number of size-based strata typically ranges from two to four, with three most commonly applied for C&I program evaluations.

- *Identification of categorical characteristic strata bounds* – Efficiencies can be gained by defining strata along categorical qualities such that the coefficient of variation of project realization rates for each stratum is lower than the resulting CV of the aggregated group without the categorical strata. This basis for stratifying may be applicable when a certain segment of the project population is expected to have different or more variable realization rates than the rest of the population. Units that are generally more alike should be grouped together in a stratum. For commercial projects, strata could be defined by building type (e.g., schools, office building, and multi-family). Similar buildings could be expected to have a lower variance in the estimated realization rate across sites (i.e., within the stratum) than when combined with other building types. Although categorical strata bounds are frequently applied in many DSM studies, they are not mandatory and should be prudently applied.

The sample designer may be required to make trade-offs between stratification approaches. Defining the appropriate strata is often the most important part of sample design; however, it requires data analysis skills, subject matter expertise on the project types, and knowledge of program administration and participation issues.

Step 3: Estimate an appropriate variance for each stratum.
In ratio estimation, the variance considered is that of the residuals on the stratum average realization rate rather than the variance of the verified savings. Accordingly, a CV or error ratio should be based on the assumed distribution of individual realization rates for the population of projects in each stratum.

The CVs should be based on the un-weighted[53] realization rates historic sample data, when such data are available. Any changes in program composition, administration, or participation from the previous year will decrease the validity of applying prior year CVs, and the assumed CVs should be adjusted upward by 0.1-0.2 to prevent under-sampling. It is not recommended to apply a coefficient of variation less than 0.30, in order to ensure sample sizes sufficient for robust results and to allow for increasing variances that may result from evolving measurement approaches and program participation.

A two-staged sample provides an opportunity to adjust the assumed CVs in the second stage to incorporate the sample data already observed in the first stage. The observed CVs in the first stage should still be slightly adjusted upward to account for variance and size unknowns in the second stage sample.

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[53] The realization rates are un-weighted rather than weighted because it is assumed that any correlation between the size of a project in a stratum and its realization rate is coincidental (especially in small sample sizes). So, applying the historic correlation could result in under-sampling or over-sampling in subsequent program evaluation efforts.

A CV of 0.5 may be assumed when historic data are not available. This is a standard industry assumption and is generally conservative in ratio estimation if the population tracked savings in the tracking database are reasonably accurate. However, custom projects with poor tracking database estimates may produces CVs as large as 1.0. It is not uncommon to observe program CV's lowering over time as programs mature and tracking estimates improve. CVs can also increase if more rigorous and precise methods are used to evaluate project savings; however, this should not be viewed as a negative since rigorous methods create a more accurate understanding of project and program results.

Step 4: Allocate observations to each stratum.

The overall sample should be designed to achieve 10% precision at a 90% one-sided confidence level (i.e., 90/10 one-sided).[54, 55] This confidence and precision target is meant to be used for each custom program in each year. If changes are made to this target, these changes can be addressed in the sample size calculations and do not necessarily warrant changes in the recommended methodology. Appendix A and Figure 19 provide additional explanation and illustration for the 90/10 one-sided confidence interval and the other reporting confidence intervals.

Allocating the sample across strata to achieve target confidence and precision is not a simple exercise and can often require an iterative approach. Proportional sampling is one technique that is often applied, where the total sample size is calculated for the population and subsequently allocated to strata in proportion to some characteristic such as savings. Proportional sampling, however, fails to realize the efficiencies gained from stratifying and very frequently results in over-sampling. Lohr notes:[56]

> *If the variances are more or less equal across all the strata, proportional allocation is probably the best allocation for increasing precision. In cases where the variances vary greatly [across strata], optimal allocation can result in lower costs. In practice, when we are sampling units of different sizes, the larger units are likely to be pre variable than the smaller units [in absolute terms] and we would like to sample them with a higher fraction.*[57]

The California Evaluation Framework notes the skills required:

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[54] Based on October 25, 2012 Technical Evaluation Committee decision, the sample design should be based on a 90/10 one-sided confidence interval. Reporting of achieved confidence and precision should present the precision achieved for three confidence intervals: 90% one-sided on the lower bound, 90% one-sided on the upper bound, and 90% two-sided intervals. Appendix A provides additional explanation and illustrative examples for these reporting confidence intervals.

[55] This target may be inferentially interpreted as the intent to ensure that there is a 90% likelihood that the actual savings of the program population exceeds 90% of the sample estimate of program population savings.

[56] Lohr, S. L., "Sampling: Design and Analysis," Second Edition.2010. (Section 3.4.2 discusses optimal allocation)

[57] Lohr, S. L., "Sampling: Design and Analysis," Second Edition.2010. (Section 3.4.2 discusses optimal allocation in more detail – p. 87.)

> *Stratified ratio estimation is somewhat more complex [than simple random sampling]…it probably still requires someone to have basic training and/or experience in statistics to ensure that it is understood and applied correctly.*[58]

Given the judgment needed to develop a sample design, it is important to test the robustness of the design by simulating different scenarios. Assessing several alternative allocations of the sample across strata can usually improve sample efficiency.

Step 5: Determine criteria for assessing sample representativeness. (optional)
There are often categorical characteristics of the population that are not used in defining strata but are still desired to ensure a reasonably representative sample.[59] For example, market segment may not have been used in defining strata; however, a random sample that fails to include certain major market segments would not be viewed as a representative sample. You could establish new strata for these factors; however, it is expected that a random draw will be representative across these factors and there is a benefit for a simple stratification design.

To address this, some criteria can be defined prior to randomly selecting a sample, which can be used to assess the representativeness of the sample. Criteria should be established only for the most important characteristics, and they should only be set for high-level characteristics that, if not met, would represent an extreme sample that would not representative of the population. Failure to meet the criteria will result in discarding the full original sample and selecting an alternate full sample. Criteria can be established only for the total population or specific strata as appropriate (See example in Section 5.5). Selection of a sample that does not meet representativeness criteria should be a rare occurrence. This approach is only meant to mitigate the possibility that a randomly selected sample might result in highly inaccurate statements about the entire population. The necessity to discard the original sample should not occur in most program years.

Step 6: Select a random sample.
The sample for each stratum should be selected at random from a uniform distribution. This provides an equal opportunity for each project within a stratum to be selected.[60] This can be accomplished in Microsoft Excel using the RAND() function[61] to assign a random number between 0 and 1 to each project in a stratum. The projects should be sorted within each stratum

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[58] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004, p. 316.

[59] These criteria are not intended to be overly restrictive in selecting a sample. Rather, they are intended to prevent the unlikely but possible case where extreme over-representation or under-representation of certain project characteristics occurs in the sample.

[60] Sampling from a savings-weighted distribution can also be valid, but it is not recommended here since size-based strata are already employed.

[61] Note that the RAND() function will continue to generate a new set of random numbers each time a cell is updated. To prevent this, the values of the RAND() function can be copied and pasted (i.e., "paste values") into a separate column.

based on the random number assigned to it, and the projects with the highest random number should be selected for the sample until the target stratum sample size is reached.

The selected sample should be analyzed and documented. If criteria are set to assess the representativeness, the selected sample should be analyzed against these criteria at this point. If the sample does not meet the criteria for representativeness, then the full population sample should be discarded and a new sample should be selected.

Recruiting the full selected sample is often not achievable since some program participants may not respond or refuse to participate in the sample. Even when agreement to participate in evaluation activities is required to participate in the program, full recruitment of the selected sample can often not be achieved. Therefore, a set of potential replacement projects may be provided to recruiters to fill in for non-recruited participants.

Potential replacements should be selected from the same random number list of the population from which the original sample was selected. Replacements should be selected in priority of assigned random number until full recruitment is achieved. The full population of a stratum should not be provided to recruiters, whose incentives are not usually aligned to follow the random prioritization of the sample, unless the full sample size is not expected to be achieved.

Step 7: Recruit the sample.

Recruitment of each stratum sample can begin once the sample has been selected and assessed. Recruitment typically occurs over the phone, and may or may not involve scheduling of the on-site evaluation visit. Ensuring the accuracy and completeness of contact information in the tracking database can streamline the recruitment task.

The list of potential replacements may be initially withheld from recruiters to ensure that the originally selected sample projects are pursued fully before being replaced by alternate projects. This can help reduce the possibility for non-response bias in the sample. The California Evaluation Framework notes:[62]

> *It is very important to use the backup sample correctly. The most efficient way to recruit a sample of the desired size may appear to be to contact both the primary and backup sample at once and to schedule those sites that are first to respond and agree. But this is generally not sound practice since this approach ensures that the response will be no better than 50%, assuming that the backup sample size is equal to the primary sample size. Instead, the initial recruiting effort should be limited to the primary sample. A backup should be used only if a primary sample site is impossible to contact or refuses to participate.* (p. 350)

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[62] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

A full effort should be made to recruit the original sample before resorting to replacements, and the same effort should be made to recruit each replacement before moving on to the next.

5.5 *Example Implementation of Sample Design Methodology (Union)*

This section demonstrates how the sample design methodology might be implemented for an example set of Union program data. The data used for this example has been randomized and does not indicate historic program achievements that have undergone regulatory review in prior years. The data for this example is intended to be representative of a typical program year and are used in this example for illustrative purposes only. This example is for reference and does not preclude the judgment needed to understand and address the idiosyncrasies of actual program data.

This example applies the seven steps of the sample design process presented in Section 5.4 above.

Step 1 reviews the project tracking database for accuracy and quality. Of particular emphasis is a check on the processes used to produce the initial estimates for savings contained in the database and the contact information. This step is usually undertaken by the utility and is done to provide the third-party evaluator with the best information possible. As mentioned above, a more accurate tracking database will make it more likely that confidence and precision targets will be met. This example assumes that the tracking database has been reviewed.

Step 2 evaluates the population and defines strata. Gross *cumulative* gas savings measured in cubic meters (m^3) is the primary impact to be studied and should serve as the basis of the sample design. Figure 4 and Figure 5 show representative project distributions of savings[63] for Union's T1/R100 and C/I programs, respectively. Analyzing the distribution of project sizes indicates that size-based stratification should produce sampling efficiencies. Other categorical bases for stratification are not chosen for this example, although Union may consider isolating new technologies into a unique stratum for future evaluation efforts.

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[63] The initial manual produced in November, 2012 used net gas savings in the examples. In this revised report, the example analyses are performed on cumulative gross savings values to correctly illustrate how the sampling and the application of population-wide realization rates for the utilities should be performed in current sampling efforts.

Figure 4. Illustrative Distribution of Savings for Union'sT1/R100 Projects

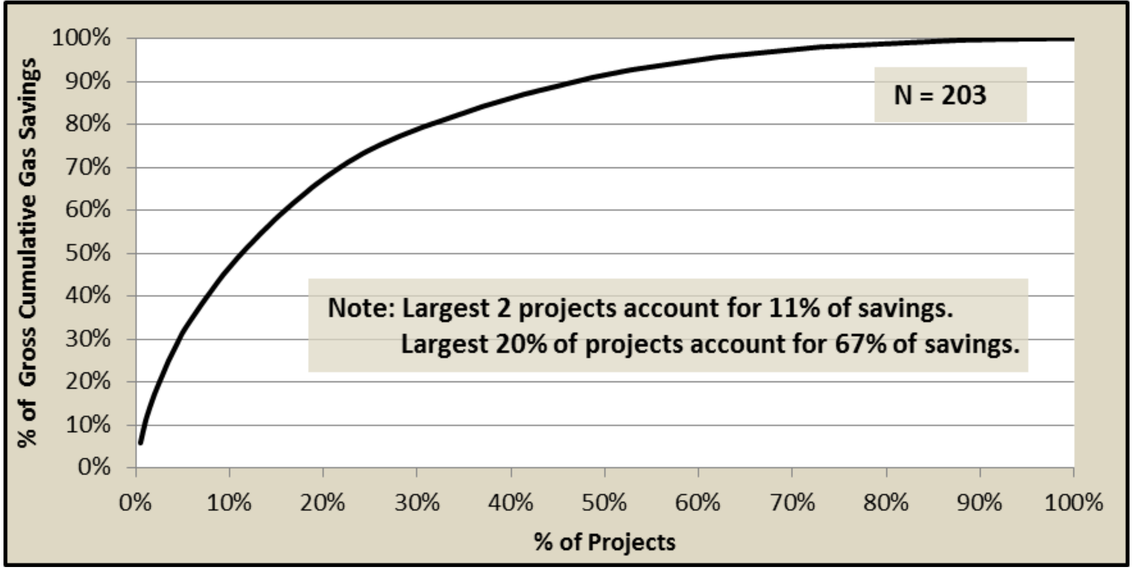
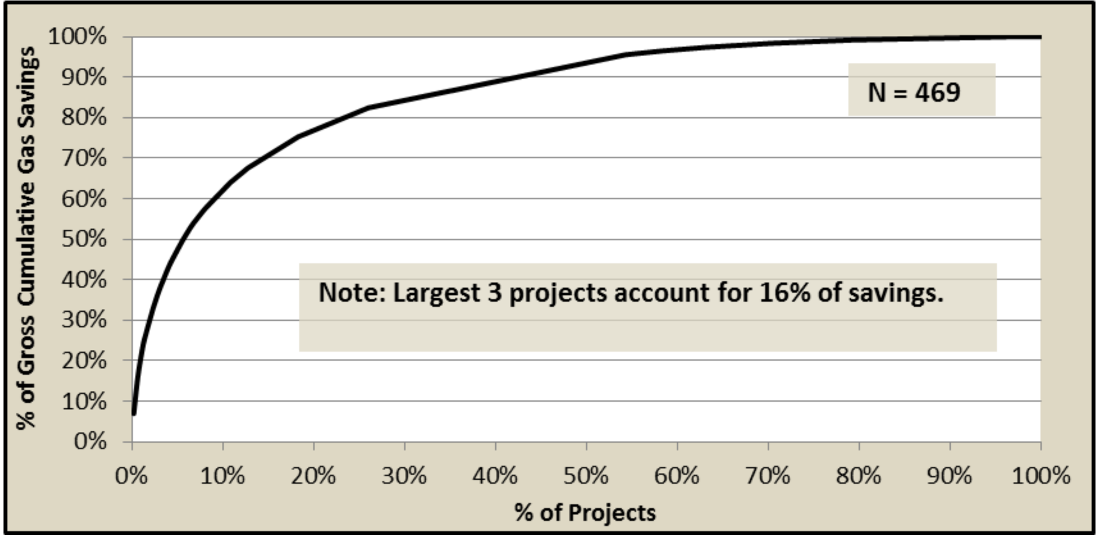


Figure 5. Illustrative Distribution of Savings for Union's C/I Projects



The sensitivity to sample sizes is investigated to determine appropriate savings thresholds for strata bounds. Figure 6 and Figure 7 show illustrative strata boundaries for Union's T1/R100 and C/I programs, respectively.

Figure 6. Illustrative Strata Boundaries for Union's T1/R100 Projects

Stratum Size	Lower Threshold of Cumulative Gross Gas Savings (m^3)	Projects	Savings Represented (%)
Large	50,000,000	10	31.4%
Medium	25,000,000	28	33.9%
Small	2,500,000	110	32.8%
Very Small	0	55	1.9%

Figure 7. Illustrative Strata Boundaries for Union's C/I Projects

Stratum Size	Lower Threshold of Cumulative Gross Gas Savings (m^3)	Projects	Savings Represented (%)
Large	25,000,000	11	33.0%
Medium	5,000,000	49	34.6%
Small	1,500,000	195	27.9%
Very Small	0	214	4.5%

The "Very Small" projects—representing the bottom 1.9% of T1/R100 program savings and the bottom 4.5% of C/I program savings—are removed from the sample frame. These projects are small enough that the value of the information gained by evaluating them is not likely to be worth the cost. These projects should be adjusted by the Small Project stratum realization rate when re-introduced in the final sample analysis.

Step 3 estimates an appropriate variance for each stratum. Historical evaluation results indicate that CVs on project realization rates have been as low as 0.20 or as high as 0.40. However, typical CVs have been near 0.25. CVs are set at 0.30 for all strata in this example.

Step 4 allocates observations to each stratum. Figure 8 and Figure 9 indicate the sample sizes[64] and the assumptions used to allocate the samples when applying the calculations presented in Appendix B.

Figure 8. Illustrative Sample Allocation for Union's T1/R100 Projects

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gross Cumulative Gas Savings	Total Gross Cumulative Gas Savings	Stratum Weight
Large	10	7	0.3	1.94	0.58	88,950,000	889,500,000	0.32
Medium	28	7	0.3	1.94	0.88	34,339,286	961,500,000	0.35
Small	110	6	0.3	2.02	0.98	8,454,545	930,000,000	0.33
	148	20		1.73				1.00

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[64] In previous program cycles when Union's custom programs were differentiated based on service contract rather than rate class, the differences between program sample sizes were much greater. Sample sizes will likely be more similar for the Union programs now that the programs differentiated based on rate class.

Figure 9. Illustrative Sample Allocation for Union's C/I Projects

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gross Cumulative Gas Savings	Total Gross Cumulative Gas Savings	Stratum Weight
Large	11	6	0.3	2.02	0.71	45,545,455	501,000,000	0.35
Medium	49	7	0.3	1.94	0.94	10,744,898	526,500,000	0.36
Small	195	7	0.3	1.94	0.98	2,176,923	424,500,000	0.29
	255	20		1.73				1.00

The sample allocations are restricted to less than 75% of the total population for the two Large Project strata. This restriction allows for some backup projects to exist for the Large Project strata so that if recruitment of the original sample is unsuccessful, backup projects can be used and the sample will likely not require re-stratification or re-allocation.

Step 5 determines criteria for assessing sample representativeness. Note that this is listed as an optional step; however, it can be important for ensuring that the most appropriate information is provided from this analysis for making regulatory decisions such as payment of incentives and future program decisions. While the sample methodology applies techniques to minimize the required sample sizes, the smaller samples are at an increased risk that a given random sample is not sufficiently representative for extrapolation to the population and used to assess whether savings targets have been met. This is why ensuring representativeness is an important step.

This example establishes simple criteria to ensure representativeness of the sample across market segment in the R1/T100 and the C/I program sample.[65] Several market segments are specified in the tracking database, and their proportions are shown in Figure 10 and Figure 11.

Figure 10. Illustrative Representativeness Analysis of Project Market Segment for Union'sT1/R100 Program

Project Market Segment	#	Large Projects Gross Cumulative m^3	%	#	Medium Projects Gross Cumulative m^3	%	#	Small Projects Gross Cumulative m^3	%
Agriculture							6	54,000,000	6%
Food Services							1	12,000,000	1%
Healthcare							5	33,000,000	4%
Manufacturing	10	889,500,000	100%	27	919,500,000	96%	86	753,000,000	81%
Resource									
Utility				1	42,000,000	4%	12	78,000,000	8%
	10	889,500,000	100%	28	961,500,000	100%	110	930,000,000	100%

The main concern is that a randomly selected sample might under-represent the most important market segments, leading to a bias in program results. In these sample designs, less than ten

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[65] Union and its sampling advisor may determine that no criteria are needed or that other criteria are needed based on judgment and assessment of actual program data.

sites may be drawn in a stratum; therefore, it is not impossible that this small sample size might be quite unrepresentative in some strata due to an unlucky sample draw. Increasing the sample sizes in each stratum could help resolve this issue, but the high cost of visiting each site and gathering the verification data makes this very expensive. As a result, this representativeness check should be considered.

In the T1/R100 program, manufacturing is clearly the dominant market segment and ensuring that a representative sample from this segment across size categories is all that may be needed; however, an evaluator may want to check to see if the random project selection (in the next step) provides some projects from non-manufacturing segments such as agriculture and utility market segments. The most significant risk is likely to occur in the small projects sample where manufacturing accounts for 78% of the projects and 81% of the savings. It could be possible to have an "extreme" sample occur in a random draw where non-manufacturing sites are "overly" represented.[66] The sample for this stratum is only six projects. If five of these projects are non-manufacturing when manufacturing accounts for 81% of the savings, this sample may not provide the information desired from this verification effort. A criteria that at least three of the projects in this stratum be manufacturing projects may represent the minimum needed to consider the sample representative overall.

Figure 11. Illustrative Representativeness Analysis of Project Market Segment for Union's C/I Program

Project Market		Large Projects Gross			Medium Projects Gross			Small Projects Gross	
Segment	**#**	**Cumulative m^3**	**%**	**#**	**Cumulative m^3**	**%**	**#**	**Cumulative m^3**	**%**
Agriculture				17	151,500,000	29%	56	121,500,000	29%
Education	2	144,000,000	29%	1	7,500,000	1%	13	36,000,000	8%
Entertainment							2	4,500,000	1%
Healthcare							19	33,000,000	8%
Manufacturing	9	357,000,000	71%	31	367,500,000	70%	99	214,500,000	51%
Multi-Family							2	4,500,000	1%
Resource							1	4,500,000	1%
Retail							1	1,500,000	0%
Transport							1	3,000,000	1%
Utility							1	1,500,000	0%
	11	501,000,000	100%	49	526,500,000	100%	195	424,500,000	100%

In the C/I program, the most important market segment is clearly manufacturing, followed by agriculture and education. To ensure that this is a representative sample, it may be important to be sure that the projects selected in the next step (random selection) contain some projects from each of these market segments. Manufacturing represents 65% of the overall savings. The agriculture and education market segments account for 19% and 13%, respectively, or 32% of total savings when taken together. Given a sample size of 20 overall, and no more than 7 in each stratum, a sample might be drawn that could be extreme and may not be an accurate

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[66] What constitutes "overly" represented simply has to be defined by judgment exercised by the evaluator.

representation of the population. Again, the concern is the high cost of conducting the site visits, which argues against simply expanding the sample size or adding new strata. To ensure that manufacturing does not entirely dominate the sample, it might be good to set representativeness criteria, for example, that at least four sites be non-manufacturing sites.

Step 6 selects a random sample. The selection of the sample should be uniformly random within each stratum. This is accomplished by applying the RAND() function in Microsoft Excel and selecting the projects with the highest randomly assigned numbers to fulfill sample size requirements. The sample is reviewed to ensure that it meets any previously established criteria. Backup projects are also selected to replace any projects from the primary sample that are not successfully recruited.

Step 7 recruits the sample. Projects from the primary sample are only replaced after four recruitment attempts on four different dates. Projects that are not successfully recruited are documented before being replaced by backup projects.

These seven steps illustrate how the sample design methodology might be implemented using representative data. Following verification and evaluation of the sample, the sample data should be analyzed according to the realization rate methodology presented in Section 6 and according to the calculations presented in Appendix B.

5.6 *Example Implementation of Sample Design Methodology (Enbridge)*

This section demonstrates how the sample design methodology might be implemented for an example set of Enbridge program data. The data used for this example has been randomized and does not indicate historic program achievements that have undergone regulatory review in prior years. The data for this example is intended to be representative of a typical program year for illustrative purposes only. This example is for reference and does not preclude the judgment needed to understand and address the idiosyncrasies of actual program data.

This example applies the steps of the sample design process presented in Section 5.4.

Step 1 reviews the project tracking database for accuracy and quality. Of particular emphasis is a check on the processes used to produce the initial estimates for savings contained in the database and the contact information. This step is usually undertaken by the utility and is done to provide the third-party evaluator with the best information possible. As mentioned above, a more accurate tracking database will make it more likely that confidence and precision targets will be met. This example assumes that the tracking database has been reviewed.

Step 2 evaluates the population and defines strata. Gross *cumulative* gas savings measured in cubic meters (m^3) is the primary impact to be studied and should serve as the basis of the sample design. Figure 12 and Figure 13 show representative project distributions of savings[67] for Enbridge's commercial and industrial programs, respectively. Analyzing the distribution of project sizes indicates that size-based stratification should produce sampling efficiencies. Other categorical bases for stratification are not chosen for this example.

Figure 12. Illustrative Distribution of Savings for Enbridge Commercial Projects

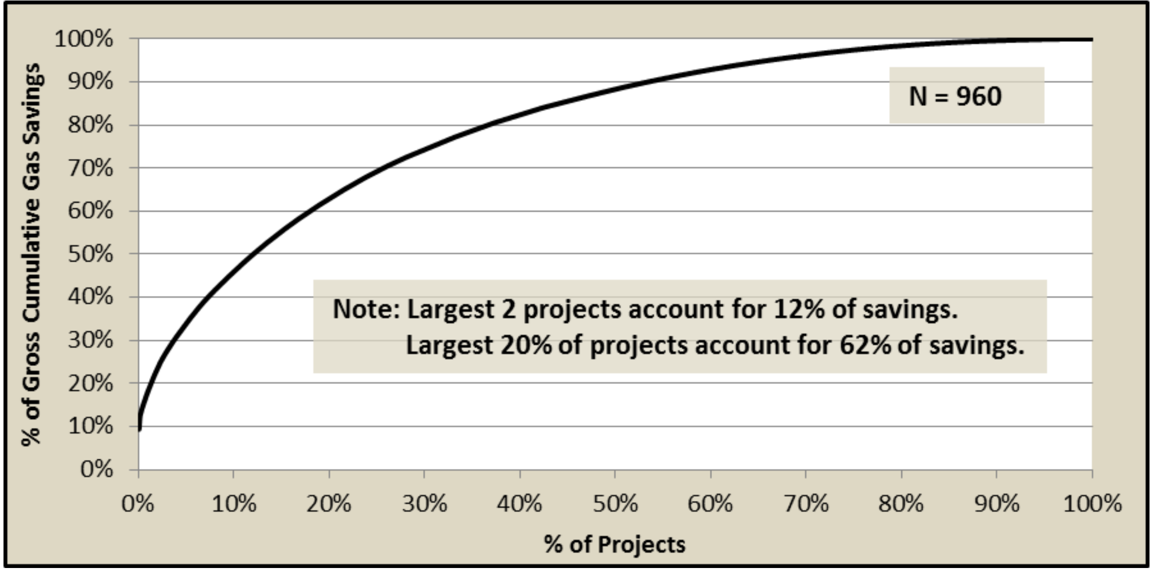
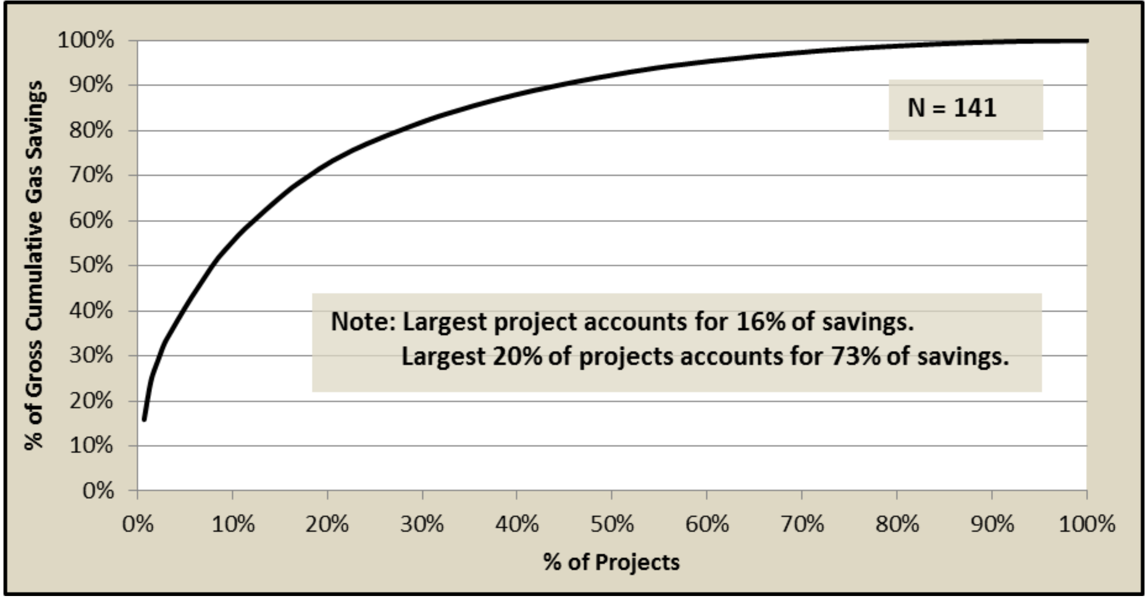


Figure 13. Illustrative Distribution of Savings for Enbridge Industrial Projects



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[67] The initial manual produced in November, 2012 used net gas savings in the examples. In this revised report, the example analyses are performed on cumulative gross savings values to correctly illustrate how that the sampling and the application of population-wide realization rates for the utilities should be performed in these sampling analyses.

The sensitivity to sample sizes is investigated to determine appropriate savings thresholds for strata bounds. Since the commercial program has a relatively large number of projects, it is necessary to balance the effects of strata weight with the effects of finite population correction when determining the threshold for the Large Project stratum. Figure 14 and Figure 15 show illustrative strata boundaries for Enbridge's commercial and industrial programs, respectively.

Figure 14. Illustrative Strata Boundaries for Enbridge Commercial Projects

Stratum Size	Lower Threshold of Cumulative Gross Gas Savings (m^3)	Projects	Savings Represented (%)
Large	8,000,000	9	17.6%
Medium	2,000,000	153	40.7%
Small	400,000	479	36.9%
Very Small	0	319	4.8%

Figure 15. Illustrative Strata Boundaries for Enbridge Industrial Projects

Stratum Size	Lower Threshold of Cumulative Gross Gas Savings (m^3)	Projects	Savings Represented (%)
Large	14,000,000	8	40.5%
Medium	5,000,000	22	32.8%
Small	500,000	79	25.1%
Very Small	0	32	1.5%

The "Very Small" projects—representing the bottom 4.8% of commercial program savings and the bottom 1.5% of industrial program savings—are removed from the sample frame. These projects are small enough that the value of the information gained by evaluating them is not likely to be worth the cost. These projects should be adjusted by the Small Project stratum realization rate when re-introduced in the final sample analysis.

Step 3 estimates an appropriate variance for each stratum. Historical evaluation results indicate that CVs on project realization rates have been very low, sometimes less than 0.10. However, applying CVs less than 0.30 is not recommended in order to ensure sample sizes sufficient for robust results and to allow for increasing variances that may result from evolving measurement approaches and program participation. CVs are set at 0.30 for all strata in this example.

Step 4 allocates observations to each stratum. Figure 16 and Figure 17 indicate the sample sizes and the assumptions used to allocate the samples when applying the calculations presented in Appendix B.

Figure 16. Illustrative Sample Allocation for Enbridge's Commercial Program

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gross Cumulative Gas Savings	Total Gross Cumulative Gas Savings	Stratum Weight
Large	9	5	0.3	2.13	0.71	751,111	6,760,000	0.18
Medium	98	8	0.3	1.89	0.97	110,384	13,798,000	0.37
Small	590	11	0.3	1.81	0.99	29,766	16,758,000	0.45
	697	24		1.71				1.00

Figure 17. Illustrative Sample Allocation for Enbridge's Industrial Program

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gross Cumulative Gas Savings	Total Gross Cumulative Gas Savings	Stratum Weight
Large	8	6	0.3	2.02	0.41	33,321,429	233,250,000	0.41
Medium	22	6	0.3	2.13	0.87	8,590,909	189,000,000	0.33
Small	79	5	0.3	2.35	0.97	1,809,938	144,795,000	0.26
	109	17		1.75				1.00

The key reason that the required sample size is smaller for the industrial program than the commercial program is that a larger fraction of the savings is concentrated in a smaller number of projects for the industrial program. The sample allocations are restricted to less than 75% of the total population for the two Large Project strata. This restriction allows for some backup projects to exist for the Large Project strata so that if recruitment of the original sample is unsuccessful, backup projects can be used and the sample will likely not require re-stratification or re-allocation.

Step 5 determines criteria for assessing sample representativeness. Note that this is listed as an optional step ; however, it can be important for ensuring that the most appropriate information is provided from this analysis for making regulatory decisions such as payment of incentives and future program decisions. While the sample methodology applies techniques to minimize the required sample sizes, the smaller samples are at an increased risk that a given random sample is not sufficiently representative for extrapolation to the population and used to assess whether savings targets have been met. This is why ensuring representativeness is an important step.

This example establishes a simple criterion to ensure representativeness of load type in the commercial program sample.[68] Three load types are specified in the tracking database, and their proportions are shown in Figure 18.

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[68] Enbridge and its sampling advisor may determine that no criteria are needed or that other criteria are needed based on judgment and assessment of actual program data.

Figure 18. Illustrative Analysis of Project Load Types for Enbridge's Commercial Program

Project Market Segment	#	Large Projects Gross Cumulative m3	%	#	Medium Projects Gross Cumulative m3	%	#	Small Projects Gross Cumulative m3	%
Space Heating	7	202,200,000	92%	135	438,300,000	86%	416	414,660,000	89%
Water Heating	1	10,500,000	5%	5	16,500,000	3%	53	37,440,000	8%
Combined	1	8,100,000	4%	13	55,800,000	11%	10	11,670,000	3%
Grand Total	9	220,800,000	100%	153	510,600,000	100%	479	463,770,000	100%

The main concern is that a randomly selected sample might over-represent water heating to the detriment of properly representing space heating projects simply due to an unlucky draw of insufficiently representative projects. As example criteria, it might be reasonable to require that space heating projects must account for at least 70% of the savings in each stratum. A sample that does not meet these criteria would be viewed as unrepresentative and would be discarded and re-selected.

Step 6 selects a random sample. The selection of the sample should be uniformly random within each stratum. This is accomplished by applying the RAND() function in Microsoft Excel and selecting the projects with the highest randomly assigned numbers to fulfill sample size requirements. The sample is reviewed to ensure that it meets any previously established criteria. Backup projects are also selected to replace any projects from the primary sample that are not successfully recruited.

Step 7 recruits the sample. Projects from the primary sample are only replaced after four recruitment attempts on four different dates. Projects that are not successfully recruited are documented before being replaced by backup projects.

These seven steps illustrate how the sample design methodology might be implemented using representative data. Following verification and evaluation of the sample, the sample data should be analyzed according to the realization rate methodology presented in Section 6 and according to the calculations presented in Appendix B.

5.7 *Summary of Sample Design Methodology*

The sample design methodology described in this section is meant to apply advanced industry practices to create a cost-efficient sample by leveraging preexisting project and program information to the greatest extent possible. The methodology can be described as employing a "stratified ratio-estimation" approach. The sample is administered in two stages to make the best use of early observations that can be collected prior to completion of the program year. The methodology provides a step-by-step description of sample design tasks, but leaves flexibility to accommodate program changes in future years and cycles.

6. Recommended Realization Rate Methodology

This section describes the recommended methodology for determining realization rates and achieved confidence and precision based on sample observations of custom DSM programs for Union and Enbridge. Section 6.1 describes the approach to determine verified realization rates. Section 6.2 describes the approach to determine the precision on the realization rate and total savings achieved by the sample. Section 6.3 discusses several potential adjustments that may be needed to ensure that the results appropriately characterize the population and provide the information needed by the utilities and stakeholders.

It is important ensure the quality of sample observation data prior to calculating achieved realization rates and savings. Data quality issues can sometimes be discovered when analyzing the sample, but it can be costly to correct the data at that point. Undetected data quality issues would result in inaccuracies of total savings and precision estimates.

6.1 Determining Verified Realization Rates

Gross realization rates should be calculated for each stratum sample and applied to each respective stratum population when estimating total gross cumulative gas savings.[69]

Applying gross realization rates to population strata is more complicated than assessing the results in a simple random sample without strata, but it is necessary when efficiencies are sought through stratification.[70]Again, efficiencies are important in this application due to the high cost of gathering the verification data at each sample site. Lohr notes:

> *The population total is the [sum across all strata of the estimated stratum population mean times the stratum population size]…This is a weighted average of the sample stratum averages; the weights are the relative sizes of the strata. To use stratified sampling, the sizes or relative sizes of the strata must be known.* [71]

Also, Wadsworth notes:

> *The estimator of the total of a stratified population can be expressed as the sum of strata of estimators of the individual stratum totals. This representation suggests the valid generalization that the estimator of the total in a stratum need not be limited to the expansion estimator, but could be any appropriate estimator of the population in the stratum, including a ratio*

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[69] Ultimately, adjusted gross savings can be converted to adjusted net savings (i.e. by applying a program net-to-gross ratio to the adjusted program gross savings). However, that would occur outside of (i.e. after) the application of the sampling work discussed in this report.

[70] There are examples in the evaluation literature where strata weights have not been used in the calculation of the mean realization weight. This is clearly an oversight in these evaluations as it is a simple matter to weight the mean ratios of each stratum by the appropriate stratum weight (i.e., the proportion of the population in that stratum).

[71] Lohr, S. L., "Sampling: Design and Analysis," Second Edition. 2010, p. 69.

> *estimator…then an estimate of the total in a stratified population may be constructed as a sum over strata.* [72]

These are standard procedures for developing population estimates from a stratified sample. The methods for estimating the population parameters must take into account the strata weights when stratification is used. The calculations needed to develop a verified gross realization rate from stratified sample data are shown in Appendix B. This approach is based on widely recognized methods published by Lohr.[73]

This approach for determining gross realization rates is consistent with the recommended sample design methodology presented in Section 5.

6.2 Determining Achieved Confidence & Precision

A precision level cannot be calculated without first establishing the confidence level. The calculation for both confidence and precision comes from the same basic equation. Either confidence or precision is first established, then the other is solved for. For example, a precision of +/- 10% implies that the stated confidence level should span +/- 10% from the mean estimate. The confidence may turn out to be 90%, 82% or another value. The confidence level is more typically established and the precision is solved for. For example, the level of precision achieved at a 90% level of confidence can be calculated and may turn out to be 10%, 12%, 15% or some other number (as illustrated in Appendix A). Regardless, the calculating confidence and precision are part of the same equation and one cannot be estimated without establishing the other. Misunderstanding this basic concept frequently leads to problems in presenting and discussing evaluation results in the industry. Additional discussion on confidence and precision can be found in Appendix A.

Confidence and precision calculations also have to take into account the fact that a stratified random sample has been used. The equations for calculating confidence and precision from a stratified sample design are shown in Appendix B. This approach for determining confidence and precision is consistent with the recommended sampling methodology in Section 5, and it is consistent with the population realization rate and savings estimates described in Section 6.1.

Communications with the TEC indicated that they were interested in both the likelihood that savings exceeds a given value and the likelihood that it falls above a given value. As a result, the recommendation is to report achieved confidence and precision in three ways:[74]

1. Achieved precision corresponding to 90% one-sided confidence on the lower bound
2. Achieved precision corresponding to 90% one-sided confidence on the upper bound[75]

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[72] Wadsworth, H.M., “Handbook of Statistical Methods for Engineers and Scientists,” 1990, p. 9.25.

[73] Lohr, S. L., “Sampling: Design and Analysis,” Second Edition.2010. (Sections 4.1-4.5)

[74] The achieved precision is a result of analyzing the sample data, and will usually differ to some extent from the targeted precision applied in designing the sample.

3. Achieved precision corresponding to a 90% two-sided confidence interval

Appendix A provides additional explanation and illustrative examples for the reporting of confidence and precision in the estimated realization rate. The Figures in Appendix A are intended to clarify the interpretation of confidence and precision in making decisions based on the estimated realization rate.

6.3 *Sample Adjustments & Related Issues*

This section discusses several sampling adjustments that may be needed to accurately synthesize the total population realization rate and savings estimates. The following three types of adjustments are discussed:

1. Treatment of outliers and influential observations
2. Replacing sample projects
3. Post-stratification

Appropriately treating outliers and influential observations is important in accurately estimating the realized savings for DSM programs. Parties to a discussion of estimating program savings should understand appropriate treatment of outliers and influential observations when estimates are based on a sample of the population.

Treatment of Outliers & Influential Observations

This section first presents a conceptual discussion. Following this discussion, an example from a recent Union custom program evaluation is presented. Most statistical analyses should examine the data for outliers and test to determine whether these outliers may be "influential observations" that can skew the accuracy of a sample. Kennedy states the rationale for treating outliers:

> *The rationale for looking for outliers is that they may have a strong influence on the estimates…an influence that may not be desired.* [76]

In other words, the reason for looking for evaluating outliers is that there may be a sample case drawn that is well outside the expected bounds of the distribution and that this observation may exert undue influence on the estimates of the analysis (i.e., an influential observation). Osborne and Overbay further describe the effect of outliers:

> *The presence of outliers can lead to inflated error rates and substantial distortions of parameter and statistic estimates when using either parametric or nonparametric tests (e.g., Zimmerman,*

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[75] Achieved precision of the upper bound represents a simple inversion of the confidence interval for the lower bound. Reporting on the upper bound is intended to facilitate an understanding that sampling uncertainties can just as likely lead to underestimation of the realization rate and therefore underestimating overall program savings as they are to result in overestimates.

[76] Kennedy, P. "A Guide to Econometrics." Third Edition. MIT Press, 1992, p. 279.

> *1994, 1995, 1998). Casual observation of the literature suggests that researchers rarely report checking for outliers of any sort.* [77]

The issue is whether it is appropriate for a single observation to swing the overall results in a substantial manner.[78] If such an observation is found, then further study is needed to determine the most appropriate course of action. In general, a sample of 10 from a population of 100 projects implies that each sample point represents 10 projects. However, if a selected sample point is truly a unique case and does not represent other projects in the population, then an adjustment may be warranted. Osborne and Overbay go on to state:

> *[The appropriate treatment] depends in large part on why an outlier is in the data in the first place. Where outliers are illegitimately included in the data, it is only common sense that those data points should be removed… Few should disagree with that statement.*

The sample analysis should seek to determine whether or not outliers and influential observations can be viewed as representative members of the main population upon which population estimates may be inferred. Barnett and Lewis note:[79]

> *If they are not [suitable]…they may frustrate attempts to draw inferences about the original (main) population.*

One example can be taken from the analysis of the sample observation in Union's 2011 custom program. Two outliers were identified in the Distribution Contract (DC) custom program. One verified project observed a gas savings realization rate of 3.75 and a second project observed a realization rate of 0.18. A sensitivity analysis tested for the influence of these two observations by removing[80] them and noting the changes in results.[81]

The estimated overall realization rate for gas savings when including both observations was 1.25. This is a relatively high realization rate when compared to evaluation efforts across North America, but not an unheard of result. Excluding the high observation lowered the estimated overall estimate from 1.25 to 1.05. Excluding the low observation raised the overall estimate

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[77] Osborne, J., Overbay, A. "The Power of Outliers and Why Researchers Should Always Check for Them."2004 Practical Assessment, Research & Evaluation, volume 9, section 6. Link: http://pareonline.net/getvn.asp?v=9&n=6

[78] A simple intuitive example of the impacts an outlier can have on a statistical analysis can be found in a Wikipedia contribution (8/20/2012): *Naive interpretation of statistics derived from data sets that include outliers may be misleading. For example, if one is calculating the average temperature of 10 objects in a room, and nine of them are between 20 and 25 degrees Celsius, but an oven is at 175 °C, the median of the data could be between 20 and 25 °C but the mean temperature will be between 35.5 and 40 °C. In this case, the median better reflects the temperature of a randomly sampled object than the mean; however, naively interpreting the mean as "a typical sample", equivalent to the median, is incorrect. As illustrated in this case, outliers may be indicative of data points that belong to a different population than the rest of the sample set.*

[79] Barnett, V., Lewis, T., "Outliers in Statistical Data." Wiley Series in Probability & Statistics, 1998/1994.

[80] Removing or excluding an outlier entails isolating the sample point in a unique stratum such that the sample point still counts in the analysis, but it is not used for extrapolating results for the un-sampled population.

[81] Note that some observations may be identified as outliers but do not significantly influence the analysis results.

from 1.25 to 1.32. Excluding both outliers produced an overall realization rate on gas savings of 1.11.

Discussions were held with Union concerning the two outlier observations. It is important not to exclude an observation without examining the reasons that may contribute to the observation's extreme value. If the observation is representative of other projects in the population, it should be left in. If it can be shown to result from a one-time construct and is not likely to be replicated by other members of the population, then exclusion of this observation should be considered. The discussions with Union indicated that both observations were likely due to unique calculation issues and technologies involved.

The most conservative position in treating this outlier issue was taken—the high observation was removed and the low observation was retained in the sample data set. This produces the lowest overall program realization rate given the choices in addressing the identified outliers. However, removing outliers in strata with small sample sizes may also adversely affect the confidence and precision results and the sample may require augmentation to achieve confidence and precision targets.

Projects that implement new technologies—whose savings estimates have had less validation—or certain technology classes that are complex and difficult to estimate for the tracking database may be at an increased likelihood to result in outlier realization rates. Identifying such projects in the program tracking database could help isolate them and reduce their chance of skewing program estimates. These projects could be placed into a separate category with different confidence and precision targets for new technologies. Any projects that are truly unique should be identified and addressed during sample design. These steps would not eliminate these projects in terms of their contribution to overall program savings, but would allow for appropriate methods to more accurately estimate program savings. If sampled, these unique projects should not be considered representative of other projects in the main program. As a result, addressing this issue in advance could improve the sample analysis and the resulting program estimates.

Replacing Sample Projects

The final recruited sample should be analyzed and summarized, especially when replacement projects are substituted into the originally selected sample. Recruiters should document the reasons for unsuccessful recruitment of original sample members. Replacement samples should always be selected in priority based on the assigned random number, and full effort should be made to recruit selected replacements before substituting other replacements. If recruitment rates are very poor, this may introduce a significant non-response bias. Low recruitment rates should be investigated and documented, and recommendations may be made to improve recruitment in subsequent evaluation years.

Post-Stratification

If a sample did not achieve the desired confidence and precision and the stratification basis is thought to be sub-optimal, post-stratification may be used to retrospectively re-stratify a sample along more appropriate dimensions to demonstrate an improved precision achieved by the sample. Often, post-stratification will not improve achieved precision, especially at relatively small sample sizes; however, under certain circumstances this technique may be useful. The Ontario Power Authority notes that:

> *A technique known as post-stratification may be used to develop estimates about sub-populations after the study is complete and can be used if characteristics about the sub-populations are unknown at the time the study in conducted.*
>
> *This advanced technique should be reserved for special situations and utilized only after careful consideration of other options and well documented in the experimental approach of the Draft Evaluation Plan.* [82]

Post-stratification should not be used on a normal basis, and if necessary should inform subsequent program evaluation cycles to improve the sample frame and prevent the need for post-stratification in future years.

6.4 Summary of Realization Rate Methodology

This section presents the method for calculating verified ex-post realization rates as well as for appropriately calculating the confidence and precision levels for the estimated realization rate and overall program savings. It also discusses three issues that can lead to adjustments to the sample and recalculation of the realization rate along with confidence and precision levels. There are several important concepts presented in this section:

- The program realization rate is inferred from the sample observations based on the separate realization rates for each stratum.
- The realization rate calculations should apply the strata weights to accurately interpret sample observations. This adds a bit of complexity, but no alternate application of the observed data would be appropriate. This is considered standard practice in the application of a stratification approach in statistics.
- There are some important and legitimate considerations that should be examined when inferring estimates for a population from an observed sample. The following three factors are discussed in this section:
    1. Outliers and influential observations
    2. Replacement projects when data cannot be gathered from the originally sampled project

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[82] "EM&V Protocols and Requirements: 2011-2014." Ontario Power Authority. March 2011, p. 130.

3. Post-stratification to provide higher precision and greater confidence in the results

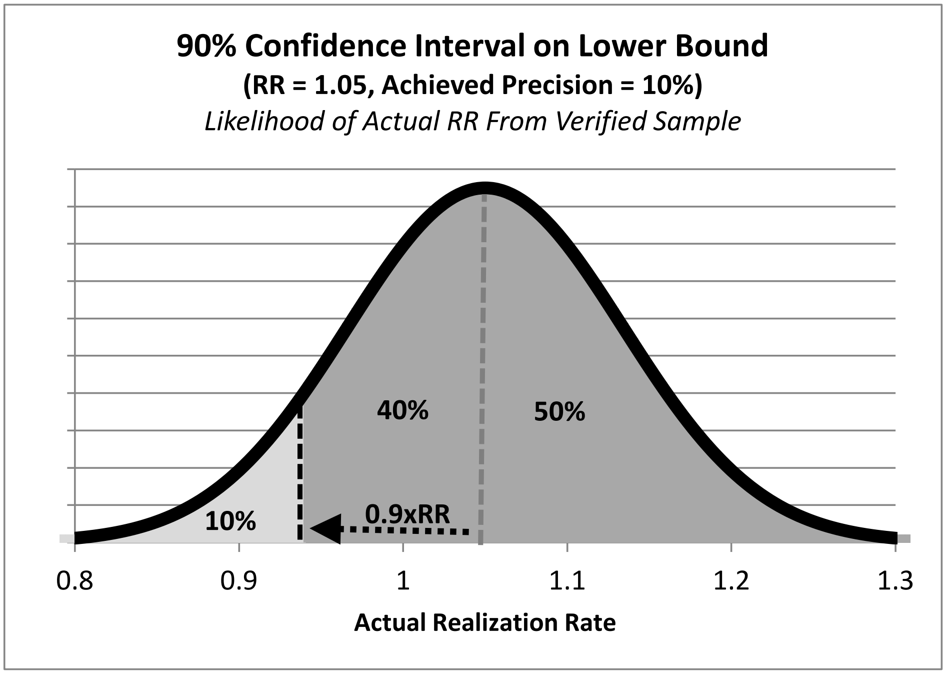
The equations needed to calculate the realization rates and achieve confidence and precision from the sample data are contained in Appendix B.

Appendix A. Explanatory Note on Confidence & Precision

The level of certainty associated with a statistical sample is most often stated in terms of a confidence interval. A confidence interval contains two components: confidence level and precision. Confidence level indicates the likelihood that an actual variable either exceeds a value (i.e., one-sided confidence) or falls within a range (i.e., two-sided confidence). Precision[83] indicates the bounding values of the corresponding confidence level. Confidence and precision are both necessary to sufficiently describe a confidence interval.[84]

At the time of this report, the target confidence interval for the design of the sample is established as 90/10 one-sided.[85] Figure 19 illustrates a 90% one-sided confidence interval with 10% precision for a sample whose realization rate (RR) is estimated to be 1.05.

Figure 19. Illustration of a 90% One-Sided Confidence Interval on the Lower Bound



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[83] Relative precision (e.g., 10% of the estimate) is most often used to set the precision as a percentage of the estimated value rather than in absolute terms.

[84] Also, the shape (i.e., one-sided or two-sided) is often used to fully specify the confidence interval.

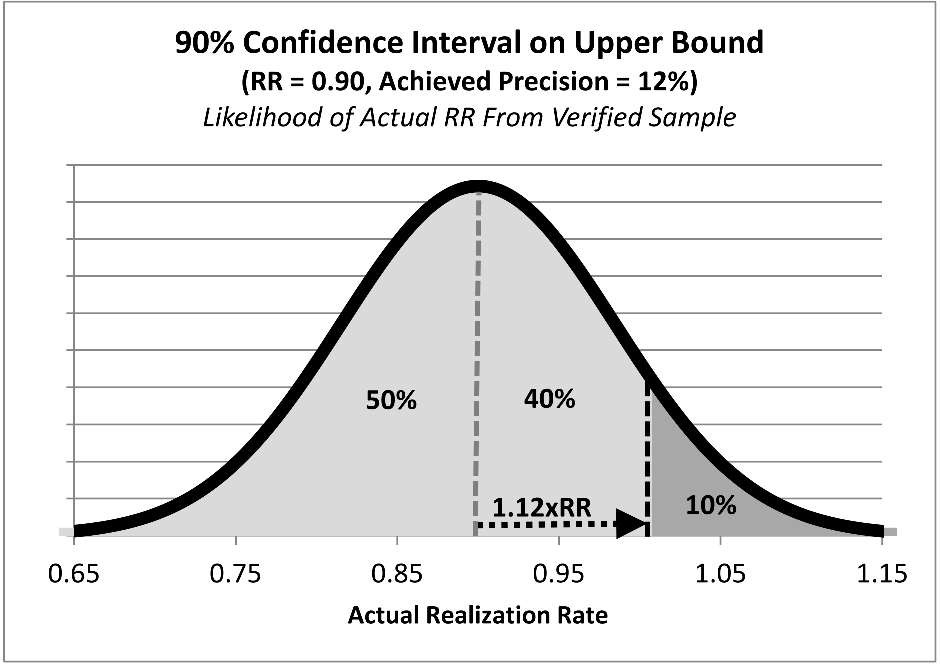
[85] Based on October 25, 2012 Technical Evaluation Committee decision the sample design should be based on a 90/10 one-sided confidence interval. Reporting of achieved confidence and precision should present the precision achieved for both the 90% one-sided and 90% two-sided intervals.

Reading off of Figure 19, this confidence interval can be interpreted as showing that:[86]

- There is a 10% likelihood that the actual value is less than 10% below the mean sample estimate of 1.05.
- There is a 40% likelihood that the actual value falls between 10% below the sample estimate and the sample estimate of 1.05.
- There is a 50% likelihood that the actual value exceeds the sample estimate of 1.05.

The reporting recommendations in Section 6.2 of the main report also call for the reporting of a one-tailed test around an upper bound and a two-tailed test at a 90% confidence level. These are illustrated in Figure 20 and Figure 21. Figure 20 illustrates a 90% one-sided confidence interval on the upper bound. For this illustration a different realization rate estimate is use that was used in Figure 19. In this case, the estimated realization rate is 0.90 and the level of precision achieved at the 90% confidence level is observed from the sample to be 12%. This confidence interval illustrates that the actual value has a 10% likelihood of exceeding the estimated realization rate of 0.90 plus 12% (i.e., exceeding a realization rate 1.01). This likelihood is illustrated by the dark shaded portion of the distribution in the Figure.

Figure 20. Illustration of a 90% One-Sided Confidence Interval on the Upper Bound



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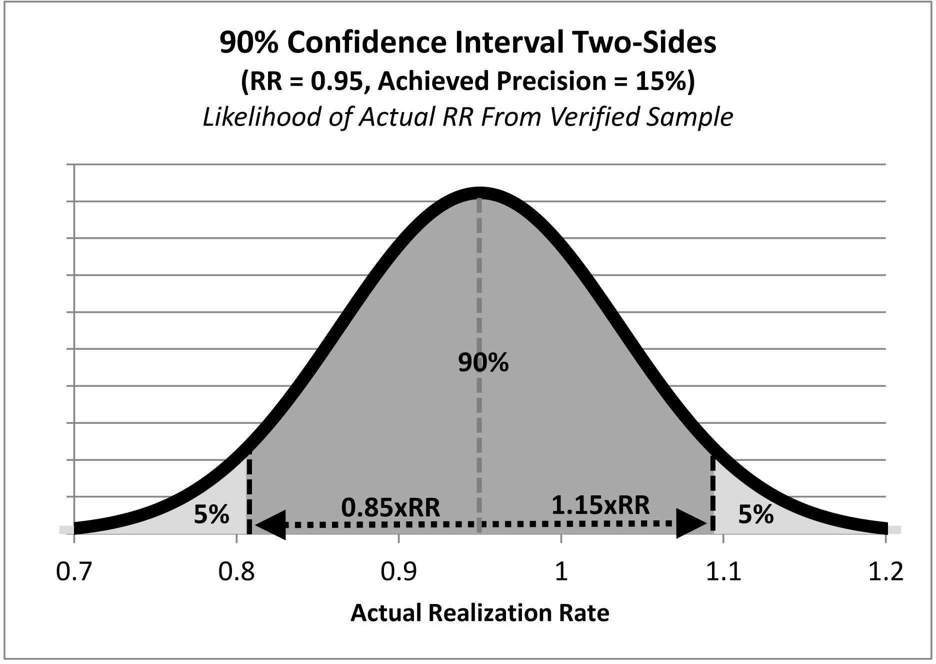
[86] This interpretation of the confidence interval is based on statistical inference, which assumes that the sample provides an adequate representation of the population.

Figure 21 illustrates a 90% two-sided confidence interval on a sample whose realization rate is observed to be 0.95 and whose achieved precision is 15%. The dark shaded area in the middle of the distribution represents the 90% confidence level that the actual value would fall between the bounds set plus or minus 15% of the observed sample estimate. There is only a 5% likelihood that the actual value would fall below the lower bound.

Figure 21. Illustration of a 90% Two-Sided Confidence Interval



Appendix B presents the detailed calculation methods for determining the confidence and precision achieved by a sample.

Appendix B. Calculation Methods & Equations

B.1 Calculating Target Sample Confidence & Precision from Assumed CV

(Note: The formulae in this appendix are based on application of Lohr[87] and Cochran,[88] and are adapted to the vocabulary of the stratified realization rate problem of efficiency program evaluation.)

The standard error of the total savings of stratum h based on tracked ex ante savings[89] is given by,

$$SE'_h = FPC_h \times \frac{CV_h}{\sqrt{n_h}} \times TS'_h$$

Where CV_h[90] is the estimated coefficient of variation in stratum h, defined as the expected stratum standard deviation divided by the expected stratum mean.[91] Where FPC_h is the finite population correction factor of stratum h, n_h is the sample size of stratum h, and TS'_h is the tracked ex ante total savings in stratum h.[92] FPC_h is given by,

$$FPC_h = \sqrt{\frac{N_h - n_h}{N_h - 1}}$$

Where $\mathrm{N_h}$ is the population size of stratum h. The relative precision at the stated confidence level of stratum h is given by,

$$RP'_h = t_h \times \frac{SE'_h}{TS'_h} \times 100\%$$

Where $\mathrm{t_h}$ is the t-value derived from the confidence requirement and the sample size of stratum h. The overall standard error can be calculated by aggregating the sample according to each stratum's weighting (i.e., expected percent contribution to total program savings). The overall standard error of the tracked ex ante total savings of the program is given by,

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[87] Lohr, S. L., "Sampling: Design and Analysis," Second Edition, 2010.

[88] Cochran, W. G., "Sampling Techniques," Third Edition, 1977.

[89] The prime symbol (apostrophe) is used to indicate that these values are based on tracked ex ante values rather than verified ex post values.

[90] In cases of ratio estimation, the error ratio is substituted for the coefficient of variation.

[91] The coefficient of variation may be based on savings or realization rate, as in the case of ratio estimation.

[92] Total tracked ex ante is not necessarily required to compute relative precision since this term is also in the denominator of the relative precision calculation.

$$SE'_P = \sqrt{\sum_h SE_h{}^2}$$

The overall relative precision at the stated confidence level is given by,

$$RP'_P = t_P \times \frac{SE'_P}{TS'_P} \times 100\%$$

Where t_P is the t-value derived from the confidence requirement and the overall sample size in the population, and TS'_P is the estimated total savings across all strata based on verified ex post savings.

B.2 *Calculating Achieved Realization Rates*

Defining $x_{i,h}$ as the tracked ex ante estimate and $y_{i,h}$ as the verified ex post estimate of a single sample point i in stratum h, the effective realization rate of a single sample point i in stratum h is given by,

$$RR_{i,h} = \frac{y_{i,h}}{x_{i,h}}$$

The stratum sample realization rate of stratum h is the sum of all verified ex post savings in the sample of stratum h divided by the sum of all tracked ex ante savings in the sample of stratum h, given by,

$$RR_h = \frac{\sum_{i \in h} y_{i,h}}{\sum_{i \in h} x_{i,h}}$$

In stratified ratio estimation, the stratum realization rate should be applied to the tracked ex ante estimates of each member j[93] of the full population of stratum h to produce the total savings estimate for stratum h. The verified total savings estimate for stratum h is the sum of all tracked ex ante estimates in stratum h multiplied by the stratum realization rate, given by,

$$TS_h = RR_h \times \sum_{j \in h} x_{j,h}$$

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[93] Note that i members of the sample are a subset of j total members of the applicable population.

The verified total savings of the program can be calculated by aggregating strata results. The program verified total savings estimate is given by,

$$TS_P = \sum_h TS_h$$

The overall realization rate across all strata is the verified total savings of the program divided by the tracked ex ante total savings of the program, given by,

$$RR_P = \frac{TS_P}{TS'_P}$$

B.3 *Calculating Achieved Sample Confidence & Precision*

A predicted estimate can be made for each member of stratum h based on the stratum realization rate, where the predicted estimate is the tracked ex ante estimate of each member of the stratum multiplied by the stratum realization rate. A residual error can be calculated for each sample point in stratum h based on the difference between the verified ex post savings of the sample point and the predicted estimate. The residual of each sampled point is given by,

$$e_{i,h} = y_{i,h} - RR_h \times x_{i,h}$$

The sample variance[94] of the verified total savings in stratum h is derived from the stratum residuals, given by:

$$V_h = \frac{1}{n_h - 1} \sum_{i \in h} e_{i,h}^2$$

The standard error of the sample of stratum h can be calculated using the stratum sample variance and the finite population correction factor. The standard error of the verified total savings of stratum h is given by,

$$SE_h = FPC_h \times \frac{\sqrt{V_h}}{\sqrt{n_h}} \times N_h$$

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[94] Sample variance is based on residuals of the verified measurement compared to the predicted estimate using the stratum realization rate when applying ratio estimation.

The relative precision for the stated confidence level of the verified estimate of stratum h is given by,

$$RP_h = t_h \times \frac{SE_h}{TS_h} \times 100\%$$

The resulting confidence interval can be stated in terms of the realization rate or the total estimate. The absolute two-sided confidence interval for the stratum realization rate and verified total savings of stratum h is given by,

$$RR_h \pm (RR_h \times RP_h) \qquad and \qquad TS_h \pm \ (TS_h \times RP_h)$$

The absolute one-sided confidence interval for the stratum realization rate and verified total savings of stratum h is given by,

$$> RR_h - (RR_h \times RP_h) \qquad and \qquad > TS_h - \ (TS_h \times RP_h)$$

The standard error of the verified total savings of the program is given by,

$$SE_P = \sqrt{\sum_h SE_h^2}$$

The overall relative precision at the stated confidence level is given by,

$$RP_P = t_P \times \frac{SE_P}{TS_P} \times 100\%$$

The absolute two-sided confidence interval for the overall program realization rate and verified total savings of the program is given by,

$$RR_P \pm (RR_P \times RP_P) \qquad and \qquad TS_P \pm \ (TS_P \times RP_P)$$

The absolute one-sided confidence interval for the overall program realization rate and verified total savings of the program is given by,

$$> RR_P - (RR_P \times RP_P) \qquad and \qquad > TS_P - \ (TS_P \times RP_P)$$

Appendix C. Summaries of Custom C&I Samples in Selected Jurisdictions

This appendix presents brief summaries of the sampling approaches used in custom commercial and industrial (C&I) programs in selected jurisdictions. The reviewed approaches are all contained within publicly available documents. Because the reviewed documents contain varying degrees of detail and explanation, the Navigant team applied its best interpretation of these documents to synthesize the available information in a consistent manner. Eight jurisdictions are discussed below. Published information on the sampling procedures allowed for a useful summary to be produced.

C.1 Summary from Illinois (ComEd)

The Commonwealth Edison Company (ComEd) Smart Ideas for Your Business program offers all eligible commercial and industrial customers financial incentives for upgrading their facilities with energy-efficient equipment. The program offers prescriptive incentives, available for qualified equipment commonly installed as part of retrofit and equipment replacement projects, or custom incentives, available for less common and more complex energy-saving measures. Examples of custom projects include heating, ventilating, and air conditioning (HVAC) measures (such as chiller upgrades and centralized thermostat control systems), large commercial refrigeration measures, air compressor system upgrades, high-rise building domestic water pumping systems, industrial process renovations, and non-prescriptive lighting measures. In 2011, the custom incentive levels were $0.03/kilowatt-hour (kWh) for equipment with less than a five-year life and $0.07/kWh for equipment with a five-year life or greater.[95] These incentive levels were applied for the first $100,000 in incentives and then reduced by half for the next $100,000, up to the project cost cap. In 2011, ComEd provided financial incentives to 887 projects. Of these, 32 projects were selected for evaluation to achieve confidence and precision targets of 90% and 8% over the three-year program.[96]

A two-stage sampling methodology was implemented, with the first projects being sampled in April of 2011 and the remaining projects sampled in July. The sampling approach stratified the population of projects by project size. All custom projects were sorted into three strata based on *ex ante* energy (kWh) savings, such that each stratum contained one-third of the total claimed energy savings.[97] The evaluation sample was drawn to represent the population distribution by stratum. Figure 22 shows the total number of projects and the evaluation sample by stratum. This sample represents 100% of the population's claimed energy savings in the first stratum,

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[95] Any project involving Energy Management System programming is eligible for the $0.03/kWh incentive. To receive the $0.07/kWh custom incentive, equipment must have a minimum payback of one year and a maximum payback of seven years.

[96] A thirty-third project had been selected but after the site-visit it was moved into the following program year (PY4).

[97] Note that ComEd's custom program application does not require that applicants submit an estimate of savings, suggesting that the claimed savings may be underestimated. In addition, more projects may be assigned to stratum 3, resulting in a less precise estimation of *ex post* gross impacts.

59% in the second, and 5% in the third. In total, the 32 projects represent 45% of the program's custom projects' *ex ante* energy savings.

Figure 22. ComEd 2011 C&I Sample Summary

Sampling Stratum	Total Number of Projects	Evaluation Sample
1	2	2
2	27	15
3	858	15
Total	**887**	**32**

Source: Navigant Review of Evaluation Report[98]

C.2 *Summary from Michigan (DTE Energy)*

The DTE Energy C&I non-prescriptive program offers business customers financial incentives for the installation of "innovative and unique" energy efficiency equipment and controls. Examples of custom measures include energy management system controls, variable-speed air compressors, and ultrasonic HVAC humidification systems. Ineligible customer measures include on-site electricity generation, renewable energy, peak-shifting, fuel switching, or changes in operational/maintenance practices that do not involve capital costs. The custom incentive levels are $0.08/kWh, based on the first year of estimated energy savings, up to 50% of the project cost. Projects require a one-year minimum payback and an eight- year maximum payback.

In 2010, DTE Energy provided financial incentives for 515 energy efficiency measures associated with 381 unique projects. Of these projects, 56 were selected for evaluation to achieve confidence and precision targets of 90% and 10%, respectively, at the program level. This sample of 56 was based on a proportional sampling of measures from each of the three major technology groups: custom lighting, custom electric and custom gas.[99] Figure 23 shows the number of energy efficiency measures, unique projects, and evaluation sample size by group. The sample of custom lighting measures, custom electric measures, and custom gas measures represents 60%, 45%, and 90% of *ex ante* gross energy savings, respectively, for the population.

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[98] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[99] Due to the small sample of "custom electric", several additional measure types were consolidated into this group to avoid a potential distortion in the realization rate. For example, custom HVAC, custom motors, and measures installed through a grocery RFP are included in the "custom electric" category.

Figure 23. DTE Energy 2010 Custom C&I Sample Summary

Sampling Stratum	Total Number of Measures	Total Number of Projects	Evaluation Sample
Custom Lighting	321	252	27
Custom Electric	150	93	9
Custom Gas	44	36	20
Total	**515**	**381**	**56**

Source: Navigant Review of Evaluation Report[100]

C.3 Summary from Massachusetts (National Grid, NSTAR, and Western Massachusetts Electric Company)

The C&I energy efficiency program run by the Massachusetts Program Administrators offers financial incentives to business customers for installing energy-efficient equipment. Custom projects are categorized as either a comprehensive design (CD) project or a comprehensive chiller (CC) project. CD projects typically involve the new construction of commercial, industrial, or municipal buildings that include at least four energy conservation measures (ECMs) that achieve a minimum of 20% energy savings relative to code.[101] CC projects typically involve the installation of a new chiller and multiple other ECMs in an existing building that achieve a minimum of 20% savings.

In 2008 and 2009, 25 custom projects were installed in National Grid, NSTAR, and Western Massachusetts Electric Company (WMECO) service territories.[102] Custom projects were stratified for National Grid, NSTAR, and WMECO separately, resulting in three strata for National Grid and one stratum for both NSTAR and WMECO. Although not specified in the evaluation report, it appears that stratification was based on project size. Figure 24 lists the number of projects and evaluation sample in each stratum by program administrator. Of these projects, five were selected for evaluation to achieve confidence and precision targets of 90% and 10%, respectively, three from National Grid and one each from NSTAR and WMECO.

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[100] "Reconciliation Report for DTE Energy's 2010 Energy Optimization Programs." DTE Energy Company. Prepared by Opinion Dynamics Corporation. April 15, 2011.

[101] Examples of ECMs are building envelope upgrades, lighting fixtures and controls, cooling system upgrades, and Energy Management System controls.

[102] Twenty-two custom projects occurred in National Grid service territory, 2 in NSTAR, and 1 in WMECO.

Figure 24. Massachusetts 2008-2010 Custom C&I Sample Summary

Sampling Stratum	Total Number of Projects	Maximum Gross Savings (kWh)	Evaluation Sample
National Grid, 1	12	332,480	1
National Grid, 2	6	608,237	1
National Grid, 3	4	1,108,409	1
NSTAR, 1	2	3,352,840	1
WMECO, 1	1	496,579	1

Source: Navigant Review of Evaluation Report[103]

C.4 *Summary from New Mexico (New Mexico Public Service Company and New Mexico Gas Company)*

New Mexico Gas Company and the Public Service Company of New Mexico have programs that offer financial incentives to commercial and industrial customers for custom energy efficiency projects.[104] The custom C&I program offered by the New Mexico Gas Company is called "Commercial Solutions" and provides low-flow faucet aerators and pre-rinse spray valves at no cost, as well as a $0.75/therm incentive for custom measures (e.g., water heating, HVAC, building envelope, and industrial process improvements). The custom C&I program offered by the Public Service Company of New Mexico is called the "Commercial Comprehensive Program" and provides rebates for a range of prescriptive and custom measures. Projects are classified as either retrofit, new construction, or QuickSaver direct-install.

The sampling methodology to evaluate C&I programs utilizes stratified random sampling to achieve 90% confidence and 10% precision levels. Projects are stratified by project size. New Mexico Gas Company stratified into three strata. The Public Service Company of New Mexico implemented the sampling strategy for retrofit, new construction, and quick-saver projects separately. Due to the large population of projects for retrofit and QuickSaver, projects were stratified into five strata, while new construction projects were stratified into three strata. Figure 25 and Figure 26 show the number of projects and evaluation sample by stratum.

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[103] "Impact Evaluation of 2008 and 2009 Custom CDA Installations." Massachusetts Energy Efficiency Advisory Council. Prepared by KEMA and SBW Consulting Incorporated. June 7, 2011.

[104] El Paso Electric Company also offers a custom C&I program. However, during 2010 and 2011 there were no participants and as a result an evaluation of the program was not conducted.

Figure 25. New Mexico Gas Company 2011 Custom C&I Sample Summary

Sampling Stratum	Total Number of Projects	Evaluation Sample
< 1,000 therms	16	3
1,000 – 5,000 therms	7	3
> 4,000 therms	5	5
Total	**28**	**11**

Source: Navigant Review of Evaluation Report[105]

Figure 26. Public Service Company of New Mexico 2011 Custom C&I Sample Summary

Retrofit		
Sampling Stratum	**Total Number of Projects**	**Evaluation Sample**
< 26.5 MWh	95	5
26.5-50 MWh	38	4
50-150 MWh	48	4
150-500MWh	29	5
>500 MWh	9	9
Total	**224**	**27**

QuickSaver		
Sampling Stratum	**Total Number of Projects**	**Evaluation Sample**
< 10 MWh	192	4
10-20 MWh	150	4
20-40 MWh	88	4
40-95 MWh	44	4
> 95 MWh	10	10
Total	**484**	**26**

New Construction		
Sampling Stratum	**Total Number of Projects**	**Evaluation Sample**
< 70 MWh	12	3
70-250 MWh	9	4
> 250 MWh	2	2
Total	**23**	**9**

Source: Navigant Review of Evaluation Report[106]

C.5 Summary from Pennsylvania (PECO Energy)

The PECO Energy Company Smart Equipment Incentives program offers financial incentives for installing energy-efficient equipment in commercial and industrial facilities and in master-metered multifamily residential buildings. The program offers incentives for both prescriptive and custom measures. Examples of custom projects include energy management systems,

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[105] "Evaluation of 2011 DSM Portfolio." New Mexico Gas Company. Prepared by ADM Associates Incorporated. June 2012.

[106] "Evaluation of 2011 DSM & Demand Response Portfolio." Public Service Company of New Mexico. Prepared by ADM Associates Incorporated. March 2012.

compressed air systems, process equipment and chillers, industrial systems, whole building systems, and outdoor lighting. Custom incentive levels are $0.12/kWh for estimated on-peak energy savings and $0.08/kWh for estimated off-peak energy savings, up to 100% of project costs.[107]

In 2010, PECO provided financial incentives to 1,085 non-multi-tenant projects and 490 multi-tenant projects. Of these projects, 39 were selected for evaluation to achieve confidence and precision targets of 85% and 10%, respectively, at the program level.[108] The sample is stratified by project size, based on *ex ante* energy savings, and by project-type (lighting, non-lighting, custom). A three-stage sampling strategy was implemented, with the first stage occurring after the end of Q2, the second stage after Q3, and the third stage after Q4.[109,110] Within the sample, custom projects make up the majority of stratum 1, accounting for 49% of *ex ante* energy savings for the sample population.[111]

C.6 Summary from Ohio (AEP Ohio)

AEP Ohio offers commercial and industrial customers energy efficiency incentives through a number of programs. The custom program provides financial incentives for "less common or more complex energy-saving measures" that are installed as part of a qualified retrofit project or equipment replacement project. Examples of custom measures include lighting retrofits, HVAC measures such as VFDs, equipment controls, and process efficiency improvements. Custom incentive levels are based on both energy (kWh) and demand (kW) savings in the first year. Specifically, the incentive levels are $0.08/kWh, $100/kW, up to 50% of the project cost. In 2011, AEP Ohio provided financial incentives to 220 custom projects. Of these, 54 projects were selected for evaluation.

The sampling methodology stratified projects both by geography and by project size. At the time, AEP Ohio had gone through a merger of two regional operating companies so that participants in the custom program were distributed across two rate zone territories. The sample design was conducted separately for each rate zone, targeting confidence and precision levels of 90% and 10%, respectively, for each zone. A two-stage sampling methodology was implemented, with the first wave of projects sampled in November of 2011 and the second wave sampled in February of 2012. Projects were first separated by zone, then stratified based on *ex ante* energy (kWh) savings. Projects were assigned to one of three strata such that there

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[107] On-peak hours include 12pm-8pm, June 1 – September 30 (excluding holiday weekdays). Off-peak hours include 8:01pm-11:59am, June 1-September 30, and all hours from October 1-May 31. https://peco.icfi.com/sites/peco/files/2011_PECO_CUSTOM_Incentive_Levels.pdf

[108] The evaluation plan targeted confidence and precision levels of 85% and 15%, respectively. However, the final sample design allowed for 85/10 confidence and precision targets.

[109] The first stage included projects implemented in both Q1 and Q2 due to low levels of participation in the program during Q1.

[110] Note that PECO reports unverified savings quarterly.

[111] Lighting and non-lighting measures account for 19% and 32%, respectively.

was a relatively even distribution of cumulative standard deviation in energy savings between strata. Figure 27 shows the number of total projects and the number of projects in the evaluation sample for each zone and stratum. In total, the evaluation sample represents 62% of *ex ante* gross energy savings for the population.

Figure 27. AEP Ohio 2011 Custom C&I Sample Summary

Sampling Stratum	Total Number of Projects	Evaluation Sample
Zone 1, Stratum 1	5	5
Zone 1, Stratum 2	19	7
Zone 1, Stratum 3	85	12
Zone 2, Stratum 1	8	5
Zone 2, Stratum 2	18	11
Zone 2, Stratum 3	85	14
Total	**220**	**54**

Source: Navigant Review of Evaluation Report[112]

C.7 *Summary from Maryland (covers five Maryland utilities)*

The five EmPOWER Maryland utilities (Baltimore Gas and Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison) offer large commercial and industrial customers financial incentives for the installation of efficiency measures that are complex and/or unique, such as commercial HVAC and industrial process improvements. Baltimore Gas and Electric (BGE) and Southern Maryland Electric Cooperative (SMECO) offer rebates for up to 50% of retrofit projects and up to 75% of the incremental cost of new construction projects. Potomac Electric Power Company (PEPCO) and Delmarva Power (DPL) programs were implemented jointly and offer $0.16/kWh for energy savings in the first year.[113] Potomac Edison (PE) offers $0.05/kWh of *ex ante* energy savings. The target evaluation sample for each utility was 12 projects to achieve confidence and precision levels of 80% and 20%, respectively. At the time the evaluation samples were drawn, only BGE had enough participants to reach the targeted sample of 12. PEPCO/DPL had 10 custom projects completed, SMECO had 7, and PE had 11. For these utilities, the entire population was used as the evaluation sample.[114]

For BGE, the sampling strategy calculated the percentage of population energy (kWh) and demand (kW) savings for each project using equal weights. These percentages were used to sort the population of projects into three strata such that each stratum represented approximately one-third of population savings. Random numbers were then assigned to projects within each

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[112] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012.

[113] As a result, participants in PEPCO and DPL's programs were combined into a single sample.

[114] The final evaluation sample for PEPCO/DPL was reduced to eight due to barriers in doing on-site verification for two custom projects.

stratum. Sample projects from each stratum were selected based on the random number designation. For BGE, the evaluation sample represents 58% of *ex ante* energy savings for the population.

C.8 Summary from Vermont (Efficiency Vermont)

Efficiency Vermont offers financial incentives for installing energy-efficient equipment in commercial and industrial facilities as well as multi-family buildings. The evaluation was conducted for two program years, 2007 and 2008. The sample size was chosen to achieve an 80% confidence level and 10% precision level for the entire portfolio of Efficiency Vermont programs.

Sampling occurred in two stages, with the first wave including projects completed by April 30, 2008, and the second wave including projects completed during the remainder of 2008. The sampling methodology categorizes projects by market type (retrofit or new construction/market opportunities) and end use (lighting, HVAC, and other).

The sample of retrofit projects includes projects of all end uses, whereas the evaluation sample of new construction/market opportunities projects only includes lighting projects. Projects were stratified into three strata based on *ex ante* peak demand savings. Because demand reductions are claimed separately for winter and summer, the population of projects/end uses was further stratified by season. In particular, if the estimated peak reduction was higher during winter, projects/end uses were assigned to "winter." If the estimated peak reduction was higher during summer or was roughly equivalent during winter and summer, projects/end uses were assigned to "summer/non-seasonal." Within each stratum, a random number was assigned to each project/end use and ordered. The evaluation sample was then selected from the top of each group. Figure 28 shows the total number of retrofit and NC/MOP projects, as well as the evaluation samples stratified by project size and seasonality.

Figure 28. Efficiency Vermont 2007-2008 Custom C&I Sample Summary

	Total Number of Projects		**Evaluation Sample**			
Sampling Stratum	**Retrofit**	**NC/MOP**	**Retrofit, Winter**	**Retrofit, Summer**	**NC/MOP, Winter**	**NC/MOP, Summer**
0.8-5 kW	263	652	8	8	15	15
5-35 kW	244	315	16	17	23	26
> 35 kW	64	35	49	49	21	23
Total	**571**	**1,002**	**73**	**74**	**59**	**64**

Source: Navigant Review of Evaluation Report[115]

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[115] "Verification of Efficiency Vermont's Energy Efficiency Portfolio for the ISO-NE Forward Capacity Market." Vermont Department of Public Service. Prepared by West Hill Energy and Computing Incorporated. July 29, 2010.

MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE

ONTARIO'S CLIMATE CHANGE UPDATE 2014

Ontario

Minister's Message

Climate change is a tremendous force disrupting and challenging every facet of our lives, from our homes and businesses to the activities, food and places we enjoy and often take for granted. We must act now to protect our health, wellbeing and work together towards a cleaner, brighter future.

Ontario has the skills, technological knowledge and capacity to be a world leader in finding and demonstrating solutions to climate change.

Where we live, where we work and how we move between our homes and our jobs determines the largest share of our greenhouse gas emissions. To keep reducing emissions with a growing population, we need to build for the future. More energy-efficient buildings, smart urban planning, low-carbon transportation options, and green infrastructure are just some of the solutions we need. And, as the world transitions to a low carbon economy, we need to design products for our children, not the dump.

Our government is already making strides in all of these areas – through investments in transit, our regional planning initiatives, and our energy and environmental policies, and there is more to do.

This report reflects on Ontario's actions towards addressing climate change and I am proud of the progress we have made to date. However, our government has set important targets for 2020 and 2050 that will require new approaches to adaptation, mitigation and science.

Let's rise to the challenge of fighting climate change and leave future generations with an essential legacy: a healthy and beautiful planet.

Glen Murray
Minister of the Environment and Climate Change

This Report

Ontario reports regularly on climate change progress. Regular, transparent reporting supports the observation of trends in the economy and society that influence greenhouse gas emissions. In addition, it enables the assessment of policies, programs and other actions as well as the forecasting of future trends. Finally, the report helps to highlight areas for further action.

We determined these targets as part of a coordinated global effort to avoid the dangerous impacts of climate change on our planet and quality of life, but also to help ensure a cleaner future for Ontario.

We expect to achieve our 2014 target, the first of three targets set out in the province's plan. While we are more than two thirds of the way to meeting our 2020 target, we know we have to act quickly to meet the target. Ontario uses 1990 as a base year for its targets, which is common practice and aligns with the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Some jurisdictions such as the Government of Canada (which uses 2005) have adopted different base years for targets. All nations reporting to the UNFCCC report historical emissions back to 1990.

In 1990, GHG emissions in Ontario were 177 megatonnes (Mt). In 2012, according to the Government of Canada's latest National Inventory Report (the Inventory), emissions in Ontario were down to 167 Mt (or 5.9%[2] below 1990 levels). Since 2007, emissions are down in Ontario by about 35 Mt (or 17%) driven primarily by the phase-out of coal-fired electricity generation. As of April 2014, Ontario no longer uses coal to generate electricity and has reintroduced legislation to ensure that, if passed, coal-burning generation on the electricity grid will never happen again.[3]

This report provides an update of Ontario's greenhouse gas emissions (GHGs) and progress towards the targets set out in the 2007 Climate Change Action Plan.[1]

The targets are:

- 2014 target: 6% below 1990 levels
- 2020 target: 15% below 1990 levels
- 2050 target: 80% below 1990 levels

Total GHG emissions forecast for 2014 are 165 Mt, which is below the target of 167 Mt. **This means Ontario is expected to not only achieve, but surpass its 2014 target.** Given current policies and trends, emissions in 2020 are forecast to be 170 Mt — which would achieve 69% of the emission reductions required[4] to meet the 2020 target.

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[1] Ontario, *Go Green: Ontario's Climate Change Action Plan* (Toronto: Queen's Printer for Ontario, 2007).

[2] 5.9% is the per cent reduction. This number is the accurate ratio when using the unrounded numbers; in 1990, actual emissions were 177,248 Mt and in 2012 were 166,878 Mt.

[3] Bill 9, Ending Coal for Cleaner Air Act, 2014, 1st Session, 41st Legislature, Ontario.

[4] Progress is calculated as the ratio of projected reductions in emissions (from Business as Usual) to reductions required to meet the target.

Overview of Sections

The information presented in this report is based on Environment Canada's *National Inventory Report 1990–2012: Greenhouse Gases Sources and Sinks*, released in April 2014.[5] Ontario relies on this report to evaluate historical emission changes in several sectors of the provincial economy. Its underlying data also forms the basis of the emission forecasts in this report.

SECTION 1

Summarizes the major sources of emissions in the province, long- and short-term trends, and the province's updated emission forecasts to 2014, 2020 and 2030.

SECTION 2

Breaks down emissions by sector — discussing the key factors influencing GHG emissions and the impacts of specific policies.

SECTION 3

Describes the modelling approach and associated uncertainty.

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[5] The Inventory is available here: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php.

SECTION 1

ECONOMY-WIDE EMISSION TRENDS AND FORECAST

Sources of Emissions

Ontario's estimated GHG emissions comprise GHGs that are emitted *within* the province's boundaries — for instance, from buildings, vehicles and industrial plants operating in Ontario.

Estimated GHG emissions do *not* include "consumption-based emissions" from the production of fuels, goods and services outside the province that are bought or consumed inside Ontario. This approach to estimating GHGs is consistent with most other jurisdictions, including the Government of Canada.

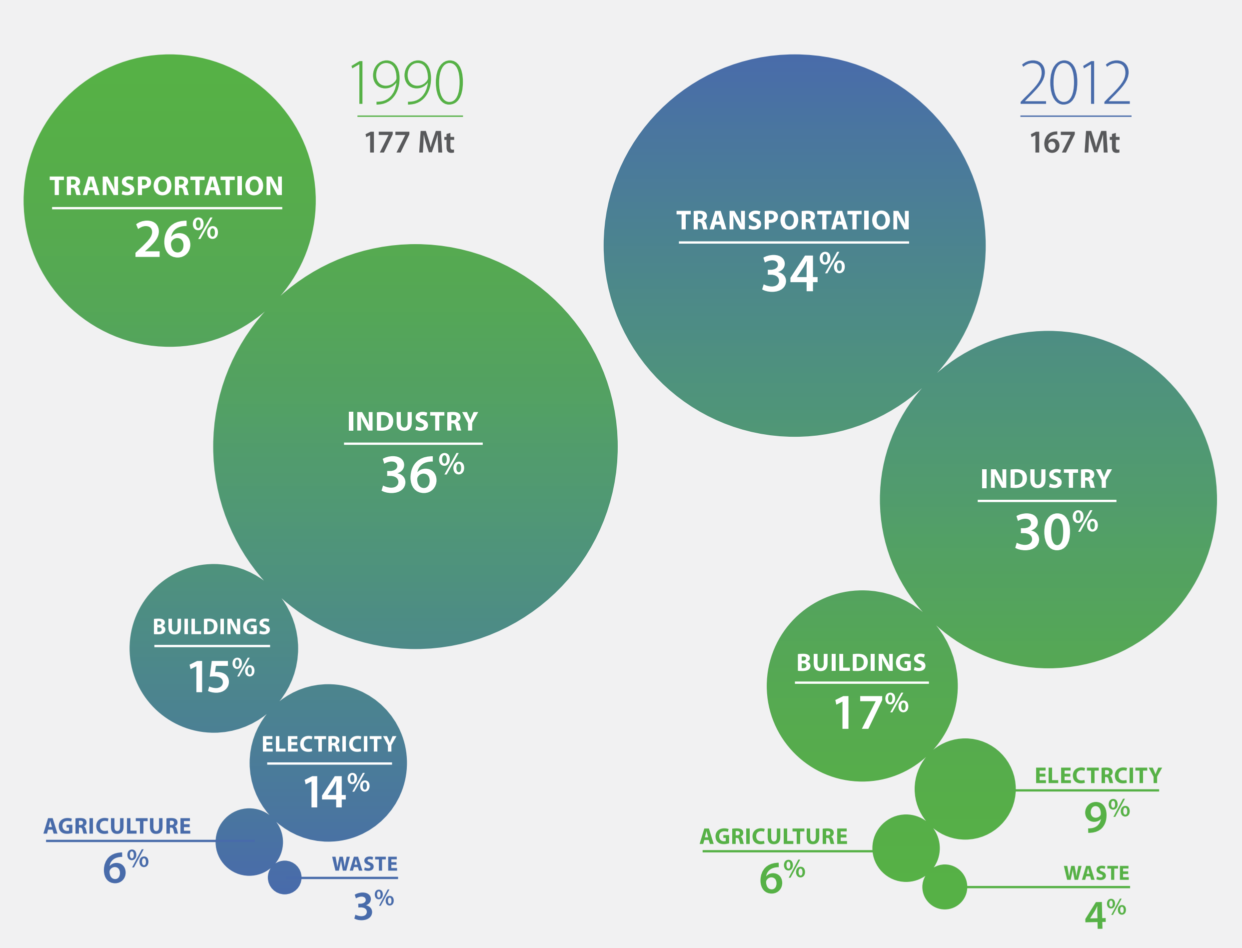
GHG emissions come from virtually all aspects of Ontario's society and economy. The main sources by far are the fossil fuels used to heat homes, run vehicles, power industries and generate electricity. But GHGs also come from waste disposed in landfills, some industrial processes, livestock, fertilizer use, and from appliances leaking refrigerants. In this report, sources are categorized into the economic sectors described in **Table 1** (further detail is also provided in Section 3: Methodology).

TABLE 1 **Sector Descriptions**

Sector	Sources of Greenhouse Gas Emissions
Transportation	The combustion of fossil fuels such as diesel, gasoline and propane by passenger and commercial vehicles on and off roads, as well as rail and Ontario's share of domestic marine and air travel
Industry	Some industrial processes and stationary combustion of fossil fuels such as coke, natural gas and coal used in mining; pipelines; construction; greenhouses; production of cement, iron and steel, chemicals, paper and wood products; and other manufacturing
Buildings	The combustion of fossil fuels such as natural gas in residential, commercial and institutional buildings for space and water heating
Electricity	Generating electricity and heat by electric utilities using fossil fuels such as natural gas
Agriculture	Enteric fermentation, manure management and fertilizer application
Waste	Solid waste disposal on land, wastewater handling and waste incineration

The “land use, land use change and forestry” sector also plays an important role in both adding GHGs to and removing GHGs from the atmosphere. This sector reflects the role of forests, grasslands, croplands, wetlands and settlements in the carbon cycle. Forests and other lands can absorb and store carbon for long periods — these are known as carbon sinks. However, carbon sinks can also release carbon back into the atmosphere as conditions change and organic material degrades. Many of these processes are natural; however, how forests and croplands are managed and land use is changed from forest to agricultural lands or other uses can have a climate impact. The federal government models and reports these emissions and removals at a national level in the National Inventory Report. However, in accordance with UN accounting conventions, Canada’s emissions and removals of GHGs from the Land Use, Land Use Change and Forestry sector are *not* included in Canada’s National Inventory totals. Therefore, these sources and sinks are not included in Ontario’s assessment of GHGs at this time. As better data become available, Ontario will consider how to incorporate these into its accounting and targets.

FIGURE 1 Emissions by Sector, 1990 and 2012



Source: the 2014 National Inventory Report: 1990–2012 data

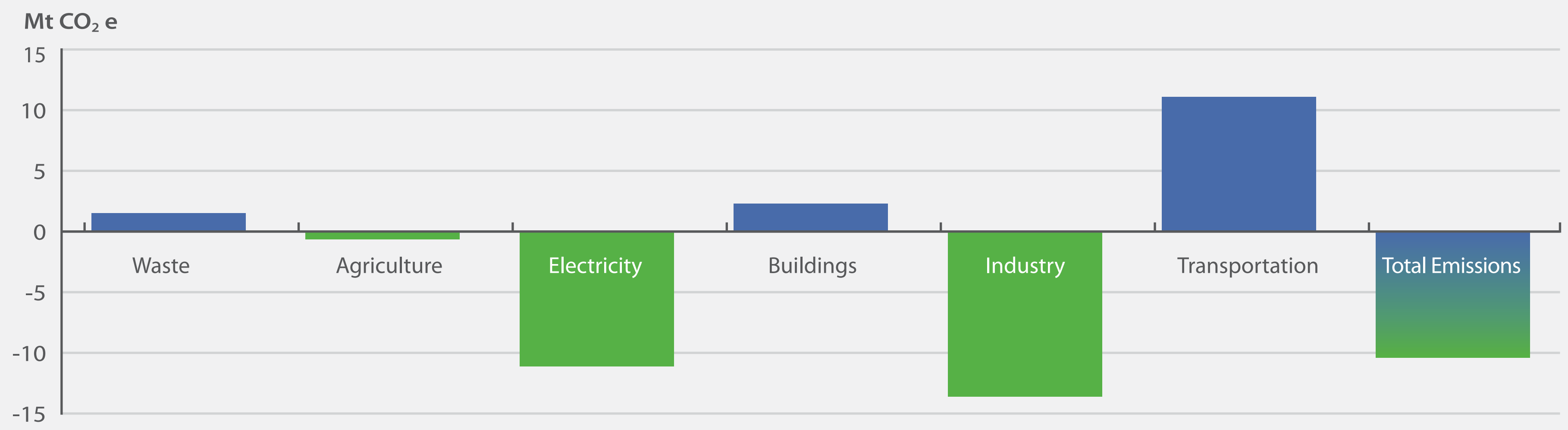
Ontario's emissions in 2012

For 2012, Ontario's GHG emissions are estimated to be 167 megatonnes (Mt). The 1990 and 2012 shares of emissions by sector are shown in **Figure 1**. Over these 22 years, the distribution of emissions by sector in Ontario has changed, reflecting changes in the economy and the electricity sector. The share of emissions in the transportation sector has grown from 26% in 1990 to 34% in 2012, while the share of industrial emissions has declined from 36% to 30%. Note that 2012 emissions do not yet reflect the full impact of the closure of coal-fired electricity in the province.

Long-term trends in Ontario's emissions (1990–2012)

Figure 2 shows the percentage changes in emissions from 1990–2012.

FIGURE 2 Long-Term Changes in Ontario Emissions by Sector, 1990–2012

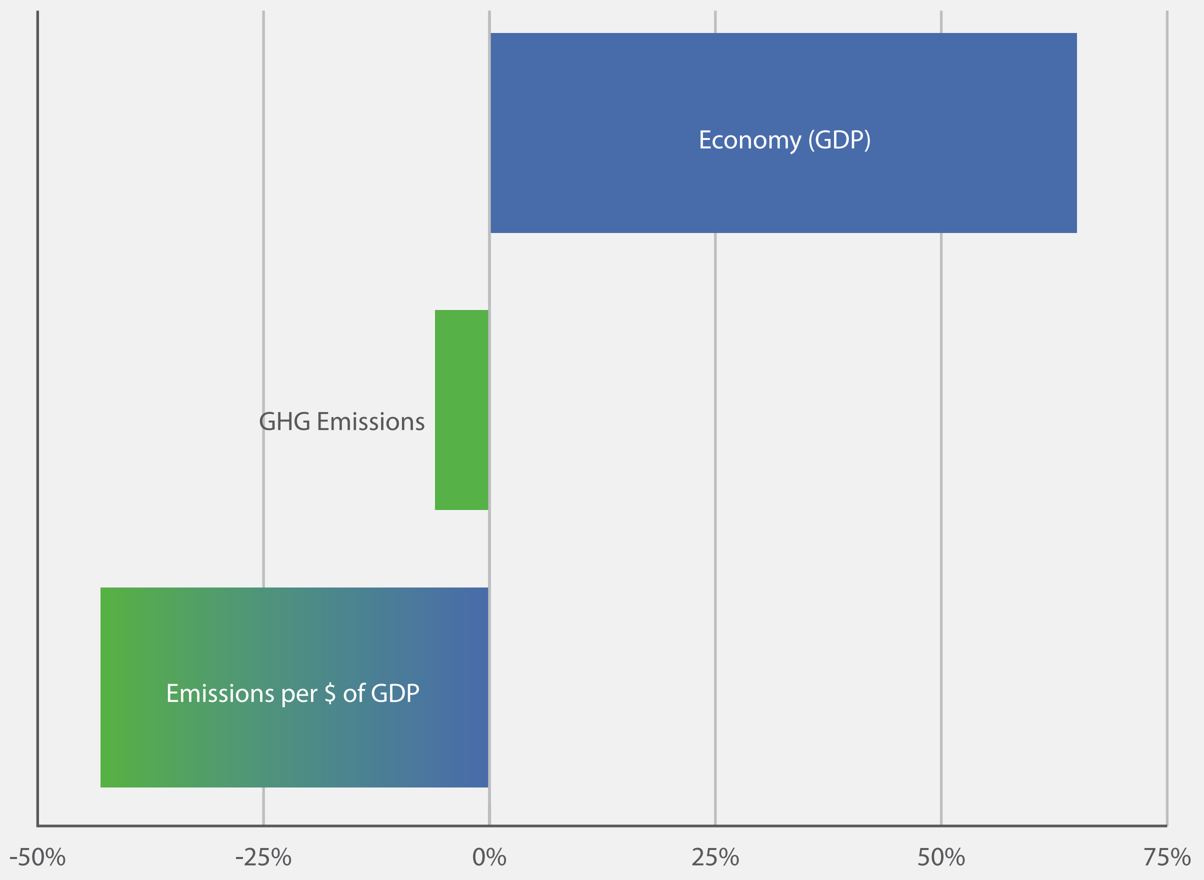


Source: The 2014 National Inventory Report 1990-2012 data

Greenhouse gas emissions are influenced by population and economic growth as well as by the use and sources of energy that support that growth. Over the period 1990–2012, Ontario's population and economy have grown steadily — putting upward pressure on greenhouse gas emissions. However, over the same period Ontario has reduced the carbon emitted from electricity generation, and made improvements in the energy efficiency of buildings, industries and vehicles.

Figure 3 shows the economy is one driver of emissions in Ontario. Other drivers such as population, housing stock and the number of passenger vehicles have all increased significantly since 1990. Yet, over the same period, emissions have declined.

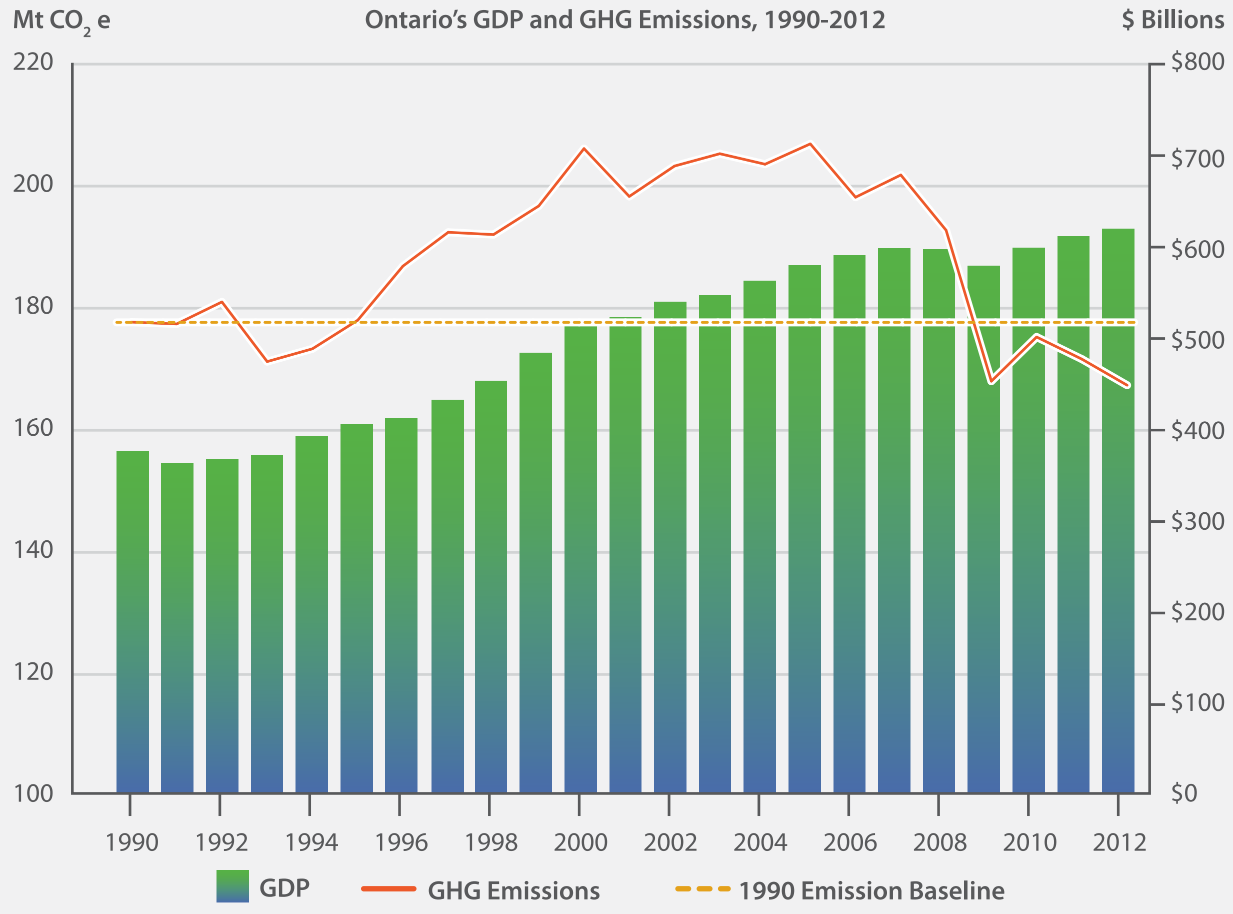
FIGURE 3 Changes in Key Drivers of Emissions, 1990-2012



Sources: the 2014 National Inventory Report: 1990–2012 data; *National Energy Use Database (2014); Statistics Canada CANSIM Tables 127 0001 and 127 0007; Ontario Ministry of Finance*, Long-Term Report on the Economy *(2014)*

From 1990–2012, Ontario's emissions fell by 5.9%; **Figure 4** shows this long-term trend compared with GDP. Emissions grew from 1990 to the early 2000s, then stabilized and declined in recent years. Improved energy efficiency, the changing mix of electricity generation and the shifting composition of Ontario's industrial base are mitigating the impact on greenhouse gas emissions of population and economic growth.

FIGURE 4 Long-Term Trends

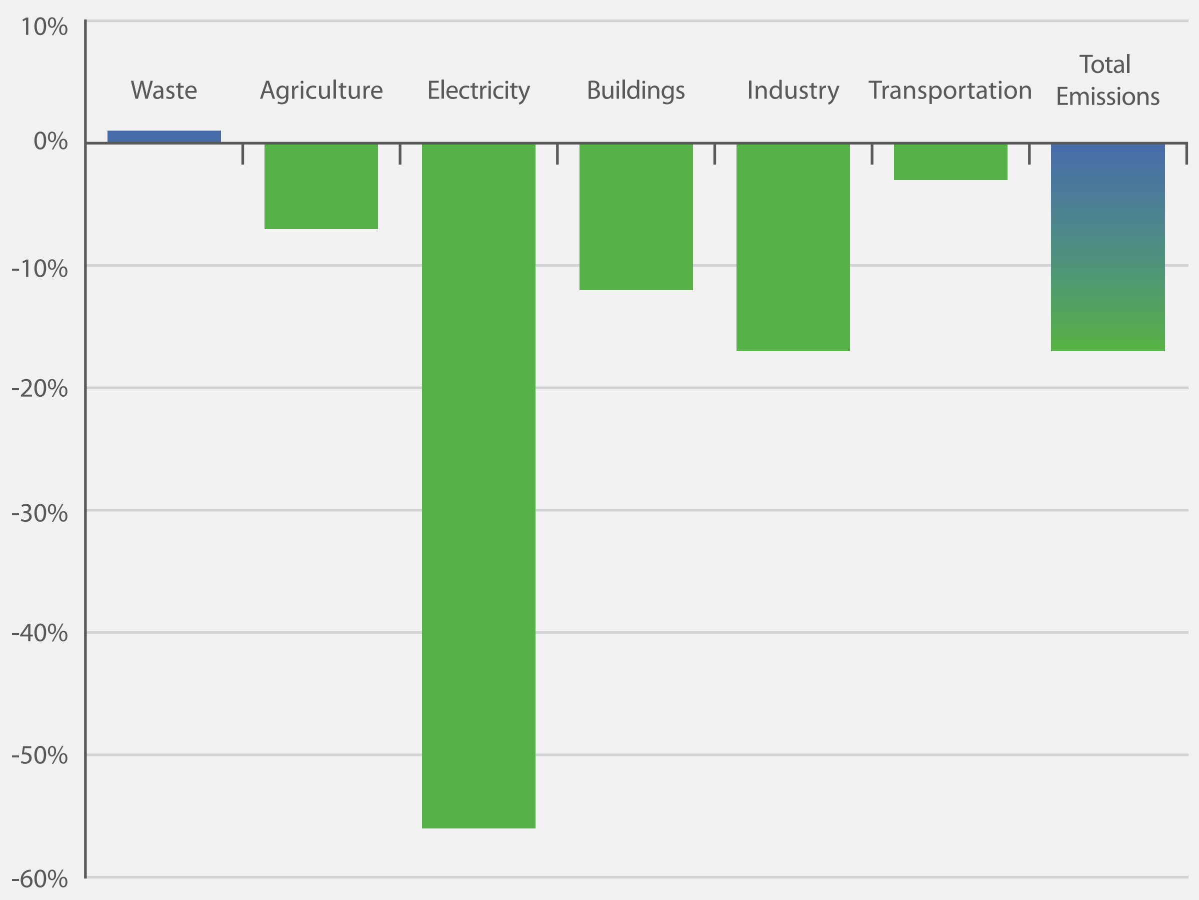


Sources: the 2014 National Inventory Report: 1990–2012 data; *Ontario Ministry of Finance*, Long-Term Report on the Economy *(2014)*

Short-term trends in Ontario's emissions (2007–2012)

In 2007, Ontario released a Climate Change Action Plan that set out its emissions reduction targets and identified policies intended to help meet those targets. Since 2007, total emissions in Ontario have declined by approximately 34 Mt or 17%. The greatest reductions are in the electricity and industrial sectors (see **Figure 5**). The reduction in electricity is attributable to the phasing out of coal-fired electricity generation. The reduction in the industry sector is attributable to reduced production — including plant closures — and improved emissions intensity. Buildings' emissions also declined as energy efficiency improved due to policies and programs in the sector. See Section 2 for more detail on sectoral trends.

FIGURE 5 Short-Term Changes in Ontario Emissions by Sector, 2007–2012

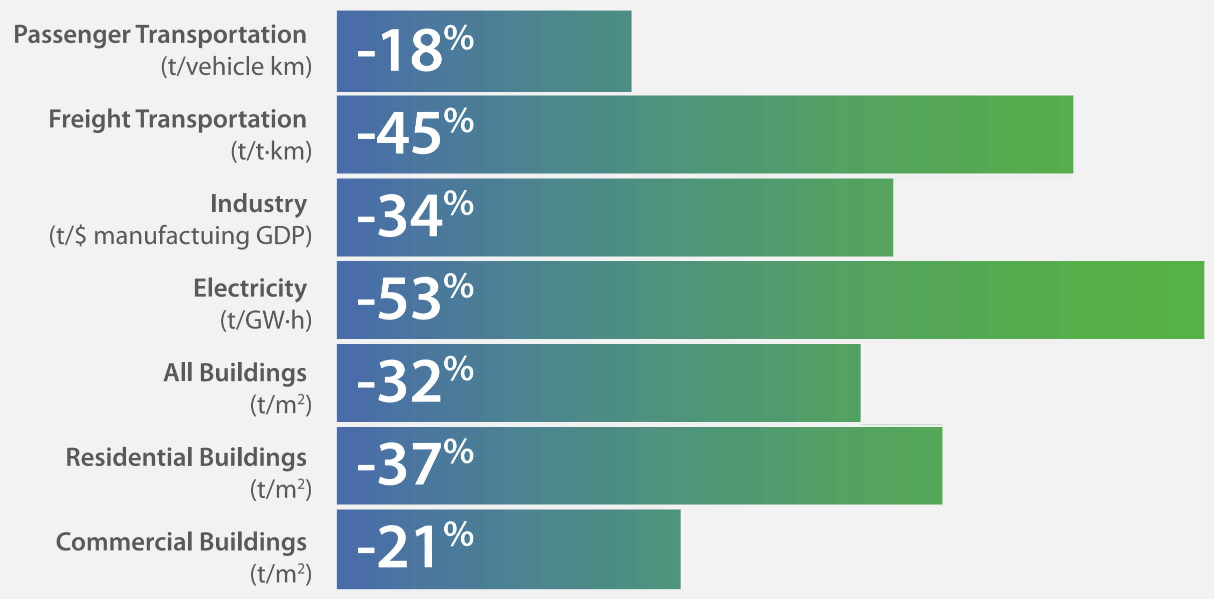


Source: the 2014 National Inventory Report: 1990–2012 data

Emission Intensities

Emission intensities across most sectors improved between 1990 and 2012, which indicates a trend towards a less carbon-intense economy. **Figure 6** depicts emission intensities based on greenhouse gas drivers such as buildings, electricity, industry and transportation. Trends in specific sectors are described in more detail in Section 2 of this report.

FIGURE 6 Changes in Emission Intensities of Key Activities, 1990–2012



Sources: the 2014 National Inventory Report: 1990–2012 data; *National Energy Use Database (2014); Statistics Canada CANSIM Tables 127 0001 and 127 0007; Ontario Ministry of Finance,* Long-Term Report on the Economy *(2014)*

TRANSPORTATION

Between 1990 and 2012, emissions per passenger vehicle kilometre travelled in Ontario decreased by 18% while emissions per freight tonne-kilometre decreased by 45%. Passenger vehicle intensity saw most of its decrease after 2006. Most of the improvements in freight intensity occurred before 2000.

INDUSTRY

In the industrial sector, most emissions are generated by manufacturing industries. **Figure 6** shows the emission intensity of overall manufacturing, calculated as emissions per dollar of manufacturing GDP. In 2012, emissions intensity was 34% lower than in 1990. Note that this figure does not show the variability across the sector and should not be taken to mean that every industry has reduced its emissions since 1990.

BUILDINGS

In the buildings sector, the measurement of emissions per unit of floor space gives an indication of changes in the "carbon intensity" of the sector, which is linked to energy use and the type of energy being used. **Figure 6** shows changes in emission intensity, measured as emissions per square metre of floor space in residential and commercial/institutional buildings.

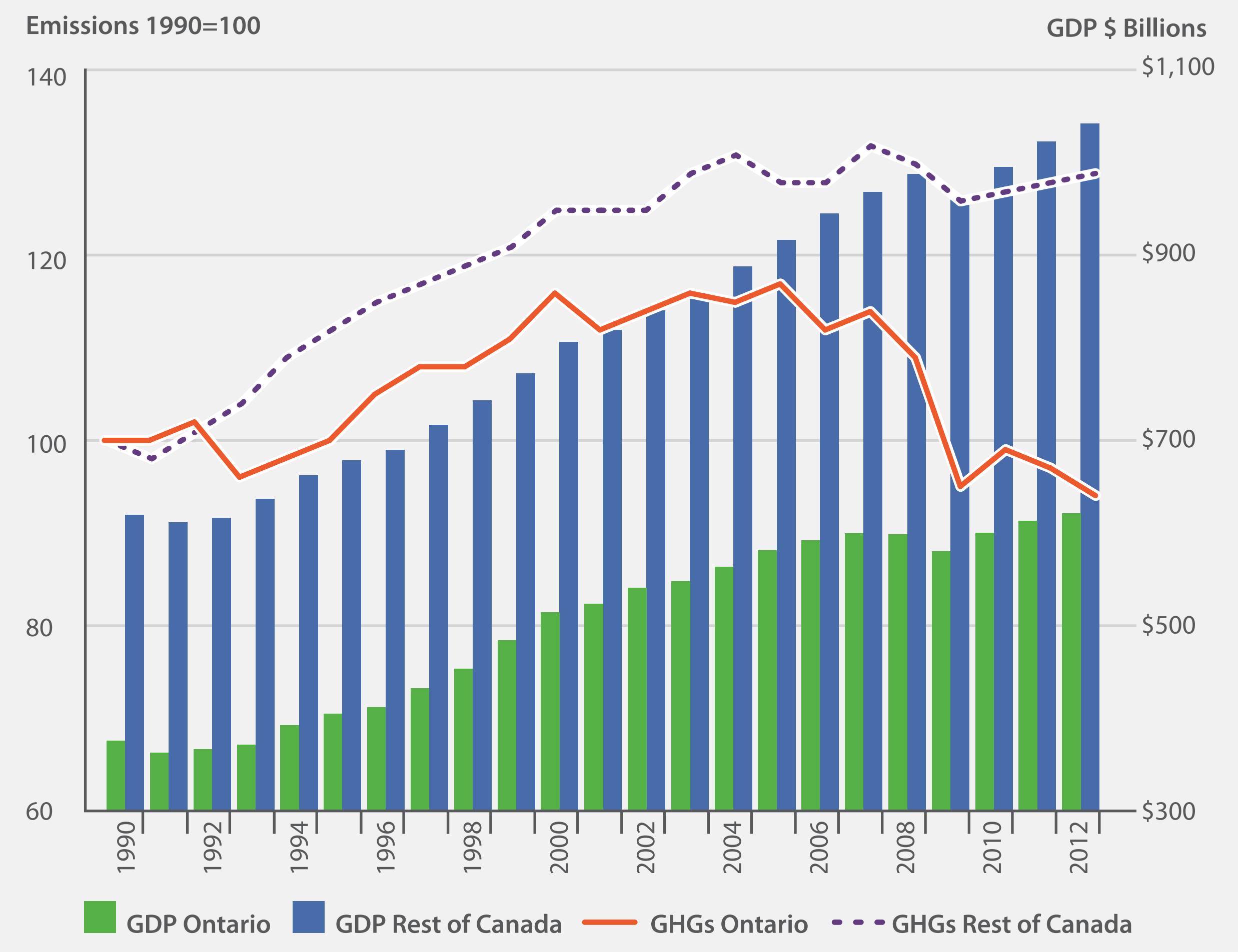
Building emission intensities improved by about 32% from 1990–2012, in both the residential (37%) and the commercial/institutional (21%) sub-sectors.

ELECTRICITY

In the electricity sector, emissions per unit of electricity generated (tonnes per gigawatt-hour) give an indication of changes in the emission intensity of electricity generation at Ontario's utilities. **Figure 6** shows changes in the emission intensity relative to the base year 1990.

Emission intensity improved by about 53% from 1990–2012. This means that greenhouse gases (tonnes of carbon dioxide equivalent) per gigawatt-hour of electricity generated was less than half what it was in 1990.

FIGURE 7 Changes in GHG Emissions, 1990–2012 (Ontario and the Rest of Canada)



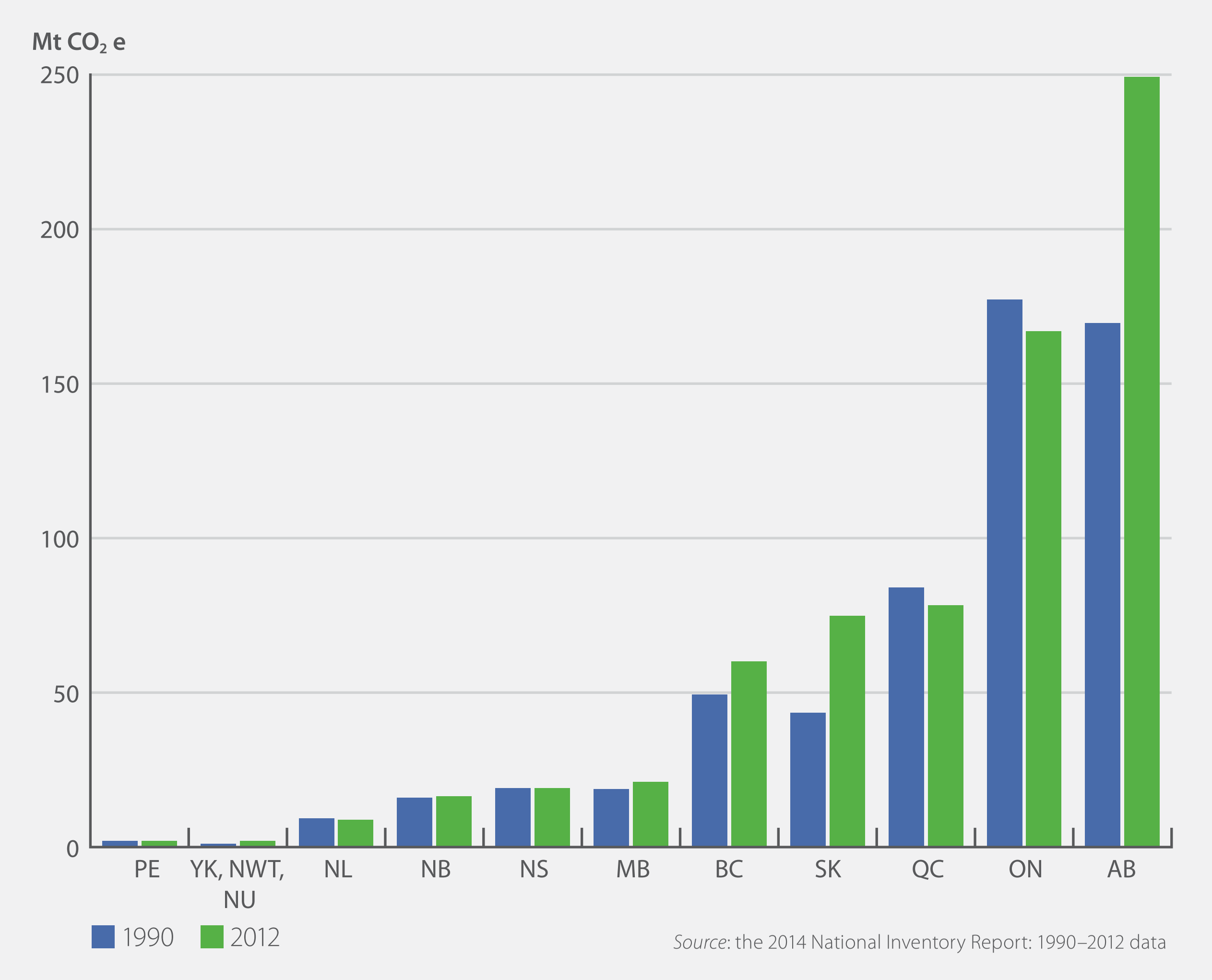
Source: the 2014 National Inventory Report: 1990–2012 data; *Statistics Canada CANSIM Table 384 0038*

Interprovincial Comparisons

Greenhouse gas emission trends across Canada are quite different than those in our province, with clear increases in areas of expanded resource development and slower growth or decreases in other areas. Overall, Canada's emissions have increased 18.2% since 1990 but have declined in recent years, primarily because of the significant reductions in Ontario. **Figure 7** compares emission changes in Ontario to those of Canada overall.

Emission profiles and trends vary significantly across Canada. **Figure 8** shows the change in emissions by province since 1990.

FIGURE 8 Provincial/Territorial Emissions, 1990 and 2012



Source: the 2014 National Inventory Report: 1990–2012 data

In contrast to Ontario's stable-to-declining emissions, the national trend is one of increasing emissions. In 2012, Canada's GHG emissions totalled 699 Mt, an increase of 18% since 1990. However, increases by province vary. Ontario and Quebec are the only jurisdictions in Canada with significantly declining greenhouse gas emissions. Ontario's emissions decreased by 6% and Quebec's decreased by 7%. In absolute emissions, Ontario's decrease of 10 Mt since 1990 is the largest in Canada.

Both the emission intensity of Ontario's economy — measured as emissions per unit of GDP — and per capita emissions are among the lowest in Canada (see **Table 2**).

TABLE 2 Provincial/Territorial Emission Intensities, 2012

Province/ Territory	Emission Intensity of the Economy (Mt CO_2 eq./$ billion GDP)	Rank
QC	0.24	1
YK, NWT, NU	0.27	2
ON	**0.27**	**3***
BC	0.29	4
NL	0.32	5
MB	0.39	6
PE	0.40	7
NS	0.53	8
NB	0.58	9
AB	0.86	10
SK	1.28	11

Province/ Territory	Emissions per Capita (t/capita)	Rank
QC	9.69	1
ON	**12.32**	**2**
BC	12.96	3
PE	13.30	4
MB	16.63	5
NL	17.03	6
YK, NWT, NU	17.92	7
NS	20.03	8
NB	21.70	9
AB	63.81	10
SK	68.84	11

Sources: the 2014 National Inventory Report: 1990–2012 data; *Statistics Canada CANSIM Tables 051 0001 and 384 0038*

* YK, NWT, NU's emission intensity is lower. When rounding the number, it appears to be equal to Ontario.

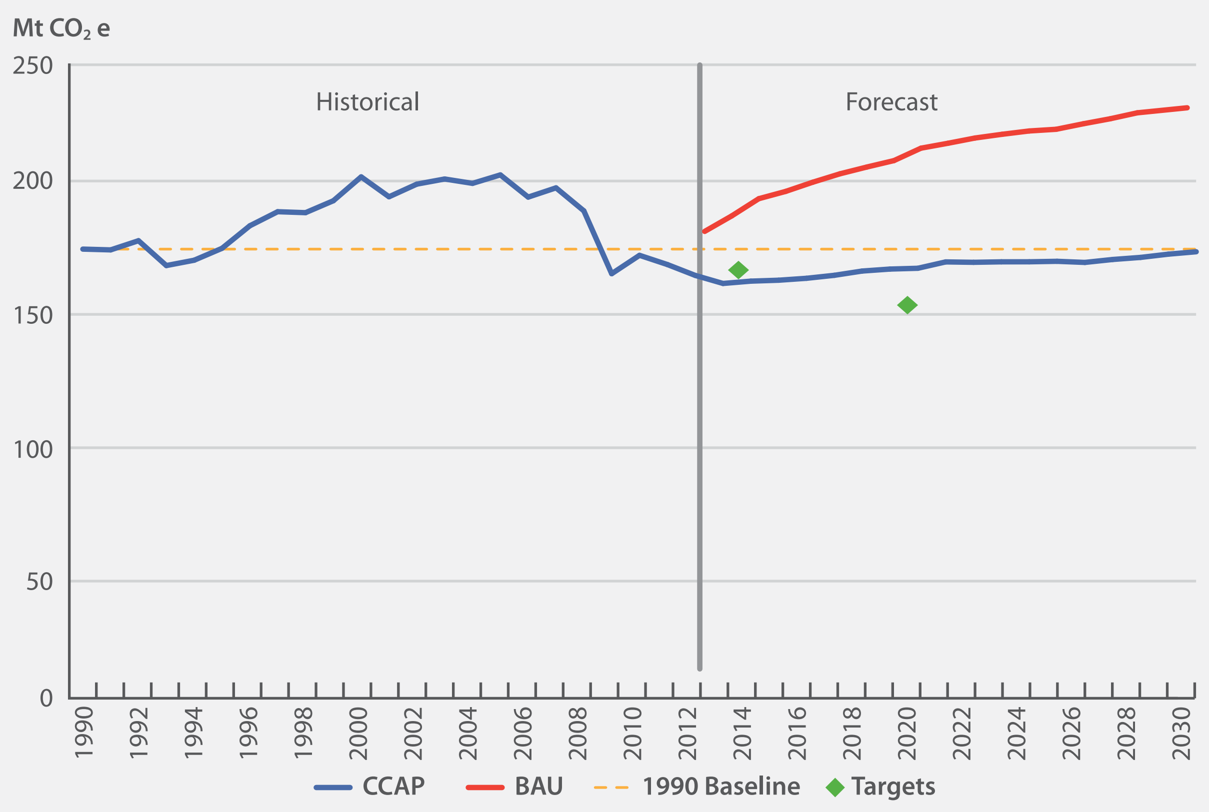
Emission Forecast to 2030

Figure 9 shows historical and forecast emissions for the province out to 2030. This forecast takes into consideration provincial and federal policies up to March 2014 that are expected to affect emissions, including Ontario's regional transportation plan for the Greater Toronto and Hamilton Area.[6] The initiatives section below describes the transportation plan further.

In addition, in order to illustrate the progress Ontario is making towards its 2007 Climate Change Action Plan targets, a "business as usual" (BAU) emission projection is also forecast. The BAU is an estimate of what Ontario's emissions would have been in the absence of policies introduced since CCAP. The BAU provides a reasonable estimate of what GHG emission levels would have been if the CCAP had not been in place, taking into account actual economic, demographic and activity trends.

42 Mt from BAU in 2020

FIGURE 9 Ontario's Historical and Forecast Emissions, 1990–2030



Source: the 2014 National Inventory Report: 1990-2012 data; MOECC forecast

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[6] The transportation plan is called *The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area* (November 2008 Metrolinx); updates to the plan as of February 2013 were also incorporated http://www.metrolinx.com/thebigmove/en/ .

Table 3 shows the most recent forecast of progress to Ontario's GHG targets. Since the 2012 progress report, Ontario's progress to its greenhouse gas targets has improved. The main reason for these improvements is the 2013 revision of the *Long-Term Energy Plan* and its associated energy demand and clean energy generation forecasts. Furthermore, both the recent historical emission data and current economic forecasts are slightly lower than in 2012. Lower, more conservative economic forecasts tend to translate into lower emissions trends, since lower economic growth generally means lower energy-consuming activity and lower energy use.

TABLE 3 Projected Reductions, Progress and Gaps to Targets

2014 Update	2014	2020
Annual Projected Reductions (Mt)	26	42
Progress to Target	expected to surpass target	69%
Gap (Mt)	expected to surpass target	19

2012 Report	2014	2020
Annual Projected Reductions (Mt)	31	42
Progress to Target	91%	60%
Gap (Mt)	3	28

Initiatives

Ontario has undertaken a wide range of initiatives to reduce greenhouse gas emissions throughout the economy. Examples from specific sectors will be highlighted in the sections following. Many efforts are inter-related (such as the phase-out of coal-fired electricity generation with increases in renewable generation and conservation) or have overlapping impacts (such as federal vehicle efficiency standards with Ontario's ethanol blending requirements for gasoline). Therefore, estimated impacts are grouped by sector. Ontario's climate change initiatives cross all emission sources and economic sectors and represent a combination of short-, medium- and long-term reductions. The initiatives considered for this report include activities that are both within and outside the direct control of the Ontario Government, including federal policies that affect provincial emissions. New initiatives announced after March 2014 have *not* been included in the forecast, such as Ontario's proposal for *Reducing Coal Use in Energy-Intensive Industries*[7] and any new initiatives in *Moving Ontario Forward*,[8] the government's plan to make available nearly $29 billion over the next 10 years for investments in transit, transportation and other critical infrastructure projects across the province.

Table 4 shows the expected impact of initiatives by sector in 2014 and 2020.

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[7] Environmental Bill of Rights Registry Number 012 1559.

[8] *Building Opportunity and Securing Our Future Act (Budget Measures), 2014*, S.O. 2014, c. 7. Note that any projects included in The Big Move and funded out of Moving Ontario Forward are included in the current emissions projections. Many projects that have already been announced in the Greater Golden Horseshoe Growth Plan have also been included in estimates.

TABLE 4 Emission Reductions by Sectoral Initiatives

Sector	Initiative	Projected Reductions (Mt)	
		2014	2020
Transportation	The Big Move regional transportation plan and Greater Golden Horseshoe Growth Plan[9] Passenger vehicle efficiency regulations Freight truck speed limiter regulation Municipal hybrid bus purchase and Green Commercial Vehicle programs[10] Ethanol in Gasoline regulation[11] Greener Diesel regulation[12]	1.9	4.6
Industry	Natural gas utility conservation programs	0.3	0.8
Buildings	Greater Golden Horseshoe Growth Plan Natural gas utility conservation programs Building Code amendments Residential retrofits	0.9	2.3
Electricity	Long-Term Energy Plan: coal phase-out; Feed-In Tariff program; residential, commercial and industrial demand management programs; and related electricity plans	20.5	32.5
Agriculture and Waste	Biogas Financial Assistance Program Landfill Gas Collection and Control regulation[13]	1.5	1.8
	All initiatives	**26.0**	**41.9**

Emission reductions for all initiatives together may differ from the sum of individual initiative reductions due to interaction between them.

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[9] The regional transportation plan is an official long-term plan, produced by Metrolinx. However, capital projects are approved and funded individually as the plan is implemented over 25 years and may be subject to change. Therefore, modelling for this initiative is inherently more uncertain than for other initiatives.

[10] The Green Commercial Vehicle Program ended in 2012.

[11] O. Reg. 535/05 made under the *Environmental Protection Act.*

[12] O. Reg. 97/14 made under the *Environmental Protection Act.*

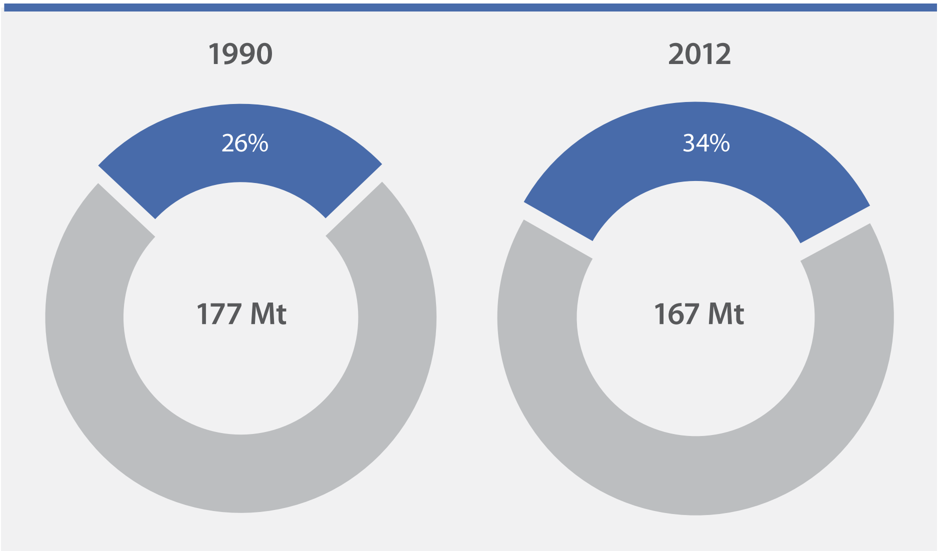
[13] O. Reg. 216/08; O. Reg. 217/08 made under the *Environmental Protection Act.*

SECTION 2

EMISSIONS BY SECTOR

This section provides specific information about GHG emissions by sector, including a description of the main sources, drivers of trends, a sector-specific forecast and sectoral initiatives.

Transportation Sector



Transportation Emissions

1990: 45.5 Mt
2012: 56.6 Mt
% Change: +24%

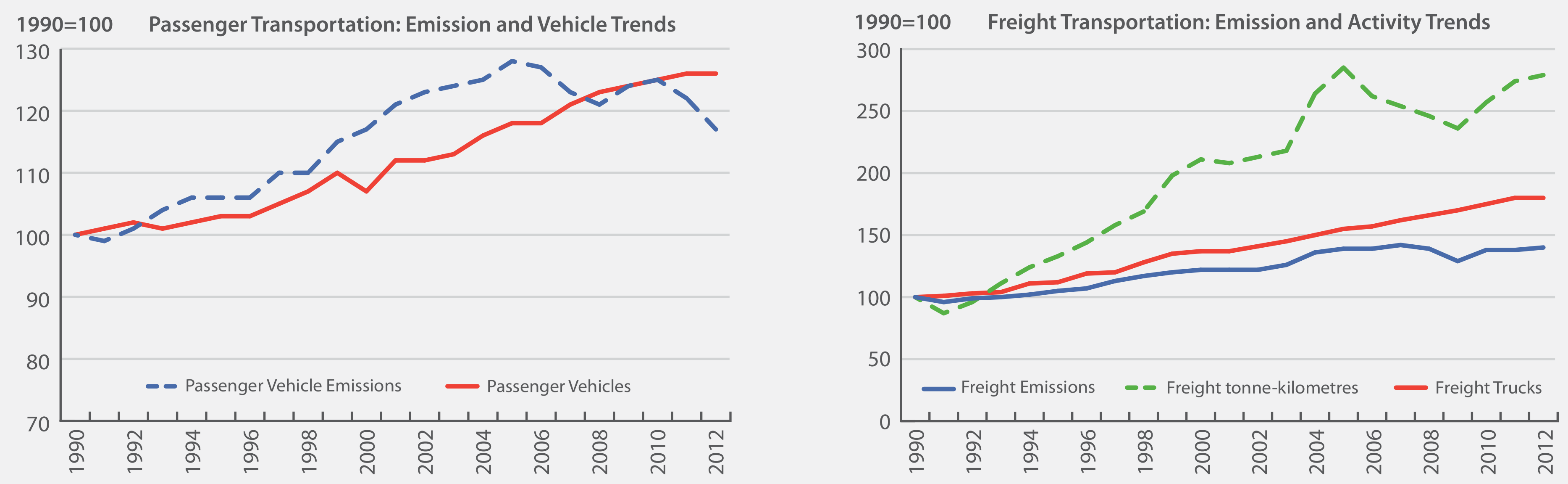
For 2012, the transportation sector represents approximately 34% of Ontario's greenhouse gas emissions. Transportation GHGs are emitted from combustion of fossil fuels in vehicles, mainly gasoline and diesel, and mostly from road travel. The largest sources are passenger cars and light-duty trucks, accounting for over half of the sector's emissions. The remainder come from other modes of transportation such as freight trucking and domestic air, ship and rail travel. International air and marine travel are not included in the Inventory.

It should be noted that while public transit vehicles (i.e., buses, commuter trains, etc.) are sources of emissions, transit use contributes to reducing overall emissions levels by removing car trips from the road.

TRENDS

Emissions in the transportation sector have grown by 24% since 1990; road transportation is responsible for the greatest increase. **Figure 10** shows how historical emission levels have changed from 1990 to 2012 for passenger vehicles and freight transportation compared to changes in the number of vehicles and amount of freight in tonne-kilometres. A tonne-kilometre represents the measure of freight [tonne] carried over the distance of a kilometre. Through the 1990s, emissions increased as travel increased with population and economic activity. Furthermore, specialization and globalization in the economy have increased the distances freight is shipped. Vehicle efficiency improvements, along with other policies, have contributed to these trends flattening in recent years.

FIGURE 10 Historical Trends in Transportation



Source: the 2014 National Inventory Report: 1990–2012 data; *National Energy Use Database (2014)*

IMPACT OF INITIATIVES

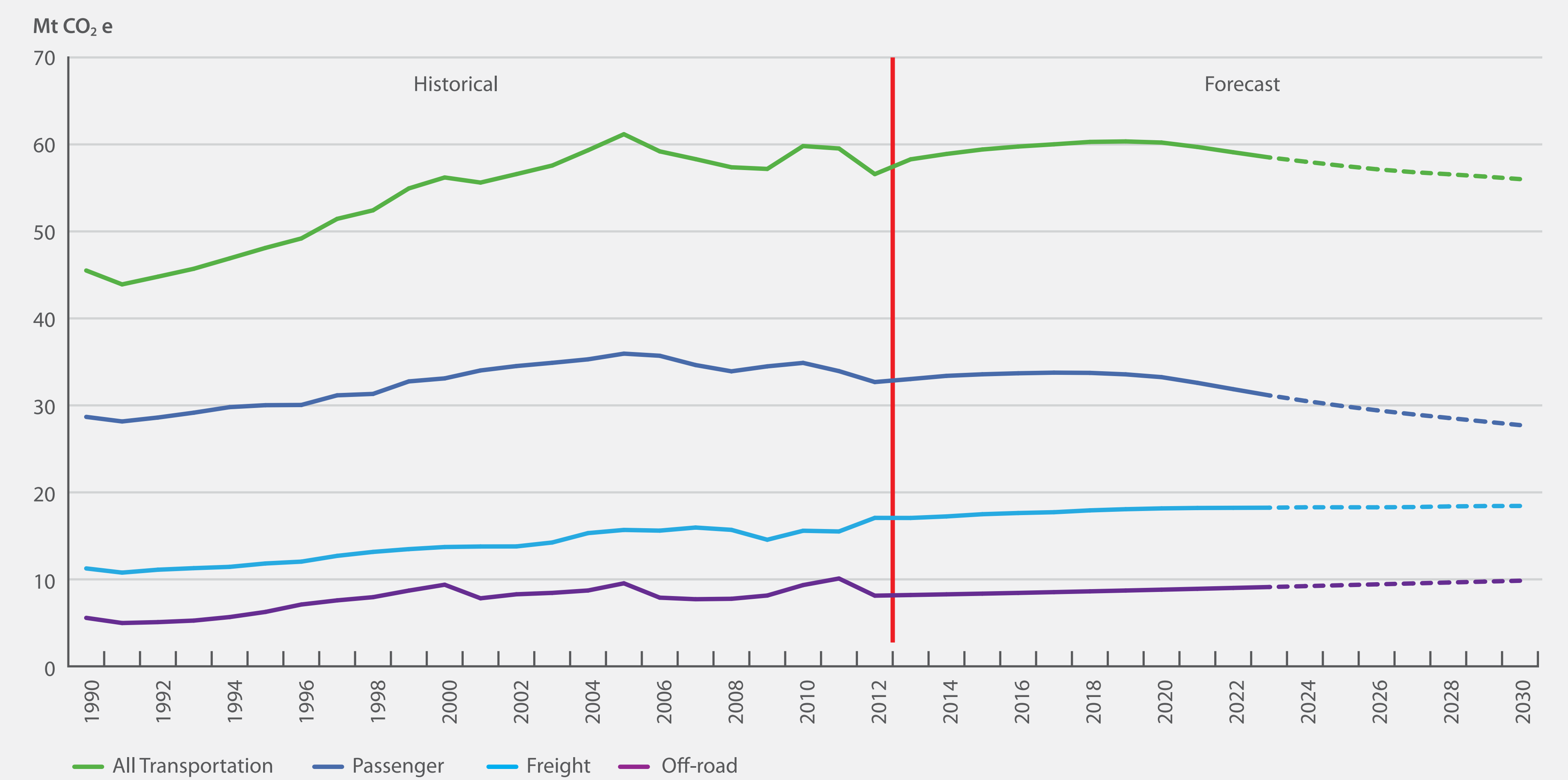
Many policies contribute to more carbon-efficient transportation. Ontario's Ethanol in Gasoline regulation (O. Reg. 535/05) has improved vehicle emission intensities in recent years. The recently introduced Greener Diesel regulation promotes the use of diesel fuels with better environmental performance. Combined with federal fuel efficiency standards, these regulations are expected to continue to improve intensities. Speed limiter requirements for freight trucks also contribute modest reductions.

Investments in public transit; the Provincial Policy Statement, 2014; and Ontario's Growth Plan encourage and promote a shift from individual car trips to car-pooling, land use, densities and mix of uses that minimize length and number of vehicle trips, and encourage the use of transit, walking and cycling — which in turn leads to fewer vehicle kilometres travelled and the associated emissions. For example, in 2012, there was an increase of more than 193 million passenger trips on municipal transit systems, compared to 2003. This has removed approximately 161 million car trips from Ontario roads.

Several major transit projects underway in the Greater Toronto and Hamilton Area (GTHA), Ottawa and Waterloo will come into service by 2020, which are projected to result in overall GHG reductions. As these lines mature and additional transit investments are made, positive impacts will continue beyond 2020.

Figure 11 shows forecast emissions from passenger, freight and off-road transportation out to 2030. The combined impact of transportation initiatives is forecast to be about 4–5 Mt from the business-as-usual projection in 2020. The impacts of current policies do not entirely offset increases that will come from population and economic growth, so near-term emissions are forecast to rise. However, emission growth after 2020 is expected to be tempered by increasing impacts of policies.

FIGURE 11 Historical and Forecast Transportation Emissions

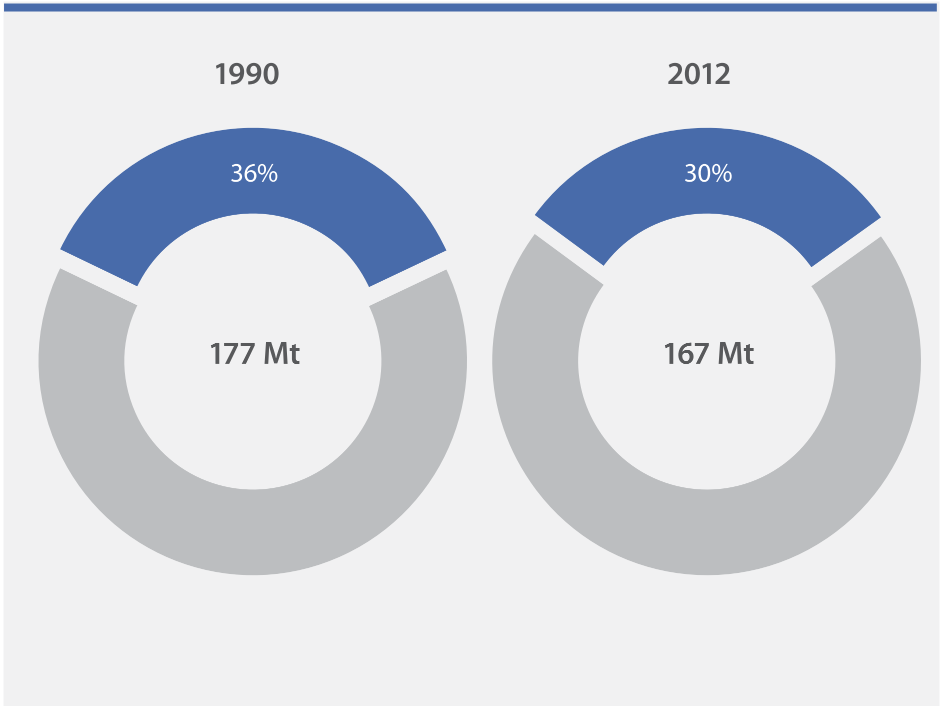


Source: the 2014 National Inventory Report: 1990–2012 data; MOECC forecast

Industrial Sector

In 2012, the industrial sector represents approximately 30% of Ontario's greenhouse gas emissions. Emissions in this sector come from the combustion of fossil fuels, such as natural gas and fuel oil. Some industrial processes themselves emit greenhouse gases. For example, when limestone is transformed into clinker, a precursor to cement, the process releases CO_2. These are called "process emissions."

Large industrial emitters in Ontario are required to report their greenhouse gas emissions.[14] Since small emitters are not required to report, this facility data does not represent the entire industrial sector in Ontario. However, this data is used to corroborate the trends estimated below.



Industrial Emissions

1990: 63.9 Mt
2012: 50.3 Mt
% Change: -21%

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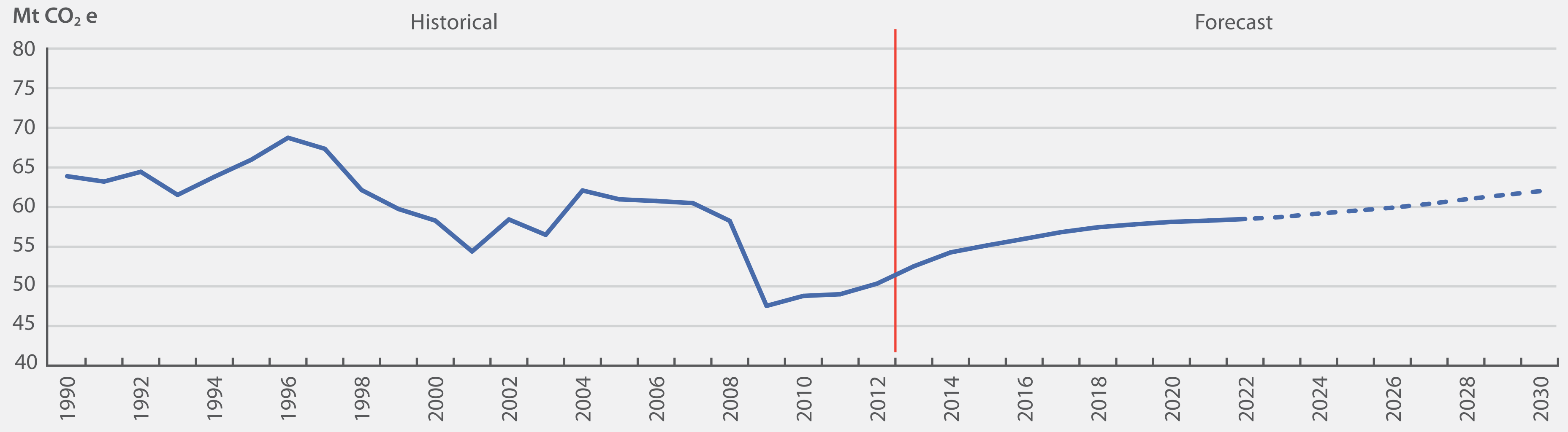
[14] Ontario's industrial emitters' report can be found here: http://www.ontario.ca/environment-and-energy/greenhouse-gas-emissions-reporting-facility.

TRENDS

Ontario's industrial emissions have dropped by 21% since 1990. In some cases, this was due to improvements in energy efficiency. This was also due to shifts in the economy from a predominance of manufacturing to a more diversified economy with a greater share of service industries. The overall improvement does not tell the story of significant variability across industries. For example, pulp and paper production has declined significantly and so too have emissions. Ontario's only adipic acid production plant reduced its emissions when it installed a catalytic emission abatement system in 1997. In 2009 this plant was indefinitely idled.

Figure 12 shows historical emissions from 1990–2012 and forecast emissions to 2030. Emissions decreased 10 Mt (17%) over the 2007–2012 period. This sharp drop was due to the recession; since then, emissions have been increasing. As the economy grows, it will be important to take the opportunity to find ways to level or decrease emission trends.

FIGURE 12 Industrial Emission Trend



Source: the 2014 National Inventory Report: 1990–2012 data; MOECC forecast

In the industrial sector, most emissions are generated by the manufacturing subsector (see Section 3: Methodology for more detail). In 2012, the emission intensity of manufacturing industries, calculated as emissions per dollar of manufacturing GDP, was 34% lower than in 1990.

IMPACT OF INITIATIVES

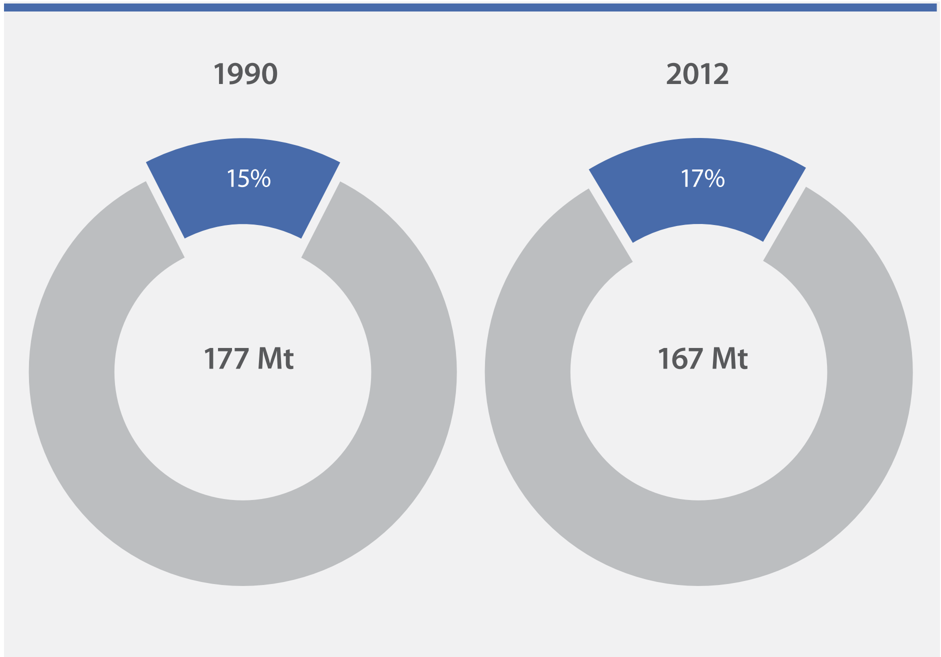
By 2020, total industrial emissions are projected to increase by 15% from the 2012 level, both combustion and process emissions. The carbon intensity of those emissions, measured as emissions per dollar of manufacturing GDP, is projected to decrease. This expected future decrease will likely be consistent with an existing decreasing trend (see **Figure 6**, p. 10).

Natural gas demand-side management programs are expected to reduce approximately 1 Mt of GHGs annually by 2020, compared to business as usual.

Looking ahead to 2020 and beyond, we will look to continue to work with industry towards the goals of clean-tech innovation and high resource productivity. Ideally, highly resource-efficient industries would increase profits and maintain a competitive edge in the global marketplace while reducing greenhouse gas emissions.

Buildings Sector

In 2012, the buildings sector represents approximately 17% of Ontario's greenhouse gas emissions. This sector includes emissions related to fossil fuel combustion — primarily natural gas — for space heating, water heating and other direct emission sources in residential, commercial and institutional buildings. While buildings also use a significant amount of electricity for lighting, air conditioning and appliances, these are considered *indirect emissions* resulting from electricity use and are included in electricity sector emissions.



Buildings Emissions

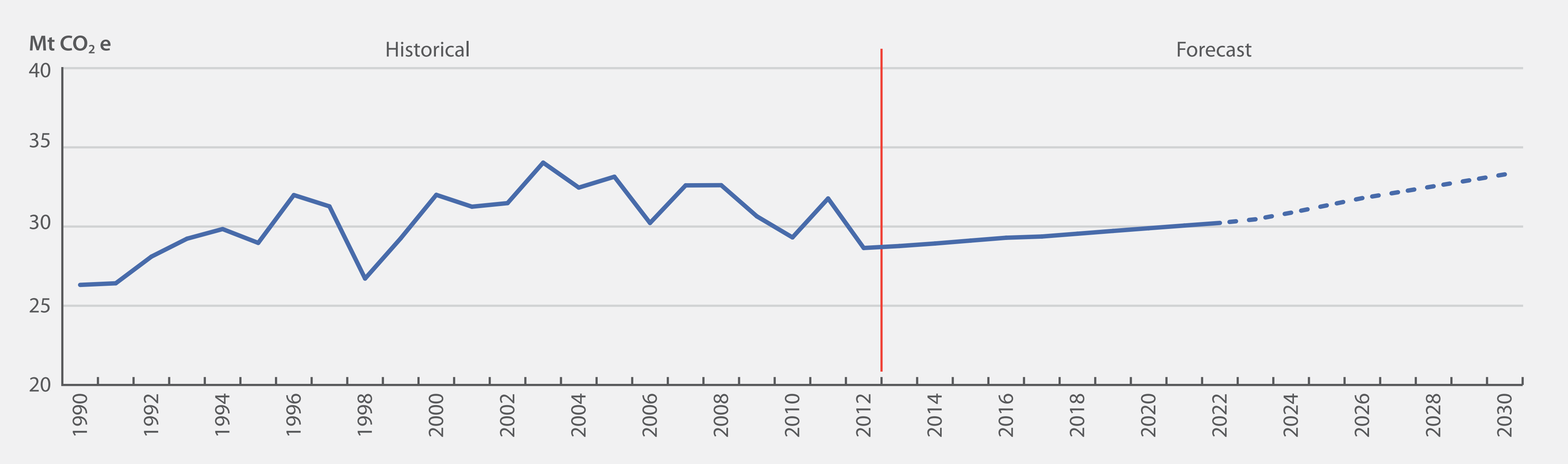
1990: 26.3 Mt
2012: 28.7 Mt
% Change: +9%

TRENDS

In Ontario, emissions in the buildings sector have grown steadily since 1990 along with population and the economy. These trends are expected to continue.

Figure 13 shows historical emissions from 1990–2012 and an emission forecast out to 2030. Annual fluctuations in historical emissions can be attributed to changes in heating demand due to weather and changes in activity in the commercial sector. Building emission intensity improved by about 32% from 1990–2012. This was due to improvements in both the residential (37%) and the commercial/institutional (21%) segments of the sector.

FIGURE 13 Buildings Sector Emission Trend



Source: the 2014 National Inventory Report: 1990–2012 data; MOECC forecast

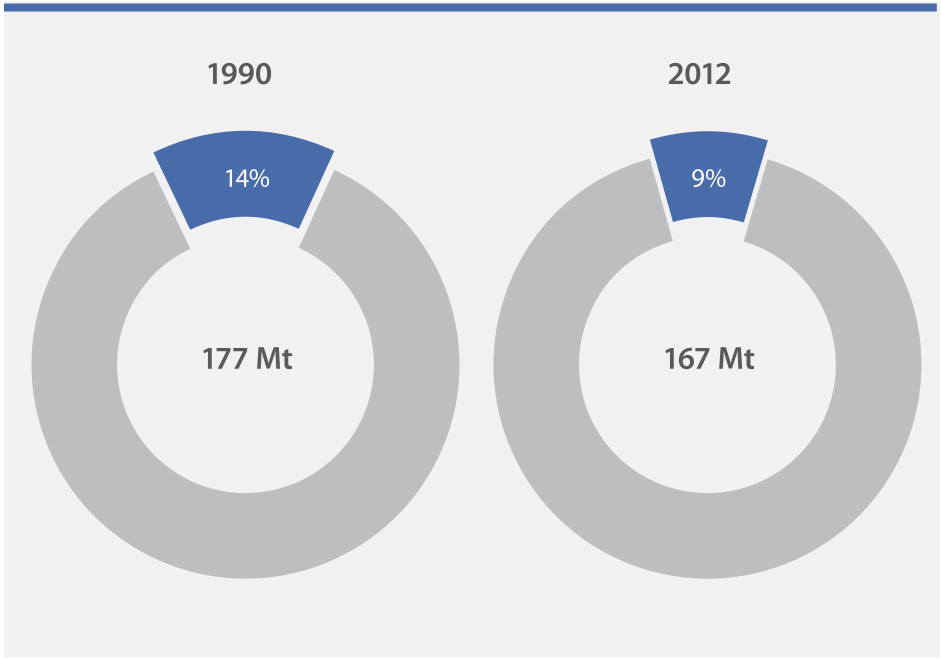
IMPACT OF INITIATIVES

Recent changes to the Ontario Building Code mandate more efficient new buildings. For building stock already constructed, property owners have added insulation, sealed cracks, upgraded windows and have taken advantage of incentives from utilities and government. New furnace standards require higher efficiency appliances. As a result of these and other initiatives, the energy use per square metre in Ontario has decreased by more than 30% (see **Figure 6**, p. 10). The Provincial Policy Statement, 2014 promotes compact land use and development forms that will contribute to the reduction of greenhouse gas emissions from the building sector and the built environment. The expected combined impact of all of the activities described here will be about 2–3 Mt from the business-as-usual projection in 2020.

However, these improvements are not expected to completely counteract emission growth in building space overall — emissions are projected to rise in the coming years.

Electricity Utilities

In 2012, the electricity sector emitted approximately 9% of Ontario's greenhouse gases. Greenhouse gases are emitted from electric generation burning fossil fuels — natural gas or coal in the province. Note that Ontario fully eliminated coal as a source of electricity generation in April 2014. Emissions from the sector are driven by the demand for electricity and the carbon intensity of the generation source.



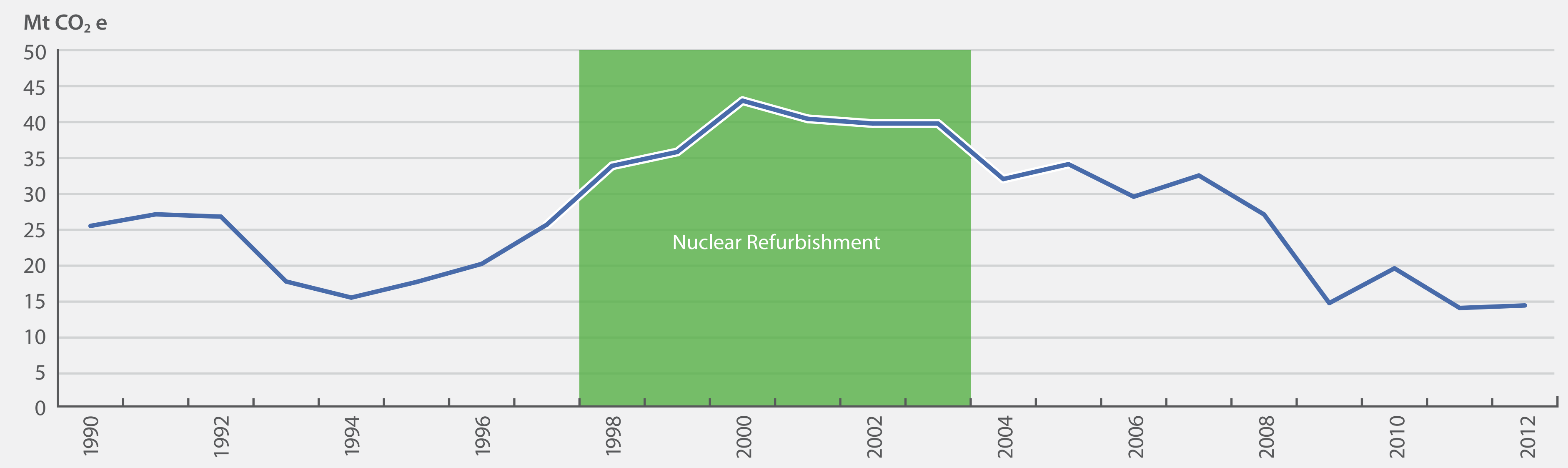
Electricity Emissions

1990: 25.5 Mt
2012: 14.5 Mt
% Change: -43%

TRENDS

There was a sharp increase in Ontario's electricity emissions from the early 1990s to 2000, when coal-fired power plants represented a larger portion of energy generation. Emissions peaked in 2000 at around 70% above 1990 levels and have been decreasing ever since (see **Figure 14**).

FIGURE 14 Electricity Generation Historical Emissions, 1990–2012



Source: the 2014 National Inventory Report: 1990–2012 data

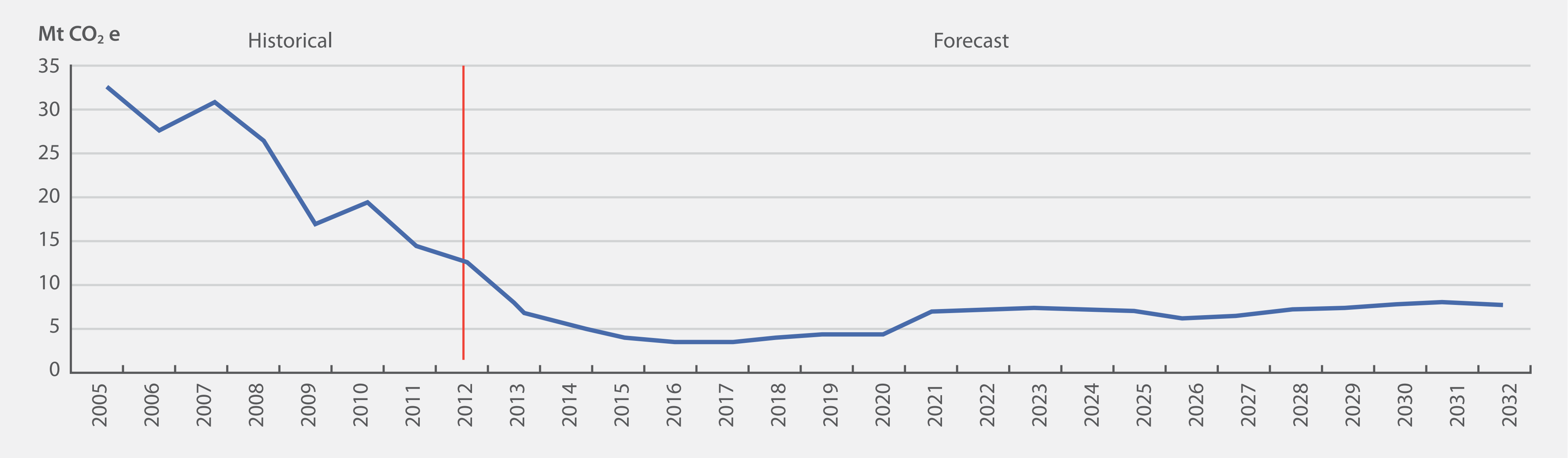
Since 2007, electricity emissions have decreased due to the phase-out of coal-fired electricity (see above). Emissions in 2012 were about the same as in 2011. Phasing out coal-fired electricity has improved the intensity of electricity in Ontario. Combined with demand management, this reduces the use of fossil fuels by electricity utilities.

IMPACT OF INITIATIVES

Phasing out coal-fired electricity generation is the single largest climate change initiative in North America to date and with associated electricity policies is projected to reduce Ontario's emissions by 32.5 Mt in 2020 from business-as-usual (see **Figure 15**).

32.5 Mt from BAU in 2020

FIGURE 15 Electricity Sector Greenhouse Gas Emission Forecast



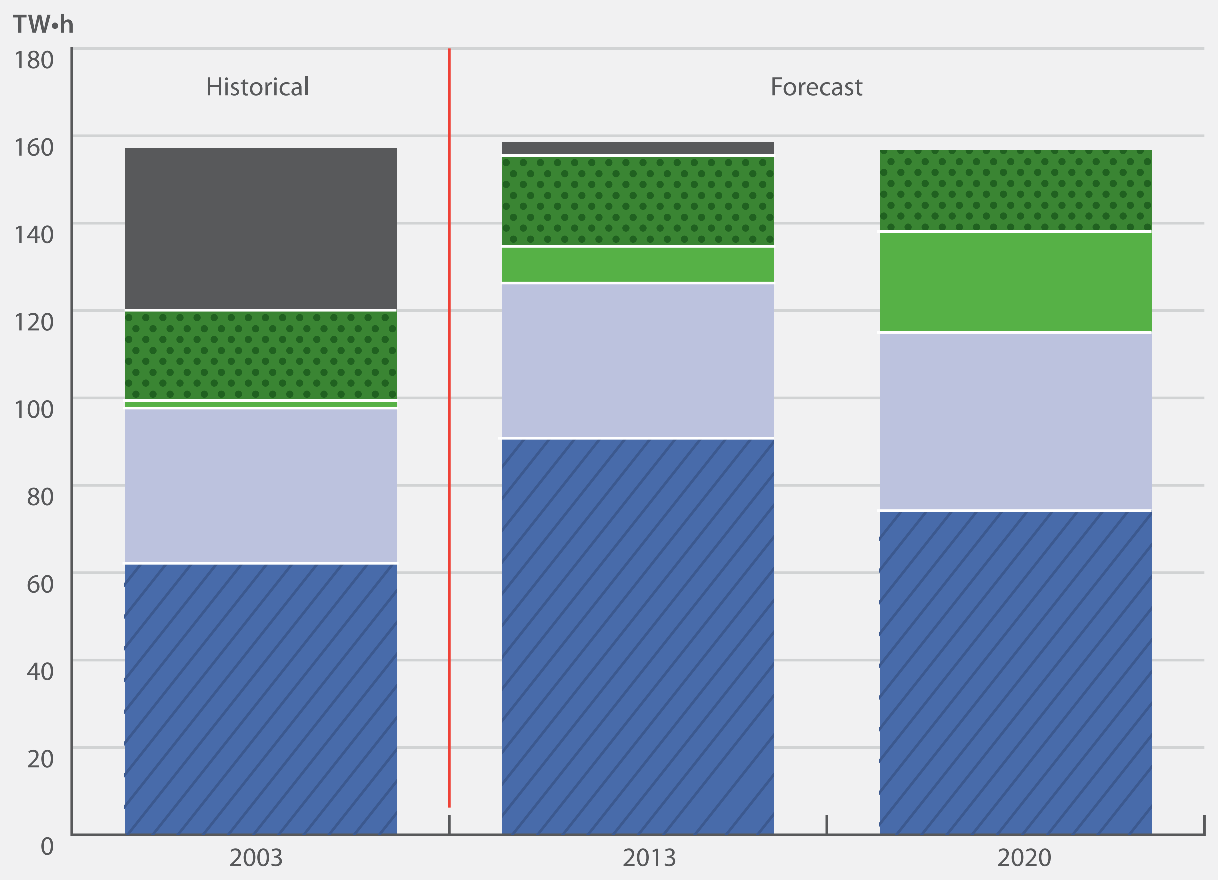
Source: Achieving Balance: Ontario's Long-Term Energy Plan *data (2013)*

Between 2010 and 2014, the Ontario Government reduced the use of coal in power plants, closing or converting all generating units at these plants. *The Green Energy and Green Economy Act*, 2009 and the 2013 *Long-Term Energy Plan* have replaced coal with hydroelectric power, nuclear power, renewable electricity generation, demand management and conservation (see **Figure 16**). In the near term, the power grid will also rely on natural gas generation, so emissions from this sector many increase, especially during the refurbishment of some nuclear plants.

We also note that Ontario's reductions in the carbon intensity of electricity generation means households, businesses and industries have a smaller carbon footprint. This change also provides opportunities for electricity to be a low-carbon alternative to other, more carbon-intense energy sources. For example, the carbon footprint of the operation of an electric vehicle in Ontario is substantially lower not only than that of a gasoline vehicle but also of an electric vehicle used in a jurisdiction dependent on coal-fired electricity.

In the future, we will continue to look to further develop Ontario's clean energy sources and new technologies, as well as promote energy and resource efficiency and conservation across government, and among businesses and individuals.

FIGURE 16 Ontario's Electricity Production by Source

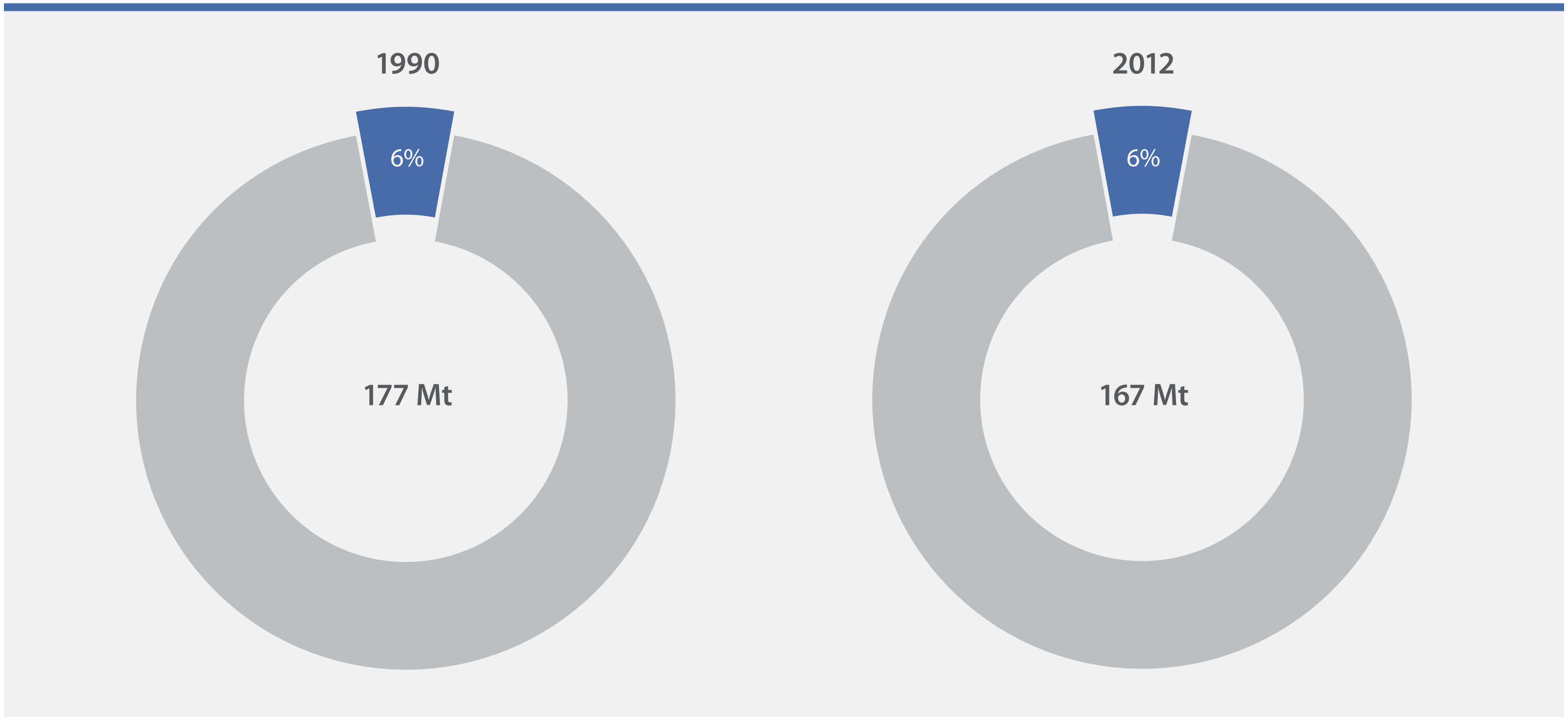


Sources: Ontario's Long-Term Energy Plan: Building Our Clean Energy Future *(2010)*; Achieving Balance: Ontario's Long-Term Energy Plan *data (2013)*

Agriculture Sector

Agriculture has numerous roles with respect to greenhouse gas emissions and the carbon cycle. Many agricultural activities are sources of GHG emissions, while others *remove* carbon from the atmosphere and store it in soils. According to the UN accounting conventions, emissions and removals of GHGs from agricultural lands are part of the Land Use, Land Use Change and Forestry (LULUCF) sector, which are estimated but *not* included in Inventory totals. Ontario does not include LULUCF emissions and removals in this report. Emissions from fossil fuels used in agricultural equipment like combines and tractors are included in the transportation sector, while emissions from fuels used to heat greenhouses are included in the industrial sector.

For the purposes of this report, emissions from the agriculture sector are restricted to livestock and crop production. A more detailed description of the sources can be found in the Inventory.



Agriculture Emissions

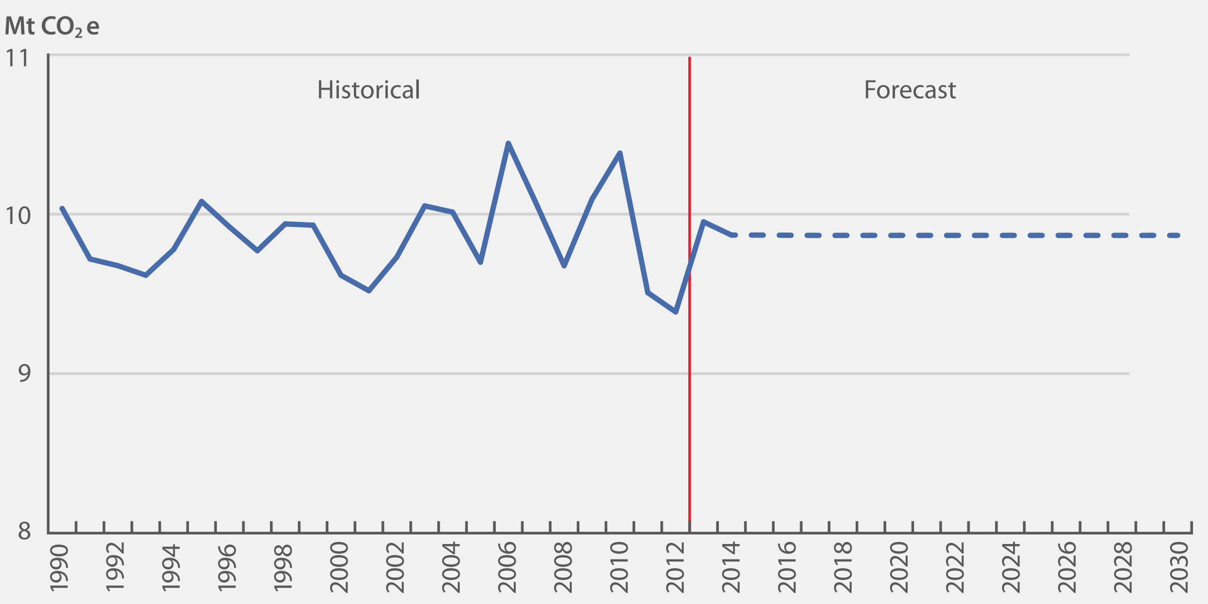
1990: 10.0 Mt
2012: 9.4 Mt
% Change: -6.5%

TRENDS

In 2012, the agricultural sector was responsible for 9.4 Mt (6%) of total GHG emissions in Ontario (6.5% below 1990 levels). Most of the agricultural emissions accounted for in this sector are from the application of nitrogen-based fertilizers and manure to agricultural soils (55%), followed by methane from the digestive processes of livestock (enteric fermentation (29%)) and manure management (16%).

The agriculture sector emissions have remained fairly constant since 1990 (see **Figure 17**).

FIGURE 17 Agriculture Forecast Emissions to 2030



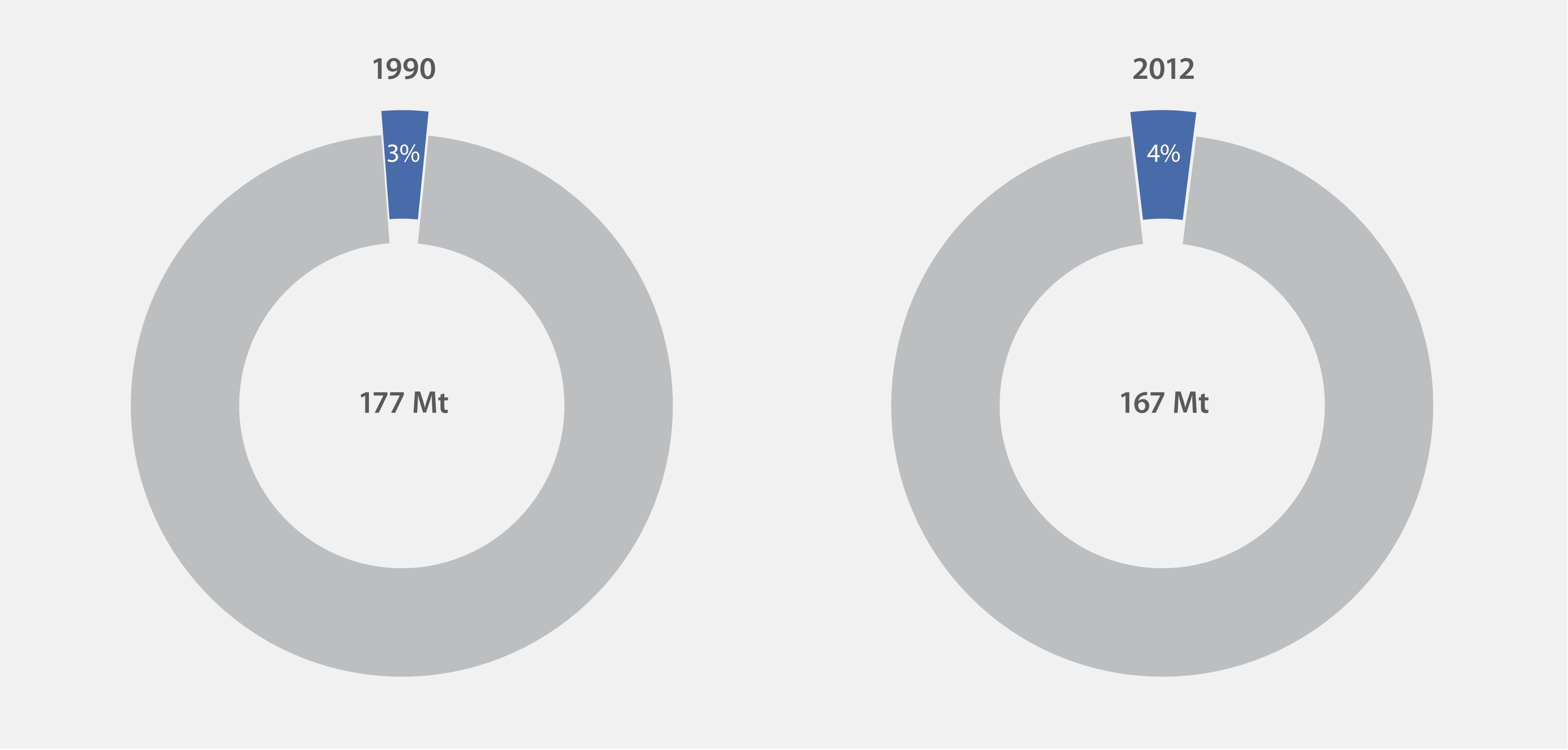
Source: the 2014 National Inventory Report: 1990–2012 data; MOECC forecast

While the direct emissions from agriculture in Ontario are relatively small, the sector plays a critical role in the carbon cycle and the production of biofuels, which can displace fossil fuels in other sectors. On-farm biogas facilities (which were funded under the Ontario Biogas Systems Financial Assistance Program) are expected to achieve a reduction of 11 kilotonnes in 2020. Tillage practices can have an impact on emissions from agricultural soil; however, most of this impact is accounted for in the cropland category of the LULUCF sector and is not included in Ontario's inventory or forecast at this time.

Waste Sector

Emissions from Ontario's waste sector are primarily methane from the disposal of solid waste on land and, to a lesser extent, emissions from wastewater handling and waste incineration. Methane is generated from the decomposition of organic material over time in a landfill. The rate of methane generated depends on the amount and nature of the waste disposed and the conditions of the landfill.

Emissions from landfills are determined using a simulation model to account for the slow, long-term generation and release of these emissions.



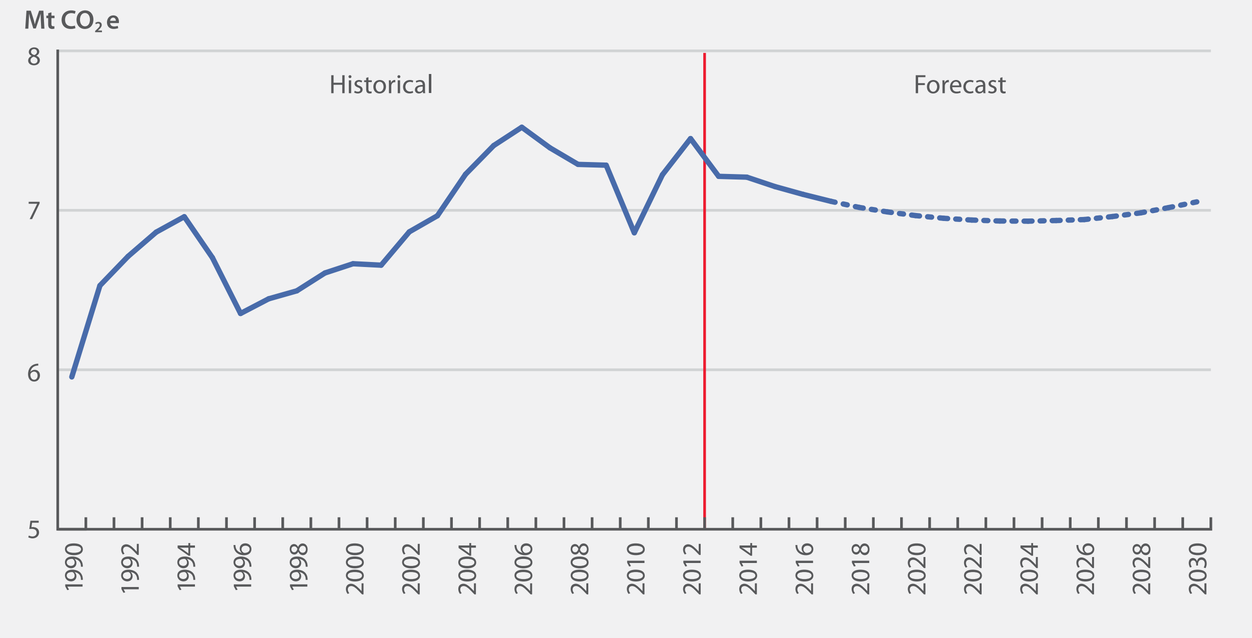
Waste Emissions

1990: 5.9 Mt
2012: 7.5 Mt
% Change: +25%

TRENDS

In 2012, the waste sector in Ontario was responsible for 7.5 Mt (4%) of the total GHG emissions in Ontario. Most of these (92%) came from methane emitted by public and private landfills. **Figure 18** shows the emission trend and forecast for the waste sector. From 1990–2012, emissions grew by 25% as waste disposal on land increased. There are initiatives underway to reverse this trend that could be expanded; for example, by diverting organic matter from landfill and capturing or destroying the methane generated. Methane from landfill gas can also be used to generate electricity or heat.

FIGURE 18 Waste Forecast Emissions to 2030



Source: the 2014 National Inventory Report: 1990–2012 data; MOECC forecast

IMPACT OF INITIATIVES

Waste emissions are expected to remain relatively stable in coming years. Ontario has implemented regulations[15] requiring large landfills to capture and destroy methane generated. To date, 31 landfills are capturing landfill gas and these systems are expected to reduce emissions by 1.8 Mt in 2020.

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[15] O. Reg. 216/08; O. Reg. 217/08. Made under the *Environmental Protection Act.*

SECTION 3

METHODOLOGY

How Ontario estimates GHG emissions

Ontario's approach reflects Canada's *National Inventory Report 1990–2012*. Each year, Environment Canada submits an updated Inventory to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat.[16]

Historical emissions in Ontario's report are taken from the latest Inventory, which covers the period 1990–2012. As discussed in the introduction (see p. 5), the data cover most activities in Ontario's economy that influence GHGs but do *not* include impacts relating to land use, land-use change, and forestry at this time.

The Inventory uses numerous categories defined by UNFCCC reporting protocols. It is important to be aware that these often do not match categories used by many sources of economic, industrial and environmental data. For Ontario's report, the categories are rolled up into six key sectors (see **Table 1** on p. 4).

It should also be noted that international air and marine transport are currently not included in national inventories. In this report, the pipeline transportation of petroleum products is included in the industry sector. In addition to pipelines, the main non-manufacturing subsectors included in industry are mining, construction, energy emissions from agriculture and forestry. Emissions from manufacturing comprise more than two thirds of the industry sector, which is why its intensity is calculated using manufacturing GDP.

Improvements in the *National Inventory Report*

Environment Canada continually works to refine the data and methods used to estimate national and provincial emissions. These refinements lead to recalculations or re-statements of emission estimates for the whole time period of the Inventory (dating back to 1990). This means that provincial 1990 base year emissions and historical trends can change with each release of the Inventory — which consequently influences Ontario's emission forecasts and assessment of progress. These recalculations and improvements are documented in each Inventory Report. The improvements made to the inventory since the 2013 report have not significantly changed Ontario's overall emissions or their general breakdown.

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[16] Canada's submission can be found here: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php.

Emission modelling overview

Ontario's emission forecast has been updated to reflect new Inventory data, macroeconomic forecasts,[17] demographic forecasts,[18] 1–2 more years of program compliance data and the latest Long-Term Energy Plan.[19] This forecast takes into consideration provincial and federal policies up to March 2014 whose impacts on emissions are expected to be significant and can be estimated with reasonable confidence, as well as Ontario's regional transportation plan for the Greater Toronto and Hamilton Area.[20]

Reporting on the progress of Climate Change Action Plan initiatives and projecting future emissions are essential to understanding Ontario's progress towards meeting its targets. Ontario's model is updated periodically to incorporate the latest data available and refinements based on best practices. In addition, the projections of emission reductions are adjusted as required to incorporate data collection and changes to programs or policies.

This information was used to create:

- A *Business-as-Usual* (BAU) projection (assumes underlying historical emission trends continue without impact from reduction initiatives while taking account of the current economic and demographic outlook for Ontario)
- A *Climate Change Action Plan* (CCAP) projection (includes the anticipated future impact of emission reduction initiatives)

Uncertainty

The emission forecasts estimated in this report are based on a single set of economic, demographic, energy, and policy assumptions (except for the absence of policies in the BAU case). As with any modelling of this kind, there are significant uncertainties inherent in this projection.

Projections used to forecast Ontario's emissions usually start with historical emissions. Historical data from the Inventory are estimates of emissions of each greenhouse gas in each sector in each year. They are subject to a range of uncertainties.[21] Generally, uncertainties associated with time series trends and aggregated totals are much lower than those associated with individual gases, sectors, years and provinces. Unfortunately, the Inventory only analyses uncertainties in the national inventory; no assessment is made of uncertainties in provincial breakdowns. At the national level, total emissions from the Inventory's "Energy" category had the least uncertainty, followed (in increasing levels of uncertainty) by "Industrial Process Emissions," "Solvent and Other Product Use," "Waste" and ending with "Agriculture" with the highest levels of uncertainty.

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[17] Consistent with Ministry of Finance's projections in Ontario's *Long-Term Report on the Economy* (April 2014).

[18] Consistent with Ministry of Finance's projections in Ontario's *Long-Term Report on the Economy* (April 2014).

[19] Ministry of Energy, *Achieving Balance: Ontario's Long-Term Energy Plan* (November 2013).

[20] Metrolinx, *The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area* (November 2008); updates to the plan as of February 2013 were also incorporated http://www.metrolinx.com/thebigmove/en/. Note that, although the regional transportation plan is an official long-term plan, capital projects are approved and funded individually as the plan is implemented over 25 years and may be subject to change. Therefore, modelling for this initiative is inherently more uncertain than for other initiatives.

[21] For a more detailed analysis of estimate uncertainty, see Annex 7 of the *National Inventory Report 1990–2012* (2014).

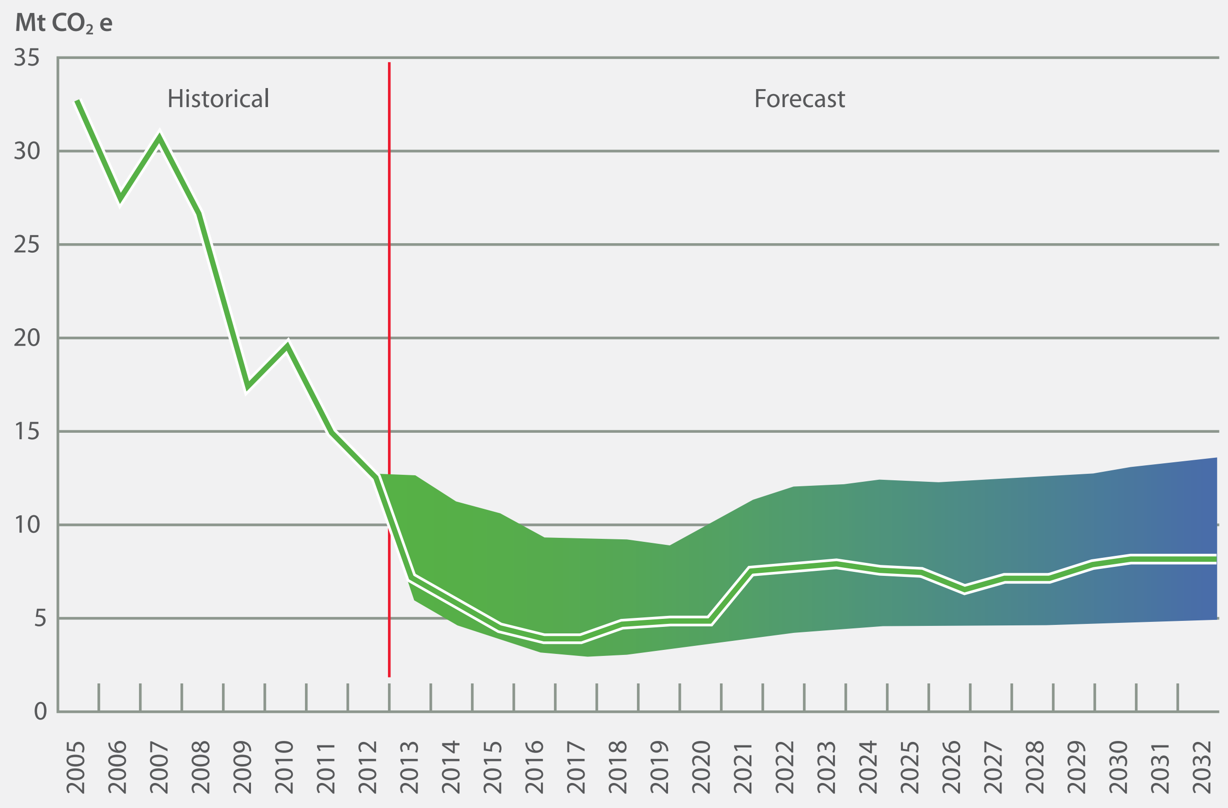
Although the uncertainty in Ontario's forecast is not quantified, the following points can be made about the forecast:

- Trends over time should be less uncertain than individual years
- Policy case emissions should be less uncertain than BAU
- Total aggregate emissions should be less uncertain than sectoral emissions
- Nearer-term (pre-2020) emissions should be less uncertain than later (post-2020) emissions

As a rough example of the model's sensitivity, if in 2020 both real GDP and population were 1% higher than forecast, the projected non-electricity emissions would be almost 1 Mt greater (about 0.5% of non-electricity emissions). This change is a generalized effect — the increase could be significantly higher or lower depending, for example, on whether energy-intensive manufacturing's output is higher than that of the service sector.

On the electricity side, the 2013 *Long-Term Energy Plan* contains a reasonable range for the projected sector emissions (see **Figure 19**). Electricity emissions are sensitive to weather — more frequent hot summer afternoons, especially combined with higher GDP, would increase emissions much further.

FIGURE 19 Range of Electricity Sector GHG Emissions



Source: Long-Term Energy Plan (2013) data

Third-party validation

To provide confidence in the province's forecasts, Ontario has periodically had its emission forecasting methodology and assumptions validated by independent third parties. Starting in 2009, Ontario was the first jurisdiction to undertake a validation of its forward-looking emission reduction forecasts. Validation ensures these are reasonable and align with best practices where available. For Ontario's 2012 climate change report, Ontario retained Navius Research Inc., who concluded the estimates were a fair representation of greenhouse gas forecasts using current best practices in GHG emission forecasting and evaluation of GHG mitigation programs.[22] Since no significant methodological changes were incorporated into the model since Navius's conclusion, the current report has not been validated. Ontario expects that its next report will contain new initiatives and possibly changes to methodologies.

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[22] Ontario, *Climate Vision: Climate Change Progress Report* (2012), Appendix C.

Ontario

Learn more about Ontario's efforts to address climate change by visiting:

Ontario.ca/climatechange

Feeling the Heat:

Greenhouse Gas Progress Report 2015

Environmental
Commissioner
of Ontario

July 2015

The Honourable Dave Levac
Speaker of the Legislative Assembly of Ontario

Room 180, Legislative Building
Legislative Assembly
Province of Ontario
Queen’s Park

Dear Speaker:

In accordance with Section 58.2 of the *Environmental Bill of Rights, 1993*, I am pleased to present the Annual Greenhouse Gas Progress Report 2015 of the Environmental Commissioner of Ontario for your submission to the Legislative Assembly of Ontario. This Annual Report is my independent review of the Ontario government’s progress in reducing greenhouse gas emissions for 2014-2015.

Sincerely,

Ellen Schwartzel
Environmental Commissioner of Ontario (Acting)

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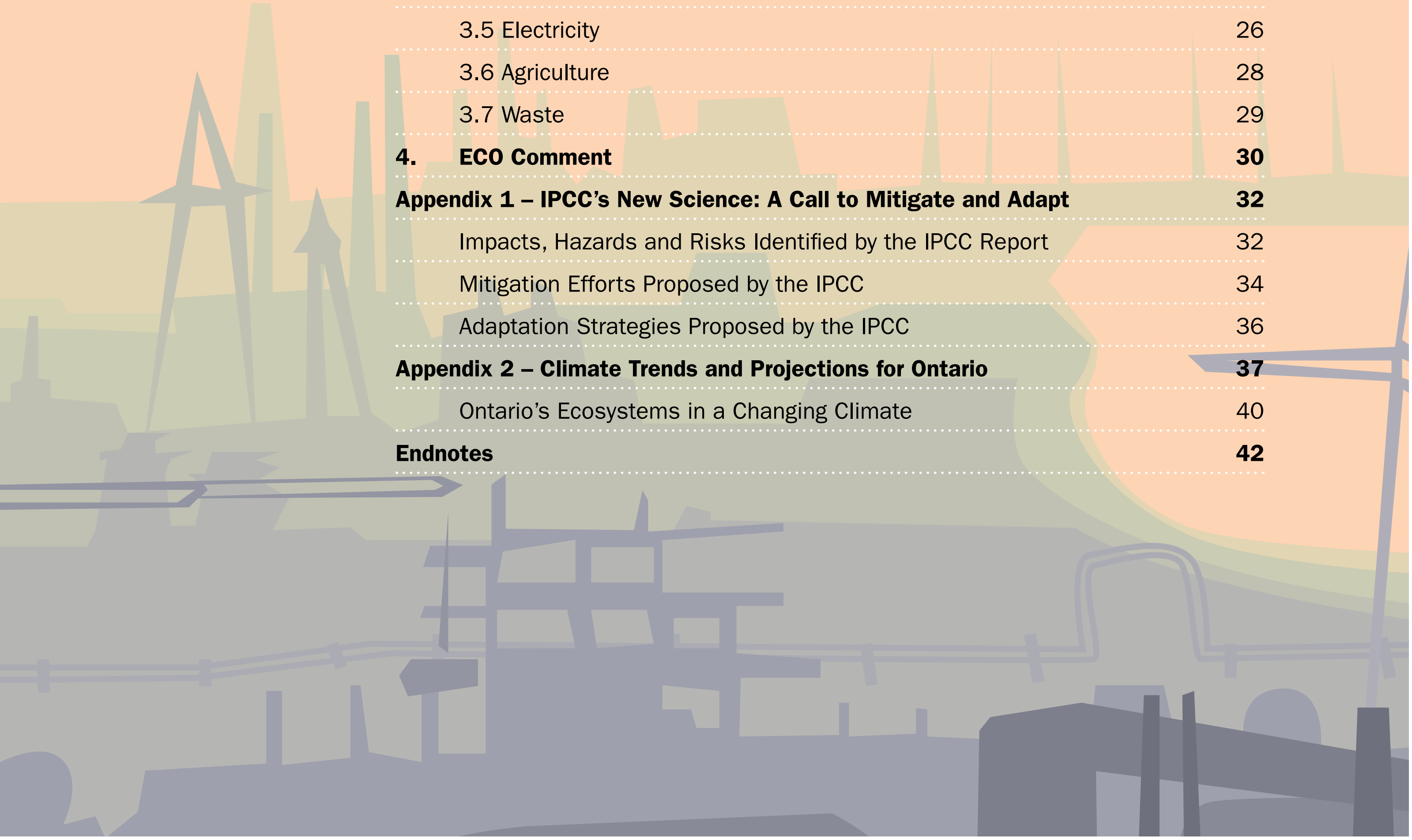


June
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1.

Introduction: Ontario's Changing Climate

1.1 Rebooting the Climate Change File

Ontario's climate is changing – both environmentally and in its policy mindset. In recent years, Ontario has struggled to make much progress on reducing greenhouse gas (GHG) emissions outside of the electricity sector. However, this seems poised to change as the government has recently unveiled several measures that suggest 2015 will be a key year for climate policy in Ontario.

Over the past year, Ontario has declared its commitment to major action on climate change. In June 2014, the government added "Climate Change" to the name of the Ministry of the Environment. In September 2014, the newly re-elected Premier issued a mandate letter to the Minister of the Environment and Climate Change that included clear instructions to update Ontario's climate change strategy, engage the public, and integrate climate change considerations into government decision-making processes.[1]

The government established a Climate Change Directorate in late 2014, housed within the Ministry of the Environment and Climate Change (MOECC), to co-ordinate, report on and drive climate action across all provincial ministries.[2] Ontario has also deepened its relationships with other provinces such as Alberta, British Columbia and especially Quebec, aiming to work together on climate and energy issues through bilateral action, as well as in other inter-provincial fora. In November 2014, Ontario signed a Memorandum of Understanding with Quebec on climate change that outlines key areas for future co-operation, including carbon pricing and regulatory alignment on emissions reporting. In March 2015 the government announced the appointment of a special advisor and an external advisory council on climate change. On April 13, 2015, the government announced that it will create a cap-and-trade system to achieve emissions reductions across sectors.[3]

Drivers for Action

The push for Ontario's reboot on climate change has been growing steadily for years, with pressure coming from stakeholders, increasingly evolved climate science, more evidence of climate change impacts, and increasing international climate action. Municipalities, corporations and conservation authorities have been clamouring for greater provincial leadership, policy guidance and support (including financial support) to address climate change issues.

Over the past year, climate change has gained considerable attention at the highest political levels in the world's largest economies, providing further motivation for Ontario to act. The U.S. will be targeting emissions reductions in its highest emitting sector, electricity,[4] as well as methane emissions from oil and gas production.[5] The U.S. and China also announced a historic joint commitment to strengthen bilateral co-ordination on climate change.[6] Carbon pricing continues to spread across the globe; according to the World Bank, as of May 2014, there was some form of carbon price in over 40 countries and in 20 sub-national jurisdictions, covering 12 per cent of global GHG emissions.[7]

Despite little progress at past United Nations Framework Convention on Climate Change Conferences of the Parties, December 2015's session in Paris, France seems poised for a potential agreement. In anticipation, many jurisdictions are gearing up for Paris by introducing new climate change policies and plans – including Ontario.[8] Recently, Ontario and other sub-national governments have been playing a more prominent role in international climate diplomacy. The Compact of States and Regions, first announced at the September 2014 Climate Summit in New York City, with further signatories added at the Conference of the Parties in December 2014, looks to be a promising initiative to drive climate action at the state and regional government level.

An even bigger impetus for a reboot, however, is the growing recognition of the rapidly changing climate and the high costs of inaction. Thousands of scientific reports and peer-reviewed articles have established that the Earth's climate is changing. In Chapter 1 of the ECO's 2014 GHG Report, the ECO described the conclusions of Working Group I for the *Fifth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC); specifically, the IPCC concluded – with 95 per cent confidence – that human activities have been the dominant cause of climate warming since the 1950s. The IPCC findings, along with other reports, highlight how global average temperatures have increased and are expected to continue to rise, as well as the observed and expected intensification of extreme weather events such as heat waves and storms. It has become harder and harder to ignore the potential looming costs – economic, environmental and social – of climate change for Ontario.

In 2014 the IPCC released the remainder of its findings for the *Fifth Assessment Report*, culminating in a *Synthesis Report*. Among many other conclusions, that report calls for additional mitigation actions by all levels of government to decrease the likelihood of the many serious risks that the IPCC identifies from increased warming. The IPCC's *Synthesis Report* further highlights the need for adaptation measures to those climate change impacts that are unavoidable based on emissions already in the atmosphere (see **Appendix 1** for a more detailed summary of this report).

As the IPCC continues to publish increasingly stark, authoritative climate science reports, much of the world has moved beyond the old debates about whether and why climate change is happening. In keeping with this trend, the Ontario Legislature unanimously passed a motion on March 12, 2015, recognizing that climate change science and the serious threats it represents for Ontarians are now also beyond debate in Ontario politics.

The ECO has moved on as well; rather than expend pages in the introduction of our report making the case that climate change is occurring in Ontario, **Appendix 2** provides an overview of climate trends and projections for Ontario.

1.2 The Economic and Social Impacts of Climate Change

Climate change is not only altering our weather patterns and environment, it has also already begun to affect Ontario's economy and communities. Although the changing climate brings mixed positive and negative effects, it is predicted that the increasing economic costs related to damage to both public and private infrastructure and other property will be fiscally unsustainable for government.[9] Costs to the government associated with inaction also include potential negligence lawsuits, further discussed in the box on page 7. These costs of climate change impacts justify the upfront capital costs that are needed by the public and private sectors to adapt to the changing climate and more extreme weather events.[10]

At the same time, the long-standing belief that economic growth necessitates a certain degree of increasing GHG emissions has been debunked. As Ontario's *Climate Change Update 2014* indicates, economic growth in Ontario can break from this historic trend of emissions growth.[11] A low-carbon economy presents important economic opportunities for the province.

Economic Impacts to Industry

Many sectors of the Ontario economy will be challenged by a changing climate. Resource-based industries will be especially hard-hit. Although a warmer climate potentially brings a longer growing season, a 2014 Natural Resources Canada (NRCAN) study explains that Ontario agriculture could be at greater risk from drought, pests, disease and climate variability.[12] The costs to the province could be enormous; between 2000 and 2004 alone, droughts in Ontario resulted in crop insurance payouts of $600 million, and according to the National Round Table on the Environment and the Economy (NRTEE) in 2010, this figure will only rise.[13]

Climate change has already had variable effects on Ontario's tourism industry. For example, NRCAN's 2014 study highlights how recent warm winters have had negative impacts on the ski industry, while warm weather activities, such as golf, may benefit from an extended summer season.[14] This same report discusses how many other sectors of the economy will be affected by climate change; for example, the manufacturing sector may be negatively affected as a result of extreme weather damaging infrastructure and interrupting supply chains, as well as higher temperatures and humidity affecting employee health and productivity.[15]

Even where increases in annual average precipitation are projected, increased evaporation and evapotranspiration due to higher temperatures may lead to overall lower water levels.[16] Lower water levels could negatively affect important transportation networks, such as the Great Lakes-St. Lawrence Seaway. Shallower navigation channels, docks and harbours reduce the amount of cargo that ships can carry and may require more trips; as a result, shipping costs could increase.[17] According to the NRTEE, lower water levels in lakes and rivers will also reduce the potential for hydro-electric generation in parts of Ontario and could lead to economic losses of $660 million per year, as well as result in energy shortages during peak summer demand.[18]

In the Far North of Ontario, the winter road network is a vital link for communities and resource industries that are not serviced by a permanent road system. Shortened, warmer winters mean a reduced season for building and operating winter roads.[19]

Risks to Public Assets and Government Operations

Ontarians face costly climate change-related risks to public assets and government operations, including infrastructure (e.g., roads, the electricity grid and buildings), services (e.g., emergency response), and finances (e.g., consequences of reduced insurance affordability). Additional investment over a number of years will be required to make public infrastructure more resilient to extreme weather. Delivery of government services will be affected in different ways: some impacts may be sudden due to extreme weather and others more gradual due to longer-term climatic shifts. For example, in 2012, Emergency Management Ontario projected that emergency management services will be challenged to keep up with the increased frequency and greater severity of natural disasters, such as floods, predicted under a changing climate.[20]

The provincial government has already begun to encounter the need to make additional financial payouts due to extreme weather (ultimately coming out of taxpayers' pockets). Periodic provision of emergency funding to hard-hit municipalities or individuals may be needed, as was required during the Burlington flood in 2014 and the December 2013 ice storm in the Greater Toronto Area. As the number and magnitude of natural disasters increase, Ontario's disaster fund, the Ontario Disaster Relief Assistance Program[i], will be under additional stress to provide financial support to hard-hit communities and individuals. Furthermore, under its proposed expansion of crop insurance for Ontario farmers, the government will likely need to make additional payouts for crop failure due to extreme weather. Existing government insurance or emergency management programs such as Ontario's disaster fund were not designed with climate change in mind, highlighting the need for a more strategic approach to funding adaptation.

[i] Changes to Ontario Disaster Relief Assistance Program (ODRAP) are likely coming; in the 2014 mandate letter to the Minister of Municipal Affairs and Housing, the Premier instructed the Minister to examine ODRAP to ensure its design and eligibility criteria reflect current needs in addressing extreme weather events. The future of this program is more important than ever given that, as of February 1, 2015, the federal government reduced financial support for the provinces from the Disaster Financial Assistance Arrangements program, meaning Ontario will have to cover an increased share of disaster-related rebuilding costs.

Provincial Legal Liability for Damage Caused by Climate Change

Extreme weather events have already begun to stress infrastructure in Ontario, and will continue to do so, even in the best-case GHG mitigation scenario.[21] The resulting damage to personal property and/or human health may create legal liabilities for the provincial government, most likely in the form of negligence lawsuits.[22] Such lawsuits, if successful, could result in costly awards or settlements.

Some legal research states that the provincial government could be held legally liable for negligence in relation to an extreme weather event in circumstances where the following basic elements are present:

- an individual or group has suffered personal or property damage;
- the damage was, at least in part, caused by the provincial government's acts or omissions;
- the provincial government had a legal duty to the individual/group; and
- the provincial government ought to have reasonably known its act or omission could cause a risk for that individual/group (and knowledge of extreme weather events might factor into this reasonableness analysis).[23]

The provincial government is responsible for managing or regulating various types of infrastructure. Depending on how the province executes such responsibilities, these obligations could create liability for the government as a potential defendant in a negligence lawsuit. For example, the province could face liability arising from its role in establishing design standards[24] and in providing regulatory approval authority for stormwater systems.[25] Extreme weather events increase the likelihood of flooding and sewer back-ups, which can cause significant property damage (see the ECO's 2013 GHG Report.)

Another example is publicly-owned electricity transmission infrastructure. The courts have found that Ontario's crown corporation Hydro One has a duty to deliver electricity safely and that the former Ontario Hydro had a duty to have adequate emergency response systems in place.[26] Similarly, the provincial government has been found to have a responsibility to protect against hazards from electrical infrastructure on provincially owned land that may cause physical harm to members of the public.[27] As extreme weather events increase, the province will face greater potential liability, both via its ownership of electricity transmission assets and as an owner of land where electrical infrastructure is installed, from weather-related electrical hazards.[28]

The province also has a duty to plan, design, maintain and repair provincial roads and highways[29] and to ensure they are safe for use.[30] The province's potential liability with respect to this responsibility could increase as a result of the predicted rise in intense rain events, freeze-thaw cycles, and climate variability.[31] What's more, the government's own precipitation projections suggest the province should be aware of these climate change risks, factoring into the reasonableness analysis of the province's actions (or inactions) under the law.[32]

In negligence cases, the court will consider various factors when determining liability, including whether the action or inaction that lead to the damage was reasonable.[33] The assessment of "reasonableness" could take into account relevant statutory requirements and guidance, publicly available knowledge, as well as government custom and practice.[34] Government policy decisions are generally immune from liability; however, legal experts have pointed out that governments that fail to consider climate change in policy making will not be immune from potential negligence claims if this information would have been considered by a reasonable person (or government) in similar circumstances.[35]

Climate Change and Human Health

Climate change also holds serious consequences for the health of Ontarians. NRCAN reported in 2008 that by 2050, cities such as Toronto and Windsor can expect double the current average number of days exceeding 30°C.[36] As a result, the report continues, mortality due to heat could also double by the 2050s, while mortality from air pollution could rise as well.[37]

The warming climate is also heightening the risk of certain diseases. As the ECO wrote in our 2009/2010 Annual Report, and NRCAN discussed in a 2014 report, black-legged ticks – the species that transmits Lyme disease – are spreading northward into Canada at a rate of 35–55 km/year, exposing more of Ontario to this debilitating disease.[38] Annual incidences of Lyme disease in Canada have already increased from approximately 144 cases in 2009 to 682 cases in 2013.[39] In 2010 the NRTEE reported that warmer winters and warm, humid summers may also result in the spread of mosquitoes that carry West Nile Virus.[40]

Extreme weather can bring about other health risks. According to the Report of the Walkerton Inquiry, one of the many factors that contributed to the deadly outbreak of *E. coli* in Walkerton in 2000 was the heavy rain that assisted the transport of manure into the drinking water supply.[41] The 2008 NRCAN scientific literature review on the impacts of climate change on Ontario also reported that intense rainfall and ice storms can result in traffic accidents, while flooded homes can lead to the spread of toxic molds and poor indoor air quality.[42]

2. Ontario's Latest GHG Numbers

The Environmental Commissioner of Ontario reports annually to the Legislative Assembly of Ontario on the progress of the Ontario government towards reducing the province's GHG emissions, as required by the *Environmental Bill of Rights, 1993*. This section uses the most recent Environment Canada data to assess the province's progress towards meeting its GHG emissions reduction targets, established in 2007.[43] The three provincial targets are to reduce Ontario's annual GHG emissions by:

- 6 per cent below 1990 levels by 2014 (to approximately 171 Megatonnes [Mt] CO_2 equivalent);
- 15 per cent below 1990 levels by 2020 (to approximately 155 Mt); and
- 80 per cent below 1990 levels by 2050 (to approximately 36 Mt).

Ontario recently announced a 2030 mid-term target of 37 per cent below 1990 levels (equivalent to 115 Mt).

2.1 Overall Emissions in 2013

According to the 2015 National Inventory Report (NIR), Ontario's GHG emissions in 2013 were 171 Mt, equivalent to emissions in 2012 (and 2009).[44] This figure is the lowest annual level of emissions since the baseline year of 1990 (and 1991), when emissions were 182 Mt. (Note: this baseline number is higher than previously reported based on the use of newer methods of calculating GHG emissions; see box.)

Revised Framework for Calculating GHG Emissions

In this year's edition of the National Inventory Report, it became mandatory for Environment Canada to use the revised United Nations Framework Convention on Climate Change emissions reporting guidelines. This resulted in recalculations of previous years' emissions, and the 1990 baseline year is now higher than was reported in previous years (e.g., the baseline was reported to be 177 Mt in 2014, but was increased to 182 Mt in 2015).[ii] The recalculation is mainly due to an updated value for the global warming potential of two greenhouse gases, methane and nitrous oxide, resulting in higher carbon emissions across all years. The sectors most affected by this change are residential buildings, agriculture, and waste.

[ii] Each year Canada produces a National Inventory Report, which provides the most recent, as well as historic, GHG data for Canada and each province. Due to continual improvements to the way emissions estimates are modelled and calculated, historic data is often restated. Accordingly, historic numbers for some years, including the baseline year of 1990, may not exactly align with data on which the ECO has previously reported and commented.

With Ontario's emissions projected to be lower in 2014 due to the closure of its final coal-powered electricity plant, Ontario looks likely to meet its 2014 target (which is also 171 Mt). As shown in **Figure 1**, the last several years have witnessed a significant decline from the peaks experienced roughly between 2000 and 2005, when emissions from coal-fired electricity generation were highest.

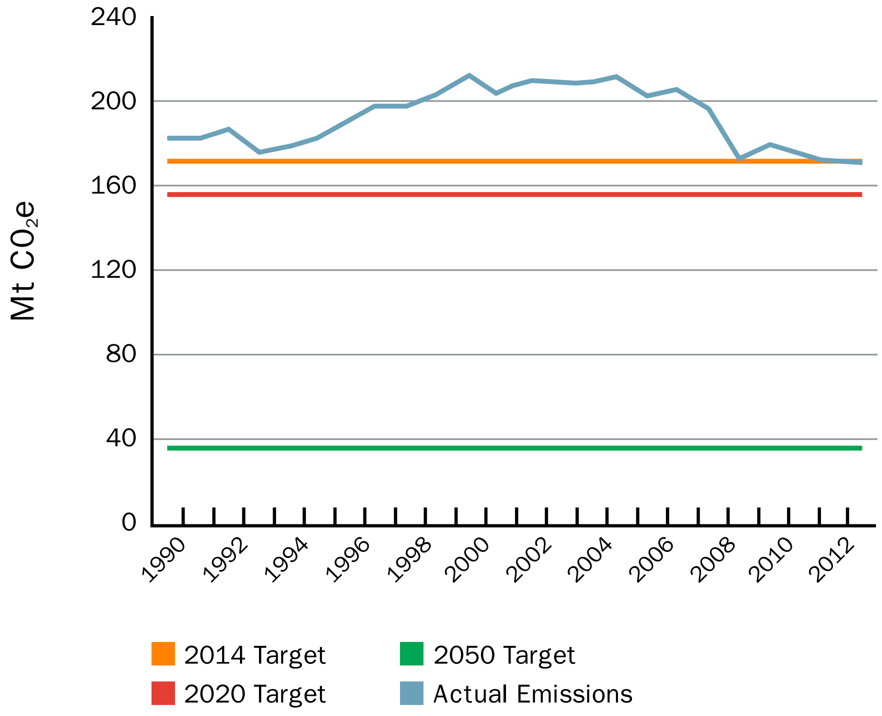


Figure 1. Ontario greenhouse gas emission trends and targets (1990-2013). (Sources: Environment Canada. National Inventory Report – Greenhouse Gas Sources and Sinks in Canada 1990-2013 (2015); Go Green: Ontario's Action Plan on Climate Change (2007); Ontario's Climate Change Update 2014 (2014)).

However, meeting the 2020 target will prove more difficult. Ontario faces a large gap (19 Mt – equal to 11 per cent of its total current GHG emissions[iii]) between the province's projected 2020 emissions based on current policies and trends and the 2020 target. Without new policy initiatives, the majority of Ontario's emissions reductions (78 per cent in 2020) will have come from the single initiative of phasing out the use of coal in the electricity sector. The government's biggest climate change challenge going forward is to achieve sufficient GHG reductions beyond the electricity sector to meet its 2020 target.

[iii] This 19 Mt gap was as of September 2014 and is based on the previous year's National Inventory Report.

2.2 Sector-Specific Emissions

Figure 2 shows Ontario's GHG emissions from each sector and how they have changed from 1990 to 2013. The electricity sector alone has seen a 58 per cent reduction in emissions over this time period, with the industrial sector contributing a further 26 per cent reduction, mostly due to reduced industrial production in the province.[46] The closure of the coal plants will not be fully reflected in Ontario's emissions profile until the 2015 emissions data becomes available.

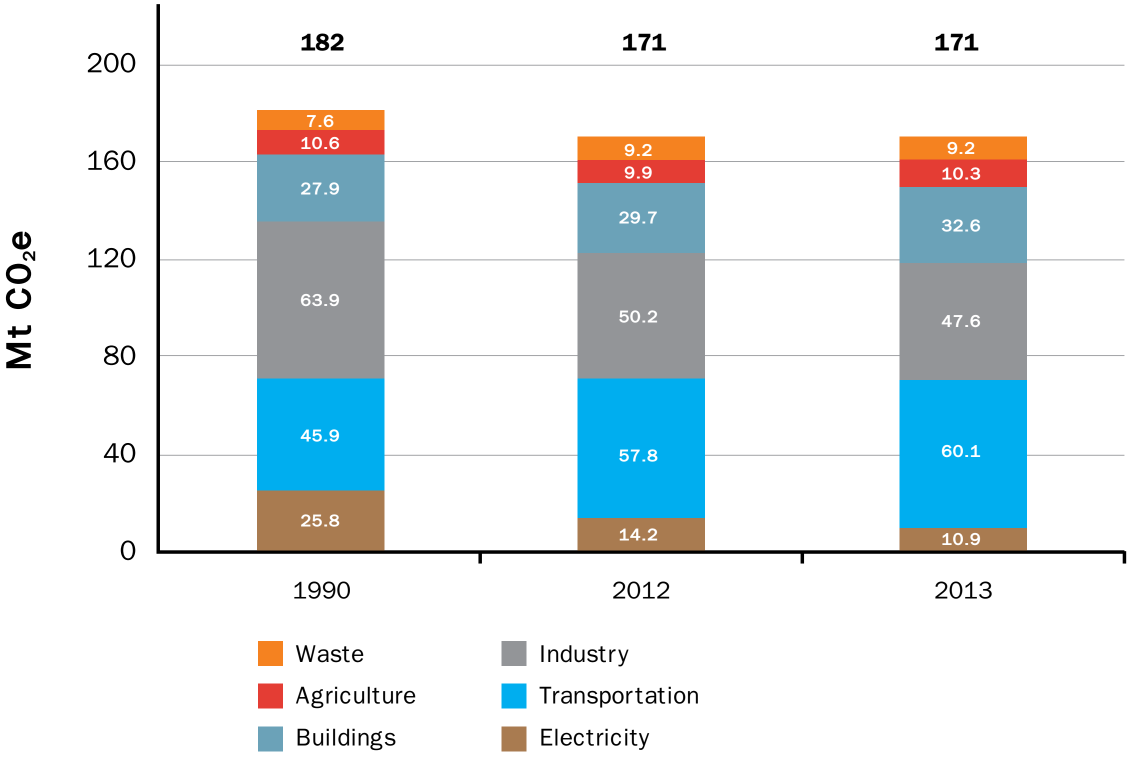


Figure 2. Ontario greenhouse gas emissions by sector for 1990, 2012 and 2013. (Source: Environment Canada. National Inventory Report – Greenhouse Gas Sources and Sinks in Canada 1990-2013 (2015)).

Since 1990, emissions reductions in the electricity and industry sectors have been partially offset by the 31 per cent increase in emissions from the transportation sector. Emissions in the buildings and waste sectors have also risen (17 per cent and 20 per cent, respectively). The transportation sector remains the largest contributor to the overall provincial inventory, with emissions rising 4 per cent from 2012 to 2013. Although emissions intensities have fallen in many sectors, in some sectors these gains are at least partially offset by economic and population growth.[47]

A more detailed breakdown of sector emissions is provided in **Table 1**.

Table 1. Ontario's Greenhouse Gas Emissions 1990–2013 (Source: Environment Canada. National Inventory Report – Greenhouse Gas Sources and Sinks in Canada 1990-2013 (2015)).

Sources	Emissions (Mt CO_2e)		Change from 1990 - 2013		Percentage each sector contributes to 2013 total
	1990	2013	Mt CO_2e	%Δ	%
Electricity	25.8	10.9	-14.9	-58	6
Transportation	45.9	60.1	+14.2	+31	35
Road (passenger)	27.3	32.7	+5.4	+19.8	
Road (freight)	8	13.4	+5.4	+67.5	
Off-road (gasoline and diesel)	5.6	9.2	+3.6	+64.3	
Domestic Aviation	2.2	2.3	+0.1	+4.5	
Domestic Marine	1.0	1.2	+0.2	+20	
Rail	1.8	1.3	-0.5	-27.8	
Industry	63.9	47.6	-16.3	-25.5	28
Fossil fuel refining	6.1	6.1	0	0	
Manufacturing	22	16.1	-5.9	-26.8	
Mineral Production (cement, lime, mineral products)	4.1	3.6	-0.5	-12.2	
Chemical Industry	10	0	-10	-100	
Metal Production (iron and steel)	10.9	7.7	-3.2	-29.4	
Fugitive Sources	1.6	1.3	-0.3	-18.8	
Other[iv]	9.3	12.8	+3.5	+37.6	
Buildings	27.9	32.6	+4.7	+17	19
Commercial and Institutional	9.1	11.9	+2.8	+30.8	
Residential	18.8	20.7	+1.9	+10.1	
Agriculture	10.6	10.3	-0.3	-3	4
Enteric Fermentation	4.4	3.6	-0.8	-18.2	
Manure Management	2.1	1.9	-0.2	-9.5	
Agricultural Soils	3.9	4.6	+0.7	+17.9	
Waste	7.6	9	+1.4	+19	5
Solid Waste Disposal on Land	7.1	8.4	+1.3	+18.3	
Wastewater Handling	.2	.3	+0.1	+50	
Waste Incineration	.3	.3	0	0	
TOTAL	182	171	-11	-6	100

[iv] The "other" category includes emissions from stationary combustion in mining, construction, agriculture and forestry; emissions from pipelines; emissions associated with the production and consumption of halocarbons; and emissions from the use of petroleum fuels as feedstock for petrochemical products. Subsector figures do not exactly match sector totals due to rounding errors and the fact that this table does not list all minor subsectors. The ECO adds up the emissions subcategories to calculate the sector totals so they may not exactly match the rounded numbers presented in the NIR.

3.

Review of Ontario's Progress on GHG Reductions

The Environmental Commissioner of Ontario annually reviews all government reports on climate change and GHG reductions published during the previous year, as required by the *Environmental Bill of Rights, 1993*. This section reviews the Ontario government's most recent GHG annual report, Ontario's *Climate Change Update 2014*, which provides an update of Ontario's GHG emissions and progress towards meetings its GHG reduction targets as set out in the government's 2007 *Climate Change Action Plan*.[48] This section also reviews additional climate change-related policy developments that occurred between July 9, 2014 (the release date of the ECO's last GHG report) and April 15, 2015.

The Ontario government's *Climate Change Update 2014*, released by the MOECC in September 2014, provides a detailed analysis of Environment Canada's 2014 National Inventory Report emission numbers for Ontario (supplemented by the MOECC's data and projections). The 2014 update report explains the sources of emissions in the province and why they may be rising or falling, including the impact of policies on GHG emissions. The report also discusses expected future emissions trends in the province based on current government policies, and mentions some potential new policy directions for each sector.

The following sections outline both existing government policies and progress towards developing new policies and regulations to reduce GHG emissions across the transportation, building, industry, agriculture, electricity, and waste sectors. The discussion focuses on progress and barriers towards meeting a rapidly approaching deadline: Ontario's 2020 GHG emissions reduction target. The sectoral reviews are presented from highest to lowest emitting sector.

3.1 Cross-Sectoral Developments

In the ECO's 2014/2015 reporting year, the government announced a number of measures that demonstrate a renewed commitment to climate action, such as adding "Climate Change" to the name of the Ministry of the Environment and including a strong emphasis on climate change in the Premier's mandate letter to the Minister of the Environment and Climate Change (see Section 1.1 of this report for more detail).

In addition, on February 12, 2015, the government posted a climate change discussion paper on the Environmental Registry for a 45-day public comment period (Environmental Registry #012-3452). The paper supported a comprehensive stakeholder engagement process that the province carried out in early 2015 to underpin the development of its new climate change plan. The paper outlined the key areas in which the government intends to introduce new policies to: take action in each sector, including putting a price on carbon; support science, research and technology; and promote climate resilience and risk management.

In April 2015, the government announced that it will introduce a cap-and-trade system. As stated in previous GHG reports, the ECO is supportive of carbon pricing in general as an economically efficient approach to reducing emissions.[49] Although globally cap-and-trade systems targeting GHG emissions are still in the initial stages of implementation, research has shown that they have been able to incent emissions reductions.[50]

The province has committed to completing its updated climate change strategy (covering both climate mitigation and adaptation) by the end of 2015.[51] With that, the ECO expects 2015 to bring numerous climate policy announcements.

No Breakdown of GHG Emissions Projections

The ECO assesses the province's progress in reducing emissions in each of the key sectors: transportation, industry, buildings, electricity, agriculture and waste. However, the ECO's role in assessing the province's progress in reducing GHG emissions on an initiative-by-initiative basis for each sector is hindered by the MOECC's "lumping" approach to reporting.

The MOECC has long used a lumping approach in its climate change progress reports when reporting projected emissions reductions for each sector; the ministry reports the expected emissions reductions for each sector as an aggregate of all GHG-reduction initiatives listed for that sector. For example, within the transportation sector, Ontario's *Climate Change Update 2014* lists six separate initiatives (though one of these is a federal initiative), but lists their projected GHG reductions in one lump figure. Although this approach is likely used due to the difficulty of attributing emissions reductions to any single initiative, it makes it challenging to ascertain whether fluctuations in the projections for a sector over time are due to the success or failure of any specific policy, or due to revised modelling assumptions.

The ECO highlighted this problem in our 2011 GHG Progress Report, but the MOECC has not changed its approach.

3.2 Transportation

At 60.1 Mt (35 per cent of total emissions), the transportation sector – including road, rail, domestic air and marine modes – remains Ontario's largest source of GHG emissions, and consequently, the biggest hurdle to achieving its 2020 GHG reduction target. What's more, GHG emissions from this sector have grown significantly, from 45.9 Mt in 1990, to 57.8 Mt in 2012, to 60.1 Mt in 2013. That is a 31 per cent increase in transportation emissions since 1990.

The ministry's emissions projections for transportation have fluctuated significantly over time. In 2007, the province projected that emissions cuts from transportation would contribute 19 Mt of GHG emissions reductions in 2020.[52] In the MOECC's *Climate Change Progress Report 2012*, the province dramatically scaled back its projected reductions for this sector in 2020 to only 3.9 Mt.[53]

Most recently, the MOECC's *Climate Change Update 2014* projected a slightly more ambitious reduction for the sector for the year 2020 – an improvement from 3.9 to 4.6 Mt.[54] The only new transportation initiative listed in Ontario's *Climate Change Update 2014* compared to its *Climate Change Progress Report 2012* is the Greener Diesel regulation (O. Reg. 97/14) made under the *Environmental Protection Act*; nonetheless, it is not possible to attribute the additional projected reduction of 0.7 Mt to this specific transportation initiative with certainty because of the ministry's aggregated reporting. The new projection could be the result of revised modelling of GHG reductions from other listed transportation initiatives, such as the province's Big Move regional transportation plan.

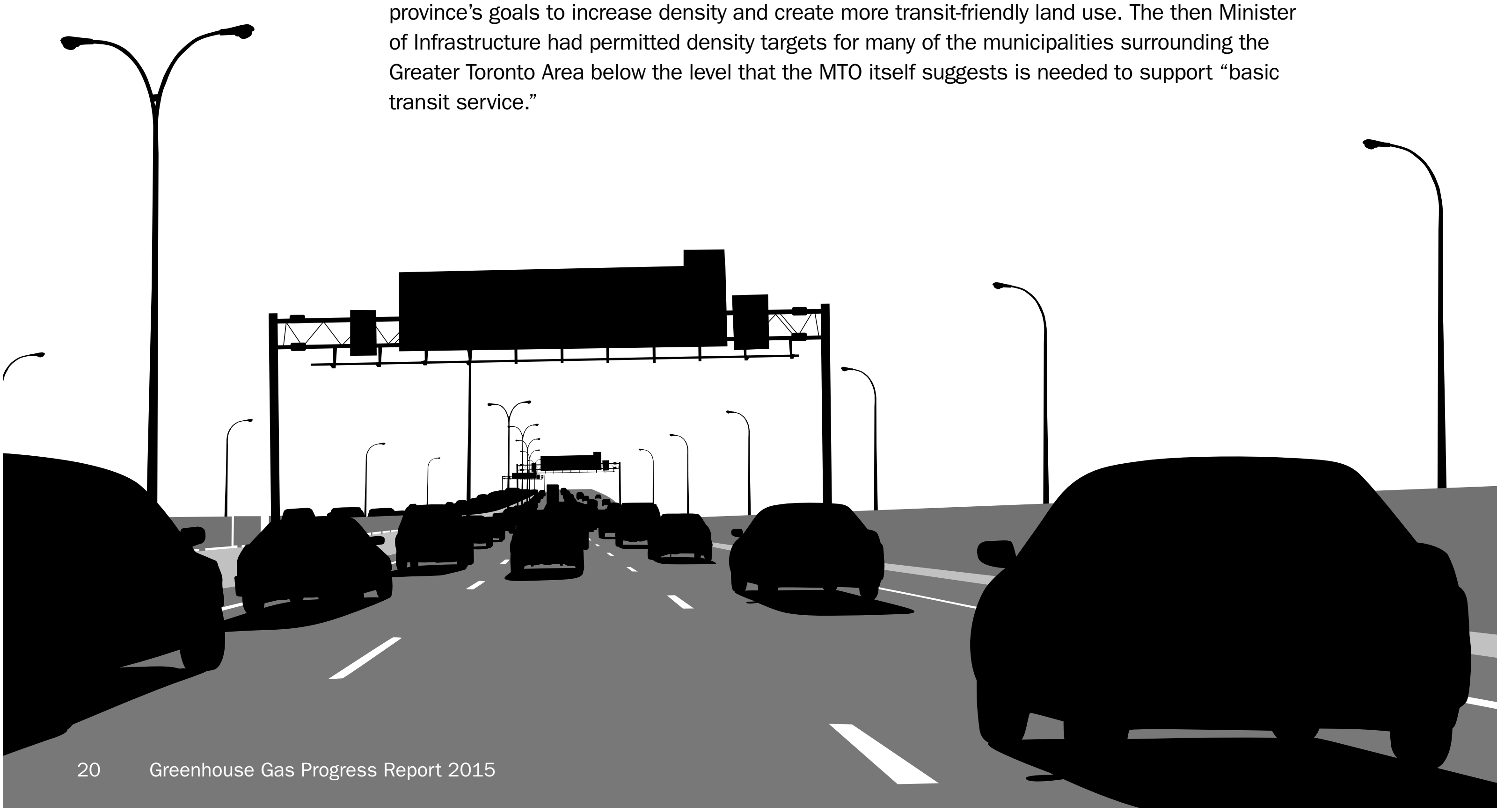
Since Ontario's *Climate Change Update 2014* was released in September, the Ministry of Transportation (MTO) continues to work on implementing pre-existing transit, electric vehicle, and cycling policies (though the latter two have represented GHG reductions too insignificant to be listed in Ontario's *Climate Change Update 2014*). The Premier's 2014 mandate letter to the MTO also called on the ministry to prioritize the implementation of high-occupancy toll (HOT) lanes; however the MTO has stated that it does not currently have sufficient data to calculate, model, or predict the impacts of HOT lane projects.[55] Beyond these measures, no new transportation initiatives have been implemented or proposed that would result in significant GHG reductions.

Another challenge in the transportation sector is the uncertainty that fluctuations in gasoline prices present for future GHG emissions. In the province's *Climate Change Progress Report 2012*, emissions projections for the sector were lowered partly based on higher prices for gasoline.[56] However, contrary to this forecast, gas prices dropped in 2014. A sustained period of lower gas prices could encourage drivers to drive more and purchase higher gas-consuming vehicles (such as pickup trucks and sport-utility vehicles) and actually increase the sector's GHG emissions, highlighting how unpredictable market forces can be within the sector.

Transit

The MTO continues to fund and expand public transit throughout the province, which if done well could help get people out of their cars – the largest source of transport emissions.[57] For example, in 2014, 96 municipalities received a total of $325.1 million in funding for improved public transit via the province's gas tax; a source of funding that was made permanent in 2013.[58] The ministry is also continuing to work on important transit expansion projects, including the Eglinton Crosstown Light Rail Transit line and the Union-Pearson Express in Toronto, as well as transforming existing GO commuter rail into an electrified rapid transit system for the Greater Toronto and Hamilton Area.

Ontario's *Climate Change Update 2014* also points to the *Provincial Policy Statement, 2014* and Ontario's *Growth Plan for the Greater Golden Horseshoe, 2006* as supporting policies that promote mixed land uses and higher densities. This in turn should encourage greater use of transit, as well as reduce vehicle kilometres travelled through other means (i.e., fewer and shorter car trips; more walking, cycling and car-pooling). However, when the ECO examined the implementation of the Growth Plan in our 2013/2014 ECO Annual Report, we found that it was not achieving the province's goals to increase density and create more transit-friendly land use. The then Minister of Infrastructure had permitted density targets for many of the municipalities surrounding the Greater Toronto Area below the level that the MTO itself suggests is needed to support "basic transit service."



The government is currently reviewing the *Growth Plan for the Greater Golden Horseshoe, 2006*. In addition, on March 5, 2015, the government proposed Bill 73, the *Smart Growth for Our Communities Act, 2015*, which proposes to (among other things) amend the *Development Charges Act, 1997* to enable increased revenue for municipal transit. The Premier's 2014 mandate letter to the Minister of Municipal Affairs and Housing had directed the Minister to amend the *Development Charges Act, 1997* to support "the development of sustainable, transit-friendly complete communities" through improved land use planning and smarter growth.

Electric Vehicles

Ontario's low-carbon electricity mix means that electric vehicles have the potential to greatly reduce emissions in the transportation sector. In 2009, the MTO established an ambitious goal to have 1 in 20 vehicles driven in Ontario by 2020 be an electric vehicle (EV).[59] The MTO has been subsidizing electric vehicle sales and charging stations in the province through its "Electric Vehicle Incentive" and "Electric Vehicle Charging Incentive" programs, but progress towards this EV target has been very modest. As of February 2015, there are only 4,030 electric vehicles in the province – to put this number in perspective, it represents approximately 1 in 1,900 passenger vehicles in Ontario in 2014.[60] As it stands, the MOECC has not determined the EV initiative to warrant being listed in Ontario's *Climate Change Update 2014*, presumably because the GHG reductions are too small.

Low Carbon Fuel

In 2007, the government committed to establishing a Low Carbon Fuel Standard (LCFS) for vehicles. The LCFS commitment was expected to reduce the carbon intensity of transportation fuels by 10 per cent by 2020. However, the Ministry of Energy has made little measurable progress toward establishing an LCFS in Ontario in the almost eight years since the commitment was made.[62] In light of stalled progress, in our 2012 Energy Conservation Progress Report the ECO called on the province to act on this commitment and recommended that responsibility for implementing an LCFS in Ontario be reassigned to the Ministry of the Environment (now the MOECC).[63]

The MOECC has proven it is better positioned to take charge of an LCFS for two reasons: the ministry already has responsibility for regulating other transportation fuel qualities to control emissions; and, the MOECC has demonstrated through design elements of the Greener Diesel Regulation (primarily using lifecycle analysis to model GHG emissions[64]) that some of the issues the Ministry of Energy deemed insurmountable to establishing an LCFS can in fact be resolved, at least partially.[65] The ECO reiterates our previous recommendation that responsibility for implementing a low-carbon fuel standard be assigned to the MOECC.[66]

3.3 Industry

The industrial sector accounts for the second highest share of GHG emissions in Ontario at 28 per cent or 47.6 Mt. This sector reduced its GHG emissions by 21 per cent between 1990 and 2012, but recently emissions have been increasing and the MOECC projects GHG emissions will continue to increase. GHG reductions in this sector are attributable primarily to reduced industrial production (including plant closures) in recent years, as well as some improvements in energy efficiency. For example, the MOECC reports that the average emissions intensity of manufacturing decreased by 34 per cent between 1990 and 2012.[67]

The industrial sector has historically been subject to relatively weak policies and oversight aimed at reining in its GHG emissions; the sole GHG policy initiative aimed at the industrial sector that is mentioned in Ontario's *Climate Change Update 2014* is the natural gas demand side management program (discussed below, in the Buildings section). However, the sector will soon be targeted for greater emissions reductions, as a result of two policy developments.

In April 2015, Ontario announced that it will introduce a cap-and-trade system under the Western Climate Initiative (WCI), of which it has been a member since 2008. Ontario intends to join Quebec and California, the other two jurisdictions in North America that have implemented cap-and-trade systems through WCI. WCI creates a common design and administrative framework for emissions trading, thus enabling the future linking of systems across jurisdictional boundaries.[68] While the exact design details of Ontario's system had not been made public at the time of publication, WCI design documents, Quebec and California's systems, as well as Ontario's past carbon pricing discussion papers[69] provide general information about the likely design decisions Ontario will make. The system will likely initially cover large industrial emitters (facilities that emit more than 25,000 tonnes of GHGs in a year). These large emitters have already been reporting their emissions to the MOECC since 2010.[70] Emissions in other sectors of the economy can be targeted indirectly by targeting upstream fuel distributors or directly by allowing offsets (as Quebec[71] and California[72] have done).

Second, on April 13, 2015, the MOECC released a new regulation that aims to reduce coal and petroleum coke use in energy-intensive industries such as cement, lime, iron and steel.[v] In 2012, 29 per cent of the cement industry's energy use came from coal; whereas in the iron and steel sector, 4.3 percent of energy use was from coal and 49 percent was from coke.[73] The regulation encourages facilities to switch to fuels that have lower carbon emissions intensity than coal or petroleum coke (e.g., various forms of biomass and other organic matter). Given the uncertainties regarding how many plants will choose to participate and the exact nature of the replacement fuel, the GHG benefits of the regulation are difficult to predict. The ECO will review this regulation in a future report.

[v] O. Reg. 79/15: Alternative Low Carbon Fuels, made under *Environmental Protection Act, R.S.O. 1990, c. E.19*.

3.4 Buildings

The buildings sector in Ontario continues to be the third largest source of GHG emissions. In 2013, it represented 32.6 Mt, or 19 per cent, of Ontario's GHG emissions. Building emissions have risen fairly steadily since 1990, increasing by 17 per cent between 1990 to 2013, tied to economic and population growth; amid the general upward trend are some annual fluctuations in emissions due to changes in weather patterns (determining heating and cooling demand) and commercial activity.[74] The MOECC projects that this sector's rising emissions trend will continue.

While the electricity sector continues to decarbonize, the reliance of the buildings sector on natural gas for space and water heating presents a key challenge to the Ontario government as it attempts to meet its 2020 emissions reduction target. Between 1990 and 2012, demand for natural gas in the building sector has increased in both the residential (23 per cent increase) and commercial/institutional (30 per cent increase) building sectors, mostly due to large increases in floor space.[75]

Policies that the government has implemented in recent years to drive emissions reductions in this sector include changes to the Ontario Building Code (the latest update – the 2012 code – came into effect on January 1, 2014 and is renewed in five-year year cycles),[76] natural gas demand side management programs, energy efficiency regulations and standards, and changes to the *Provincial Policy Statement, 2014* that promote more compact building types.[77] Ontario's *Climate Change Update 2014* predicts that these initiatives will achieve 2-3 Mt of emissions reductions by 2020.[78] The only policy initiative that underwent a change in the reporting year is the natural gas demand side management program, discussed in more detail below.

Natural Gas Demand Side Management Programs

The province's main initiative to reduce natural gas use in the buildings sector is through demand side management (DSM) programs, which are programs designed to reduce consumer demand for energy. These programs are offered by the natural gas utilities, with provincial oversight and guidelines.[79]

The Ontario Energy Board sets the DSM budgets for the natural gas utilities in multi-year plans.[vi] The provincial framework for DSM programs was updated in 2014.[80] There are two main changes that are relevant to the sector's GHG emissions. First, the Minister of Energy issued a directive to the Ontario Energy Board in March 2014, ordering the Board to bring natural gas DSM into closer alignment with the Ontario government's Conservation First energy policy, which should increase the focus on natural gas conservation. Second, when the natural gas utilities conduct cost-benefit analyses for proposed DSM programs, 15 per cent can now be added to the total estimated monetized benefits to account for environmental benefits.[81] An Ontario Energy Board letter from February 2015 specifically identified carbon reduction as one of the environmental benefits to be considered.[82] As a result of these changes, more DSM programs may pass the cost-benefit test and be approved, which could further reduce emissions in the sector.

The Ontario Energy Board also significantly increased the recommended maximum annual budget for natural gas utility DSM spending to $135 million, more than double the $65 million approved for 2014.[83] It remains to be seen whether the gas utilities will spend their maximum budgets in order to pursue as much conservation as possible.

[vi] These budgets are capped to discourage any potential upward pressure on gas rates.

3.5 Electricity

The electricity sector's contribution to Ontario's GHG emissions continues to decline. In 2013, it represented 10.9 Mt or just 6 per cent of Ontario's total GHGs. Emissions from the sector peaked in 2000, but have fallen significantly since 2007 due to the closure or conversion of Ontario's coal-fired power plants.[84] The last coal-fired power plant, operated by Ontario Power Generation, stopped burning coal in April 2014. The bulk of the remaining GHG emissions from the power sector come from the 29 natural gas-fired power plants located across the province.[85]

Under the 2013 Long-Term Energy Plan, Ontario is expected to refurbish four nuclear units at Darlington generating station and six units at Bruce generating station between 2016 and 2031. Natural gas-fired power plants will fill some of the gap, which may increase the sector's emissions. The Independent Electricity System Operator [vii] projects an increase of about 1,040 MW in natural gas-fired generation capacity from 2016 to 2017 due to diminished nuclear supply.[86] After 2017, natural gas-fired supply is projected to stay constant. The rest of the supply gap is to be partially met by increases in low-carbon, non-hydro renewables (e.g., wind, solar) between 2017 and 2020 and through energy conservation after 2020. However, it is expected that additional energy resources will also be needed after 2020. These resources are classified as "Planned Flexibility," meaning that the government has not yet determined what type of energy source (or combination of sources) will be used.

Ontario is producing an ever-increasing share of its electricity from renewable energy sources such as wind and solar power.[87] As of Ferbruary 2015, there were 2,543 MW of installed wind capacity on the transmission grid – about 7.4 per cent of total system capacity.[88] By September 2016 a total of 280 MW of solar generation projects will be connected to the transmission grid.[89] This will complement approximately 2,500 MW of "embedded" solar and wind facilities – those connected to and located within the service areas of local distribution companies – that were in operation by May 2015.[90] By 2020, nearly 10,700 MW of non-hydro renewables will represent about 26 percent of total grid capacity.[91] Further, the government's Long-Term Energy Plan has indicated that renewable generation targets will be reviewed annually as part the Ontario Energy Report.

[vii] As a result of a government decision in 2014, the Ontario Power Authority and the Independent Electricity System Operator were merged into one agency, effective January 1, 2015, named the Independent Electricity System Operator, which will assume the functions of the two agencies.

Critics maintain that due to the intermittency of wind and solar power, there will always be a need for back-up generation, primarily provided by natural gas-fired plants (when the wind isn't blowing or the sun isn't shining). However, rapid developments in the field of energy storage are now challenging this assumption. In addition to advancements in battery technology being made outside of Ontario, there are many small demonstration projects in Ontario using a variety of technologies (e.g., compressed air, batteries and flywheels)[92,93] that will allow stored energy to be integrated into Ontario's grid. In 2014, the Minister of Energy directed the Independent Electricity System Operator to procure 50 MW of storage. So far, it has procured 33 MW with the remainder to be contracted in 2015. Additional government investment in smart grid technologies such as grid automation through its smart grid fund will also enable the integration of more renewable energy into the grid.

Many older natural-gas fired electricity generating stations currently operate under contracts that pay them for producing power around the clock, whether the energy is needed or not. These stations are known as non-utility generators (NUGs). Most NUG contracts will be up for renewal in the coming years. This presents a GHG emissions reduction opportunity, as under the new contracting framework, these plants should operate less frequently.[94] However, it is difficult to confirm that this will be the case, as NUG contracts renewed to date have not been made public. The province appears to be reviewing its approach to NUG contract renewal. In late 2014, the Minister of Energy instructed the Independent Electricity System Operator to assess the framework for NUG contracting in Ontario, temporarily freezing procurement.[95]

3.6 Agriculture

Ontario's agricultural sector's GHG emissions have been steady at between 9.9-11 Mt since 1990.[96] Emissions in this sector largely result from fertilizer and manure use (55 per cent), methane from livestock (29 per cent) and manure management (16 per cent).[97] In Ontario's *Climate Change Update 2014*, the MOECC stated that the agricultural and waste sectors will only contribute 1.8 Mt (or 4 per cent) of Ontario's emissions reductions by 2020.

Ontario's *Climate Change Update 2014* mentions few concrete policies that could reduce the sector's emissions other than on-farm biogas facilities (which will contribute a reduction of only 11 kilotonnes in 2020) and tillage practices.[98] However, there are encouraging signs that the Ontario Ministry of Agriculture, Food and Rural Affairs is attuned to the need to promote and support a more comprehensive approach to soil management as a means to reduce GHG emissions in the sector (among other benefits). The Ontario government's *Climate Change Update 2014* mentions that the sector plays a critical role in the carbon cycle.[99] Improving soil health (e.g., through minimizing tillage, encouraging cover crops and crop rotations, and regularly applying compost to fields) can reduce the need for fertilizer, thus minimizing nitrous oxide (N_2O) emissions, and enable soil to sequester more carbon.[100]

3.7 Waste

Emissions in the waste sector have been steadily increasing since 1990, but fell slightly in 2013.[101] Most (92 per cent) of Ontario's 9 Mt of GHG emissions from this sector arise from methane generated in landfill sites, primarily caused by the anaerobic decomposition of organic waste.[102] The effects of methane emissions can be reduced by capturing methane and either flaring or burning it to generate electricity. Preferably, methane emissions can be avoided by decreasing or eliminating organics in landfill sites.

In 2008, Ontario implemented regulations requiring large landfills to capture and destroy generated methane (O. Reg. 216/08 and O. Reg. 217/08). However, there have been no new waste policies introduced during the period covered by this report that are aimed at further reducing the sector's GHG emissions. As the ECO has noted in previous reports, reducing (or banning altogether) organics from landfill sites would result in significant emissions reductions in the waste sector.

4.

ECO Comment

The science is clear and beyond dispute: human-caused climate change is already affecting Ontario. Profound changes in our economy and way of life are essential, and the provincial government has a clear leadership role to play in enabling and promoting these changes. The province must create a policy environment that will steadily reduce the carbon footprint of our economy and lifestyles. The costs of climate inaction are material, while the potential economic opportunities from transitioning to a low-carbon economy are substantial.

Ontario has made noteworthy strides in climate change policy since 2007, particularly by closing its coal-fired power plants and thus decarbonizing its electricity sector to a large degree. Unfortunately, this bold action was followed by a period of relative inaction. As a result, under the current suite of policy initiatives, Ontario will not meet its 2020 GHG emissions reduction target; nor will it ensure the province is prepared to manage climate change risks.

Encouragingly, the government has recently recognized the urgent need to act, and has signalled its intention to introduce policies that could put Ontario on a path to meeting its 2020 (and beyond) GHG targets. Over the past year, the government made several policy announcements for the transportation, building, electricity and industrial sectors that should result in GHG reductions over time. These are promising signs, but far more aggressive policies are still needed across all sectors to close the 2020 emissions gap. The government's level of ambition on climate change is encouraging, but the short time period between the likely introduction of new (or enhancement of existing) GHG reduction policies and the year 2020 make achieving the target extremely challenging.

In our 2014 Greenhouse Gas Annual Progress Report, the ECO recommended policy approaches with the potential to achieve substantial GHG emissions reductions in the transportation sector. These recommendations remain relevant and include: more transit-friendly urban planning; increased investments in public transit; and better efforts to encourage the use of low carbon fuels, and energy efficient and alternative energy vehicles.

In the buildings sector, the ECO believes that this year's developments at the Ontario Energy Board should result in a greater number of natural gas conservation programs, and will hopefully reduce the building sector's carbon footprint.

In the electricity sector, the ECO is encouraged by the longer-term move away from fossil-fuel based electricity sources and the potential for improved electricity storage technologies. The public interest would benefit from full transparency of all energy procurement contracts, particularly with regards to non-utility owned natural gas plants, whose production contracts are not tied to the province's actual energy needs.

For industrial emitters, the introduction of a cap-and-trade program would mark a huge change in the government's approach to reducing emissions in this sector. If designed well, there is the potential for significant emissions reductions.

In the agricultural sector, policies that support healthy soils (which sequester more carbon) should be considered. Phasing out organics from landfill sites would help reduce emissions in the waste sector.

Finally, to more transparently connect projected GHG emissions reductions to specific government initiatives, the ECO recommends that the MOECC provide estimated breakdowns of GHG emissions reduction projections for each initiative, and for each sector.

Beyond the fanfare of the United Nations Framework Convention on Climate Change conference in Paris in December 2015, the hard work of implementing more stringent GHG reduction policies will begin. With this in mind, the ECO looks forward to tracking the province's future progress in reducing its GHG emissions.

Appendix 1 –
IPCC's New Science: A Call to Mitigate and Adapt

Last year's ECO Annual GHG Report highlighted the pivotal climate change science released by Working Group I of the Intergovernmental Panel on Climate Change (IPCC); specifically, the IPCC's finding – with 95 per cent confidence – that human activities have been the dominant cause of climate warming since the 1950s.

Since the ECO's last progress report, the IPCC's Working Groups II and III released their respective findings focused on climate change impacts, adaptation and vulnerability, and on mitigation. The IPCC also released a *Synthesis Report* (SYR) summarizing the work of all three working groups. Together, these reports identify a wide range of future climate change risks and call upon all levels of governments to:

1) take mitigating actions now, to ensure maximum efficiency, limit costs and minimize risks of abrupt and irreversible climate change impacts; and
2) take adapting actions *now*, to limit the negative effects of those climate change impacts, which are unavoidable even in the best-case emissions reduction scenarios, to minimize cost and maximize resiliency of people and ecosystems.

The IPCC's findings are particularly relevant to Ontario, as subnational governments play a key role in both adaptation and mitigation efforts.[104] Accordingly, this section will provide an overview of the IPCC's most recent findings regarding mitigation and adaption measures as set out in the *Synthesis Report*.

Impacts, Hazards and Risks Identified by the IPCC Report

The IPCC outlines various climate change **impacts** that have occurred on people and ecosystems. Each observed impact is provided with its associated certainty rating that expresses the likelihood or confidence level that it is related to climate change; these impacts include:

- a decrease in cold temperature extremes and an increase in warm temperature extremes, increased heat waves in some regions (*likely*), causing increased heat-related mortality (*medium confidence*);
- increased frequency and intensity of heavy precipitation events in North America and Europe (*medium confidence*);
- changing precipitation patterns and melting snow and ice, affecting the quantity and quality of water resources in some regions (*medium confidence*);
- shifted geographic ranges, abundances and interactions of many species (*high confidence*); and
- an overall decrease in crop yields (*high confidence*).[105]

Certainty for IPCC findings is based on the authors' evaluations of the underlying scientific evidence and agreement. Where appropriate, findings are expressed as facts. Otherwise, certainty is expressed either as a qualitative level of confidence (from very low to very high) or probabilistically with a quantified likelihood of something occurring (e.g., very likely represents 90–100 per cent likelihood, likely represents 66–100 per cent likelihood, more likely than not represents >50–100 per cent likelihood). In some cases the level of underlying scientific evidence (limited, medium, or robust) and agreement (limited, medium, or high) is indicated. (Source: IPCC, 2014: Climate Change 2014: *Synthesis Report of the Fifth Assessment Report,* p.1).

The IPCC uses the term "**hazard**" broadly to mean the potential occurrence of many effects, including: climate-related physical events or trends or their physical impacts that may cause loss of life, injury, or other health impacts, damage and loss to property, infrastructure, livelihoods, service provision, as well as degradation of ecosystems, and environmental resources.[106] As a result of the unavoidable increase in temperature throughout this century, the IPCC predicts the following climate-related hazards:

- Heat waves will occur more often and last longer (*very likely*);
- Fewer cold temperature extremes and more frequent hot temperature extremes will occur (*virtually certain*);
- Extreme precipitation events will become more intense and frequent in many regions (*very likely*);
- Arctic sea ice will continue to recede;
- The ocean will experience increased acidification;
- Glacier volume, with few exceptions, will decrease by at least 15 per cent (*medium confidence*); and
- The ocean will continue to warm and the mean sea level rise (*very likely*).[107]

Climate change **risks** result from the interaction of climate related hazards (events and trends) with the vulnerability and exposure of human and natural systems, including their ability to adapt.[108] The climate change hazards set out above are predicted to result in the following risks, among many others:

- Extinctions of a large fraction of species (*high confidence*);
- Threats to global food security in a business-as-usual emissions scenario, combined with increasing food demand (*high confidence*); and
- Major impacts on water supply, food security, infrastructure, and agricultural incomes for those in rural areas.

More generally, in urban areas, heat stress, storms, extreme precipitation, flooding, landslides, air pollution, and water scarcity will increase risks to people, assets, economies and ecosystems (*very high confidence*) – especially for people lacking essential infrastructure and services.[109]

The risk of irreversible and abrupt changes in the climate system increase as the magnitude of warming increases.[110] Without additional mitigation efforts – under the business-as-usual scenario – most models predict warming is more likely than not to exceed 4°Celsius (C) above pre-industrial levels by 2100.[111] The above-noted risks will be exacerbated in such a scenario.[112]

In response to these predicted climate change risks, the IPCC outlines a variety of complementary mitigation and adaptation opportunities aimed at avoiding the most significant negative impacts on humans, animals, and the built and natural environment.[113]

Mitigation Efforts Proposed by the IPCC

The IPCC uses several emissions[viii] scenarios to model future climate change risks based on differing degrees of mitigation. Even its most aggressive emissions mitigation scenario involves increased warming until 2100 relative to the present temperature due to concentrations of greenhouse gases (GHG) already in the atmosphere.[114] The amount of global warming for the latter half of this century will depend greatly on the extent to which emissions have been mitigated (i.e., aggressive versus business-as-usual) in the first half of this century.[115] (see **Figure 1**).

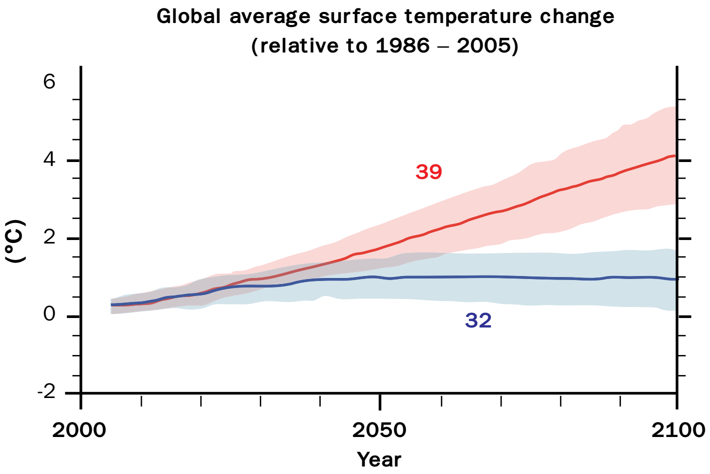


Figure 1: Global average surface temperature change from 2006 to 2100 as determined by multi-model simulations. All changes are relative to 1986–2005. A measure of uncertainty (shading) is shown for the best-case mitigating scenario (blue) and the worst-case (i.e., business-as-usual) (red). The number of models used to calculate the mean is indicated. (Source: IPCC, *Climate Change 2014: Synthesis Report of the Fifth Assessment Report*, 2014, Fig. 2.1(b))

The IPCC believes that the mitigation efforts listed in the box on the right, undertaken now and within the next few decades, can significantly reduce exposure to climate change risks within this century.

Limiting warming to a less than 2°C increase over pre-industrial levels (generally considered the tipping point for severe and irreversible climate change risks)[116] will require substantial emissions reductions over the next few decades and near-zero emissions of GHGs by the end of the century.[117] The sooner mitigation actions are taken, the better the odds for effective adaptation, and the lower the costs and challenges of mitigation in the longer term.[118] For example, delaying mitigation activities, even to 2030, would require substantially higher rates of emissions reductions, a more abrupt shift from high-carbon to low-carbon energy use, more reliance on carbon dioxide removal technologies, and a higher rate of spending.[119]

[viii] The IPCC's AR5 provides climate projections based on "scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases, aerosols, chemically active gases, as well as land use/land cover," the AR5 refers to these scenarios as representative concentration pathways (RCPs), namely: RCP 2.6, RCP 4.5, RCP 6, and RCP 8.5. These four scenarios range from business-as-usual (RCP 8.5), in which emissions continue increasing over time, to RCP 2.6 in which emissions are reduced substantially over time. (IPCC, report, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., et al. (eds.)] Glossary, p.1461, 2013.)

Examples of IPCC Suggested Mitigation Policies and Measures

(Certainty notations relate to the likelihood that the policy or measure would have a GHG mitigating effect)

Cross-sectoral

- Reducing subsidies for GHG-related activities (*high confidence*).
- Putting a price on carbon, either by use of strict caps that have a restraining effect or taxes that have restraining and substitution effects, if imposed alongside other complementary policies (*high confidence*).

Electricity Supply

- Decarbonizing electricity generation (*medium evidence, high agreement*), by way of:
  o renewable energy subsidies (*high confidence*); and
  o supporting technology development, diffusion and transfer (*high confidence*).

Energy Demand

- Efficiency enhancements and behavioural changes (*robust evidence, high agreement*), by way of energy efficiency regulations and labelling (*medium evidence, medium agreement*).

Forestry

- Afforestation, sustainable forest management and reduced deforestation (*medium evidence, high agreement*).

Agriculture

- Cropland and grazing land management, and restoration of organic soil (*medium evidence, high agreemet*).

The IPCC observed that mitigation policies are more cost-effective if they integrate multiple approaches across various sectors, such as: reducing energy demand and the GHG intensity of key sectors like transport, industry, and buildings; decarbonizing the energy supply; and increasing carbon sequestration opportunities.[121]

Adaptation Strategies Proposed by the IPCC

The IPCC report states with high confidence that adaptation measures can help secure populations, assets, and ecosystem goods against the climate change risks outlined above; however, the IPCC notes that there are limits to their effectiveness, particularly in the face of unmitigated climate change.[122] The IPCC recommends a range of adaptation measures; see box.

Examples of IPCC Suggested Adaptation Policies and Measures [123]

- Hazard and vulnerability mapping (e.g., flood plain mapping).
- Storm and wastewater disaster risk management and structural and physical improvements.
- Transport and road infrastructure improvements.
- Ecosystem management (e.g., maintaining wetlands, watershed, and urban green spaces).
- Power plant and electricity grid adjustments.
- Ecological restoration (e.g., soil conservation, reforestation, and afforestation).
- Green infrastructure development (e.g., shade trees, green roofs).
- Sustainable fisheries management (e.g., control overfishing and fisheries co-management).
- Assisted species migration and dispersal (e.g., ecological corridors).
- Financial incentives (e.g., payment for ecosystem services).
- Disaster planning and preparedness.
- Education (including sharing indigenous, traditional, and local knowledge, and knowledge sharing and learning platforms).

Adaptation policies need to address current vulnerability and exposure to climate change risks, while also incorporating a longer-term perspective.[124] The IPCC outlines several methods for improving adaptation planning and implementation, including the need for research and monitoring of adaptation effectiveness, co-ordinated and complementary actions across all levels of government, and public education about climate change risks.[125]

Appendix 2 – Climate Trends and Projections for Ontario

Climate data and projections drive climate change mitigation and adaptation policy. Climate science is continuously evolving and there is a large body of scientific research on the subject (even in Ontario), making it difficult for Ontarians to critically assess all the available science. At the international scale, the IPCC plays a critical role in providing authoritative climate science (although it does not endorse any specific projections), including some regional climate information. There is no comparable authoritative scientific body that vets and synthesizes Ontario-specific climate science. It is not the ECO's role to assess and aggregate all climate science applicable to Ontario. However, given the importance of using available climate science to make decisions, this section presents an illustrative range of climate projections that have been made for Ontario, as well as past observations that showcase how Ontario's climate is changing.

In the absence of an IPCC-like body for Ontario, the ECO reviewed federal and provincial climate change reports that have taken on the task of critically analyzing and synthesizing the best available information.[ix] Much of the government's regional-specific climate data and analysis, however, is already several years old (in many cases from 2008 or earlier), pointing to a clear need for more current Ontario-specific data. In addition, in assessing the various projections, it is important to understand the nuances of climate modelling that can lead to widely ranging projections. Different researchers use different base climate models, incorporate different parameters (or integrate them into the model in different ways), use different techniques to downscale the data to a more local level (or don't downscale at all), and so on.

It is important to note that climate projections vary based on the climate model and emissions scenario used. For further information about the climate projections summarized in this Appendix, please see the original sources listed in the endnotes.

Over the past few decades, Ontario's climate has exhibited a marked increase in temperature that has outpaced the global average. While the global average temperature has increased by 0.85 degrees Celsius (°C) since 1880[126], according to recent research out of York University, Ontario's summer and winter temperatures rose by an average of 1.0°C and 2.2°C, respectively, between 1900 and 2012.[127] Correspondingly, the number of frost days per year in Ontario decreased by 18 days between 1979 and 2009.[128] Natural Resources Canada (NRCAN) research from 2008 found that northern Ontario generally has experienced a higher rate of warming than southern Ontario; findings that were supported by recent downscaled climate projections under the IPCC's AR5 scenarios (see **Appendix 1**) by York University's Laboratory of Mathematical Parallel Systems (LAMPS) in 2014.[129, 130]

Ontario's annual average temperatures are expected to continue climbing. In fact, warming in Ontario is predicted to continue along the historic trend to outpace global increases; for example, the IPCC estimates that warming near the Great Lakes is projected to be about 50 per cent

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[ix] Appendix 2 summarizes the scientific findings featured in reputable reports, such as the most recent reports from the IPCC, Ontario's (then) Ministry of Natural Resources (MNR), Natural Resources Canada (NRCAN) and the National Round Table on the Environment and the Economy (NRTEE). It is important to note that much of this government-endorsed or mandated regional-specific climate research needs to be updated. More recently, the MOECC funded (but does not endorse) Ontario-specific climate change science via grants to several academic institutions, including the University of Toronto. The ministry also funded interactive public climate data portals produced by the University of Regina (Ontario Climate Change Data Portal) with climate data and projections provided at a resolution of 25 km^2, and a at a resolution of 45 km^2 by York University's LAMPS laboratory, each based on different climate models.

greater than that of the global mean warming. Moreover, northern Ontario is forecast to continue warming faster than southern Ontario, especially with regard to winter temperatures (See **Table 1**). The trends are consistent across most climate research. For example, ongoing research from the University of Toronto (partially funded by the MOECC) that focuses on capturing the impact of the Great Lakes on Ontario's climate found that Southern Ontario would experience 2-3°C of average annual warming in 2050-2060 compared to 1979-2001, whereas northern Ontario would experience 3-4°C.[132]

Table 1: Summary of MNR, NRCAN and NRTEE Climate Projections for Ontario.[133]

Changes in Temperature		
	Southern Ontario	**Northern Ontario**
Summer	• Southern Ontario is expected to increase by 2-4°C by 2050, and by 4-5°C by 2071 • Southwestern Ontario is expected to increase by 5-6°C by 2071.	• Northern Ontario is expected to increase by 2-4°C by 2071.
Winter	• Southern Ontario is expected to increase by 2-5°C by 2050.	• Northern Ontario is expected to increase by 2-7°C by 2050. • The Hudson Bay area is expected to increase by 9-10°C by 2071. • The northwestern section of Ontario's Far North is expected to increase by 8-9°C by 2100.
Changes in Precipitation and Flooding		
	• Southern and central Ontario are expected to receive anywhere from 10 per cent more to 10 per cent less summer precipitation by 2050, depending on the region. • Southern Ontario flooding is expected to increase by 10-35 per cent by 2046-2065, and by 35-50 per cent by 2081-2100.	• Overall, northern Ontario is expected to receive 10-20 per cent more precipitation between spring and fall, and 10-40 per cent more winter precipitation. • But, parts of northwestern Ontario are expected to receive anywhere from 10 per cent less to 20 per cent more summer and winter precipitation.[134]
Changes in Freezing Rain Events		
	• Total number of freezing rain days between December and February are expected to increase by 35-100 per cent by 2046-2065, and by 35-155 per cent by 2081-2100. This trend will be exacerbated farther north.	
	• Toronto and Windsor are expected to experience 35-55 per cent more freezing rain days by 2045-2065.	• Kenora, Thunder Bay and Timmins are expected to experience 70-100 per cent more freezing rain days by 2045-2065.
Changes in Water Surface Temperature		
	• Great Lakes surface temperatures are expected to continue the current warming trend, increasing by an additional 2.5-4.4°C by 2100.	

Along with rising air temperatures, water temperatures are warming as well. The National Round Table on the Environment and the Economy (NRTEE) reported in 2010 that between 1968 and 2002, Lake Huron warmed by 2.9°C, Lake Ontario warmed by 1.6°C, Lake Erie warmed by 0.9°C and since 1980, Lake Superior warmed by 2.5°C.[135] Great Lakes surface temperatures are expected to increase by an additional 2.5-4.4°C by the end of the century, according to a 2008 MNR report.[136] Similar warming trends were observed by a MNR study in 2007 for the lakes further north.[137]

Rising temperatures also affect the amount and timing of precipitation. Changes in rain and snowfall patterns are already evident in much of Ontario. For example, between 1990 and 2008 annual precipitation had already increased between 5-35 per cent in some parts of southern Canada.[138] However, precipitation patterns are regionally variable; recent data out of York University indicates that there has been a greater increase in both summer and winter precipitation with spatial variations from region to region; southern and central Ontario has experienced more increased winter precipitation than northern Ontario, while summer rainfall has increased more in northwestern and central Ontario than in other regions.[139]

Although total annual precipitation is projected to increase for the province overall, regional and seasonal variations are predicted to continue. For example, a 2008 Ministry of Natural Resources (MNR) study and a 2007 NRCAN study conclude that parts of southwestern Ontario could experience reduced summer and fall precipitation,[140] and the same MNR study suggests that certain areas of northwestern Ontario may also receive less summer and winter precipitation (see **Table 1**).[141]

Increases in precipitation do not necessarily occur smoothly – a changing climate is also a volatile one. The 2008 MNR study referenced above also states that precipitation will often come in the form of more frequent and intense storms,[142] something that the province has already begun to experience (see Chapter 4 of the ECO's 2014 GHG Annual Report). This trend will only strengthen; in 2014 an NRCAN study concluded that flooding due to storms is expected to increase in southern Ontario anywhere from 10-50 per cent by the end of the century (see **Table 1**).[143] This same study projected that extreme weather will extend into the winter season as well; more freezing rain days are expected province wide, with parts of northern Ontario experiencing the greatest increase (see **Table 1**).[144]

A warming climate will also affect ice cover and permafrost (ground that is frozen at or below 0°C for at least two consecutive years). According to a 2012 MNR study, warmer air and water temperatures mean that Ontario's lakes will be covered in ice for shorter periods and that ice thickness will decrease.[145] A 2014 NRCAN study projected that the warming climate is expected to melt and degrade permafrost across Canada, including in Ontario's Far North.[146] In turn, warming of Ontario's Far North, an ecosystem with some of the highest soil carbon densities in the world, is predicted to substantially alter the area's carbon storage capacity.[147]

Ontario's Ecosystems in a Changing Climate

Ontario's biodiversity is under enormous pressure from a variety of threats, including pollution, fragmentation and loss of habitat, invasive species and unsustainable harvesting of species. Climate change presents another major threat to species and ecosystems, both in and of itself, and in its potential to compound or catalyze other existing pressures.

Rising air and water temperatures, along with changes to rain and snow patterns, will reshape the ecology of the province. Some native plants and animals will be able to move with or adapt to these changing conditions, others will not. The ranges of other species – not previously found in Ontario – will expand into our province.

The effects of climate change – including increasing air and water temperatures, decreasing ice cover, and changes in precipitation – will alter Ontario's aquatic ecosystems. The then MNR noted that the effects of climate change will affect fish distribution, growth, reproduction, and survival. Rising water temperatures may cause a substantial decline in the productivity of some cold-water species (such as lake trout and brook trout), while many warm-water fish are projected to benefit from rising temperatures. For example, the habitats of smallmouth bass and walleye are expected to expand in northern Ontario;[148] this northward expansion of some fish species, however, can in turn disrupt other existing cold-water fish populations.[149]

These changes to Ontario's ecology will have profound repercussions. Indeed, Ontario's Biodiversity Council warned that climate change has the potential to dramatically alter our province's natural environment. According to this council, the potential effects of climate change on biodiversity include:[150]

- Changes in species' distributions (e.g., scientists have already observed northward shifts in some species' ranges);
- Changes in the timing of events, like the flowering of plants and the breeding and migration of animals; and
- Changes in the interactions between species that interrelate and/or depend on each other for survival (i.e., predators and prey; insects and host plants; parasites and host insects; and insect pollinators and flowering plants), for example, the timing of important events in the species' respective life cycles can become out-of-sync.

Ontario's Biodiversity Council's *2010 State of Ontario's Biodiversity* report contains specific indicators related to climate change that show worsening trends, including those related to ice coverage of all the Great Lakes in recent decades as well as reduced survival rates for the province's polar bears.[151]

The Ontario government's Far North Science Advisory Panel echoed many of these concerns about the current and future impacts of climate change for northern Ontario.[152] From the loss of peatlands, to melting of permafrost, to species' shifts in the boreal forest, the ecological effects of warming temperatures will cause sweeping environmental changes.

In southern Ontario, scientific experts appointed by the government have also warned about the ecological impacts of climate change. For example, the Lake Simcoe Science Committee identified that climate change has already had measurable effects on that watershed for which action is required now. These experts outlined the scope of impacts including on water quality, water quantity, water use, species composition, terrestrial habitat quality, the occurrence and abundance of native and invasive species, fish spawning times and production, fishing opportunities, stream flow, and plant and animal diseases.[153] The binational International Joint Commission has reported similar concerns affecting all parts of the Great Lakes[154] and the Ontario's government's Expert Panel on Climate Change Adaptation also raised profound concerns about these types of ecological impacts.[155]

Endnotes

[1] Kathleen Wynne, Premier of Ontario, mandate letter to Glen Murray, Minister of the Environment and Climate Change, *Re: Premier's instructions to the Minister on priorities for the year 2014*, September 25, 2014. https://www.ontario.ca/government/2014-mandate-letter-environment-and-climate-change

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> In case of default by the Ministry to keep the King's Highway in repair, the Crown is liable for all damage sustained by any person by reason of the default, and the amount recoverable by a person by reason of the default may be agreed upon with the Minister before or after the commencement of an action for the recovery of damages.)

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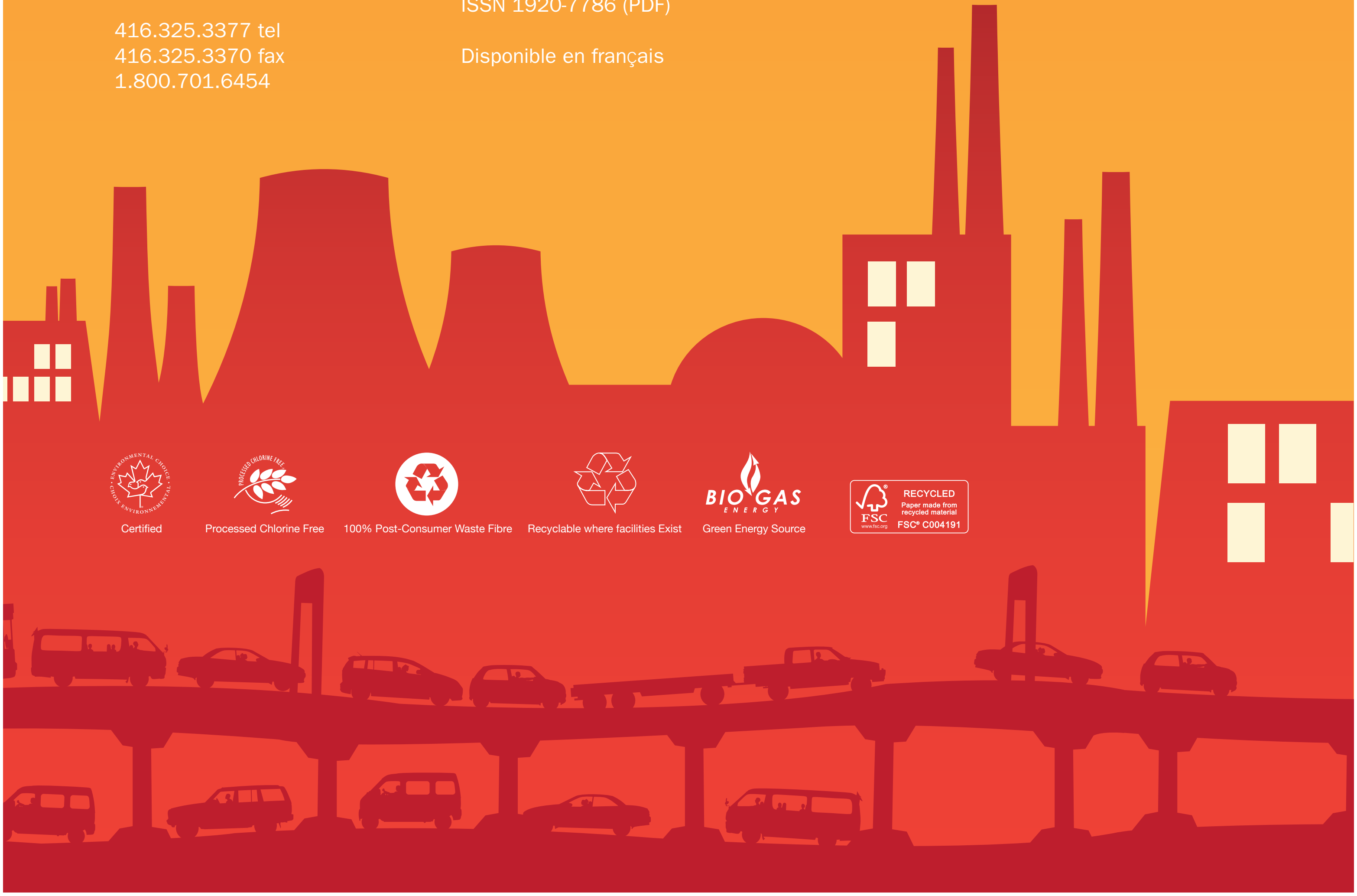

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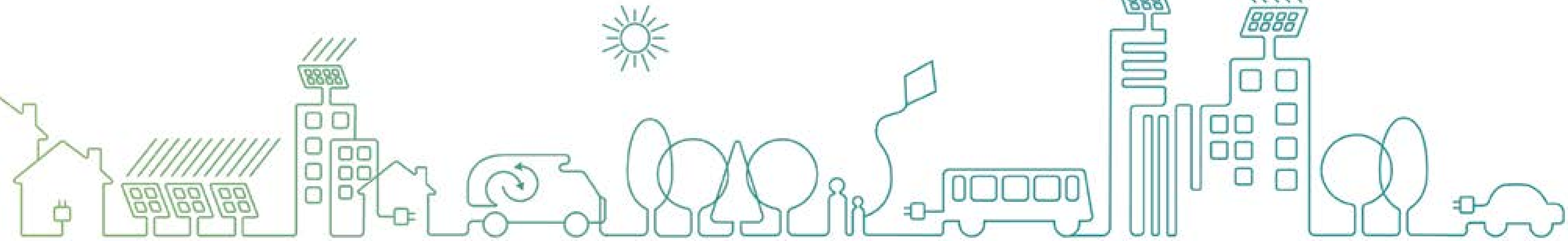
ONTARIO'S CLIMATE CHANGE STRATEGY



Ontario

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Message from the Minister

Glen Murray
Minister of the Environment and
Climate Change

Climate change is not a distant threat: it is already costing the people of Ontario. It has devastated communities, damaged homes, businesses and crops, and increased insurance rates. It is crucial that we take steps today to fight climate change, protect the environment, build a low-carbon, high-productivity economy and ensure strong communities for the future.

Ontario has demonstrated leadership and commitment to fighting climate change through a series of bold measures. We have ended coal-fired power — the largest greenhouse gas reduction initiative in North America to date. We are improving the province's transit network. We have announced a cap and trade program to limit greenhouse gas pollution and fight climate change. These actions, and others, have already taken us a long way down the road. But there is still much more to do.

This strategy sets out Ontario's vision for combating climate change and achieving our greenhouse gas emissions reduction target of 80 per cent below 1990 levels by 2050. It is our plan for a province and a future where greenhouse gas reduction goes hand-in-hand with a growing, efficient, competitive and productive economy. A separate five-year action plan to be released in 2016 will include specific commitments for meeting our 2020 emissions reduction target and establish the necessary framework to meet our 2030 and 2050 targets.

By 2050, we envision Ontarians will be using less energy and the energy we do use will be from low-carbon sources. Communities will be climate-resilient, complete and compact. More people will choose electric or other zero-emission vehicles and transit to get swiftly and efficiently where they need to go. Agricultural lands, natural areas and ecosystems will be better protected for the benefit and enjoyment of all, including First Nations and Métis peoples who rely on our shared natural environment for sustainment and spiritual benefit.

By 2050, we see an Ontario that will be employing new ways to reduce waste while ensuring that more of the waste produced is reintroduced to the economy. Industries will be thriving while generating fewer or zero emissions. Businesses and innovators will be creating world-leading clean technologies and products that drive new economic growth, productivity, and job creation.

The solution to climate change is here. It is in the individuals, cities and towns, businesses, and First Nations and Métis communities of Ontario. The cost of doing nothing to fight climate change far outweighs the cost of solving the problem. Ontario is prepared to change and move forward because our future depends on the choices we make today.

We have the ideas, the determination and the energy to lead the global drive to reduce emissions, and to make the transformational changes that must be made if we are to prevent a 2 to 4°C rise in average global temperatures and ensure a better future for our children, and our grandchildren.

We must do it. We can do it. And we will do it, together.

Introduction

Climate change is a matter of concern to Ontarians — individuals, environmentalists, scientists, organizations, industry, governments and so many others have taken small and large steps over many years to help reduce Ontario's impact.

Ontario's climate change conversation is an ongoing one. In February 2015, Ontario released a Climate Change Discussion Paper to engage Ontarians in a more in-depth conversation on this issue, and on the continuing leadership role the province should play.

The discussion paper set out a clear vision as well as near and long-term goals for fighting climate change. It asked a wide range of questions to inform the development of a climate change strategy and action plan for Ontario, including putting a price on carbon, how key sectors could best fight climate change, and how Ontario could best support the research and commercialization of technologies that would provide economic benefits and create jobs, while helping to reduce emissions.

Ontarians responded. More than 1,200 individuals and over 200 businesses and organizations attended in-person consultations in locations across the province. First Nations and Métis communities and organizations provided input. The online consultation attracted more than 300 ideas and 31,000 votes. More than 500 comments were received through Ontario's Environmental Registry. On Twitter, the climate conversation hashtag #ONclimate was used 6,900 times.

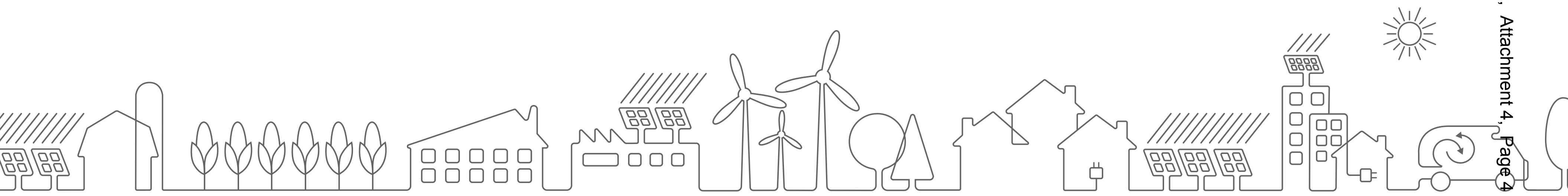
All feedback was welcomed and carefully considered. It was incorporated into this comprehensive strategy to help Ontarians adapt to climate change, meet Ontario's emissions reduction targets, and achieve our goal of a healthy, productive, prosperous province recognized as a world leader in climate change solutions.

Understanding Climate Change

Climate change is defined as any significant change in long-term weather patterns. It can apply to any major variation in temperature, wind patterns or precipitation that occurs over time.

Global warming describes the recent rise in the average global temperature. Since this rise is caused by increased concentrations of greenhouse gases trapped in the atmosphere, and since greenhouse gases are largely caused by burning fossil fuels to produce energy, scientists have concluded that human activity is largely responsible for recently observed changes to our climate.

Today, all across the planet, we are living with the consequences.



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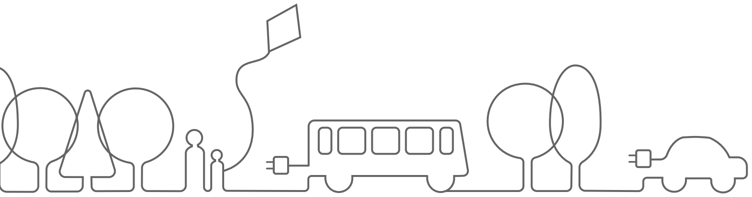
The rate of global warming over the last 50 years is almost double the rate of warming over the last 100 years. Worldwide, 14 of the last 15 years have been the warmest on record.

The National Oceanic and Atmospheric Administration predicts that 2015 will be the hottest year on record. Global warming is affecting agriculture, ecological systems, biodiversity, economies, species migration and more. Extreme weather events such as storms and droughts are becoming more frequent around the world. Melting ice at the poles has caused global sea levels to rise.

We've seen the effects in Ontario. In July 2013, a monumental rainstorm dropped 125 mm of rain in just a few hours over some parts of Ontario, leading to flooding and property damage estimated at $940 million in Toronto alone — the most expensive natural disaster in Ontario history. In December of that same year, a severe ice storm resulted in $200 million of property damage. In 2012, we experienced a March so warm it led to early blooming of apple trees, followed by a severe frost in May that caused the loss of 80 per cent of the apple crop.



The effects on infrastructure are equally apparent and costly: roads that buckle in severe heat, water mains that overflow in severe rain, hydro lines coated with heavy ice that snap and leave tens of thousands of Ontario families and businesses without power.

Climate change also affects Indigenous communities, jeopardizing First Nations and Métis ways of life, health, territories and resources. These communities depend on natural ecosystems for food supplies, and on activities such as fishing, hunting, harvesting and trapping for economic opportunities that are now being threatened by a changing climate.

Climate change is a major issue. But as a problem that humans are causing, it is also one that humans are increasingly stepping up to help resolve.

Global Priority

In 2015 — amid increasing evidence of climate change impacts — the global community has concluded that we've reached a critical point. Science tells us that greenhouse gas emissions must be drastically reduced to avoid a 2°C rise in average global temperatures. If the world does not take strong action within the next decade, we are on track to see a 4°C rise, at which point the damage from climate change would be irreversible.

There is no room for denial: we either act now to reduce carbon emissions and manage the risks posed by the impacts of climate change, or we all lose. It is with this understanding, and in recognition of our moral and ethical responsibility to this planet and to future generations, that the global community is approaching international climate talks with renewed focus and clarity.

The world's biggest and highest emitting countries have submitted greenhouse gas targets that propose significant emissions reductions and, in many cases, are working bi- and multi-laterally to pledge action and to find better low-carbon solutions.

Many provinces, states, cities, municipalities and other sub-nationals are also taking strong action on climate change and have successfully implemented solutions to reduce emissions, adapt to climate impacts, and green their economies. Many tools and technologies to reduce emissions are in existence or in development as countries and businesses invest in clean technology and innovation.

As a responsible global citizen, Ontario has already taken major steps to reduce its greenhouse gas emissions and is a leader in North America in the fight against climate change.

> "Climate change has happened because of human behaviour, therefore, it's only natural that it should be us, human beings, to address this issue. It may not be too late if we take decisive action today."
>
> **Ban Ki-Moon**
> Secretary-General, United Nations, Davos, 2015

Ontario's Leadership in Action

2015
Conference of the Parties (Paris)

Ontario will attend the UN's Conference of the Parties in Paris (COP21), held from November 30 – December 11. Governments from around the world are expected to sign a new international agreement on climate change.

2015
Climate Summit of the Americas

Ontario hosts more than 300 delegates at the Climate Summit of the Americas, a forum to advance subnational leadership on climate change ahead of the United Nations' Conference of the Parties (COP 21) in Paris in December 2015.

2015
"Under 2" MOU

Ontario is one of 11 subnational governments to sign an agreement in California to limit the earth's warming to below 2°C, which Intergovernmental Panel on Climate Change (IPCC) scientists say is needed to avoid dangerous climate change.

2015
Quebec/Ontario Joint MOU

An agreement between Ontario and Quebec to link Quebec's cap and trade program with the one under development in Ontario.

2015
Cap and trade

Ontario announces a cap and trade program to help the province meet its short and long-term greenhouse gas pollution reduction targets.

2014
An integrated transportation network

A $29-billion commitment is unveiled to improve and modernize transportation and public transit across Ontario (increased to $31.5-billion in 2015).

2014
Green diesel

New rules require Ontario fuel suppliers to include at least 2% bio-diesel (a renewable bio-fuel made from things like soy and cooking oils) in their products. The amount will rise to 3% in 2016 and 4% in 2017.

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2014
Lower emissions target met

Ontario meets its 2014 target to reduce greenhouse gas emissions to 6% below 1990s levels.

2014
No more coal power plants

Coal-fired electricity generation ends in Ontario – the equivalent of taking 7 million cars off the road.

2012
Building Code changes

New, energy-efficiency standards are added to Ontario’s Building Code to lower greenhouse gases, protect air, water and soil quality, and save energy.

2010
Incentives for electric vehicles

A new provincial program provides rebates to those purchasing or leasing eligible hybrids and electric vehicles.

2009
Clean energy

The Green Energy Act is enacted to bring more solar, wind, hydro-electric and biomass to the province, promote conservation and create clean energy jobs. Ontario becomes the leading province in wind and solar capacity as a result.

2008
The Big Move

A new plan targets expanding GO train, subway, light rail and bus rapid transit to better connect one of the largest and fastest growing urban regions in North America, the Greater Toronto Hamilton Area.

2005
Greenbelt protection

Nearly 2 million acres of environmentally sensitive areas and agricultural lands become protected in perpetuity under law.

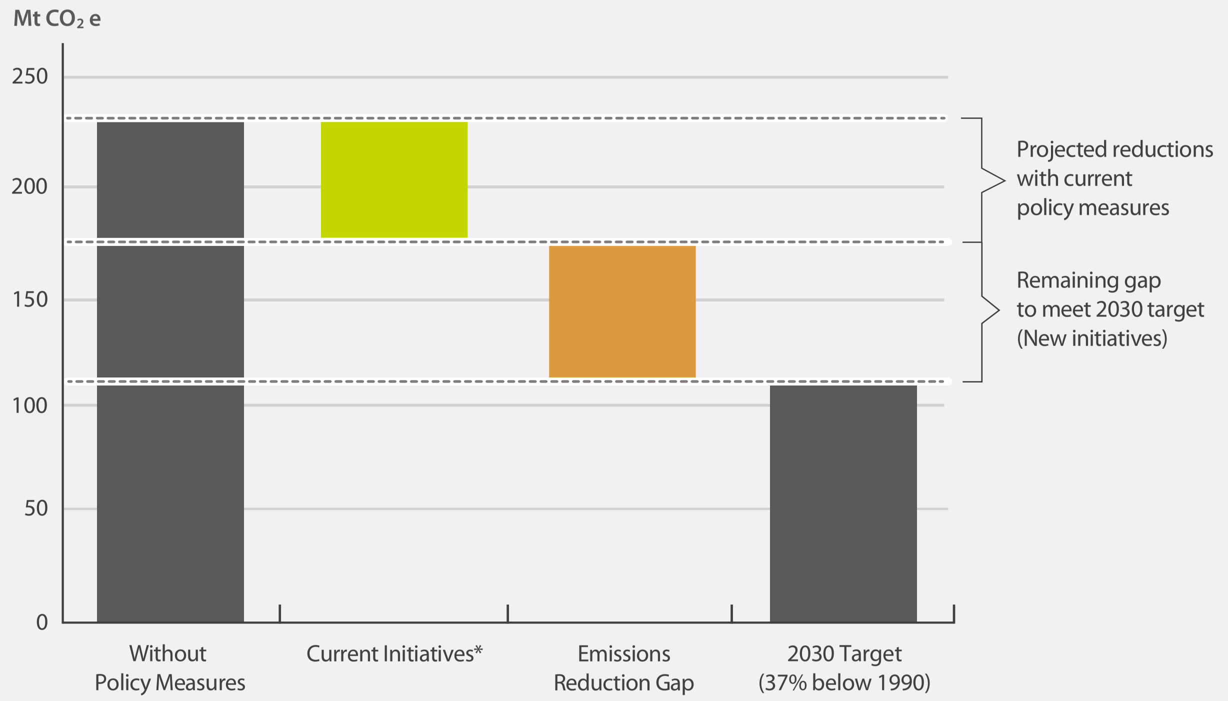
An Ontario Priority

In 2007, the Ontario government released its Climate Change Action Plan that set out a series of actions that helped us meet an ambitious goal: reduce Ontario's greenhouse gas emissions by six per cent below 1990 levels by 2014.

We succeeded. We met this goal by taking bold steps, including increasing emission-free renewable energy, smart growth planning, and supporting electric and plug-in hybrid vehicles. Most critically, we closed all of Ontario's coal-fired electricity-generating stations. This remains one of the single largest greenhouse gas reduction actions implemented to date in North America.

> "Climate change is a problem that is critically important and urgent. It needs to be fought around the globe, and it needs to be fought here in Ontario. Our actions on climate change are helping to secure a healthier environment, a more competitive economy, and a better future for our children and grandchildren."
>
> **Kathleen Wynne**
> Premier of Ontario

2030 Ontario GHG Emission Reductions with Current Initiatives*



Source: MOECC based on 2014 Ontario Climate Change Update modelling.
*Current initiatives do not include Ontario's proposed cap and trade program

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Since 2003, Ontario's coal closure plan and renewable energy policies have put us on track to eliminate 30 megatonnes of greenhouse gas emissions in 2020, compared to the business-as-usual trajectory, equivalent to taking up to seven million cars off the roads.

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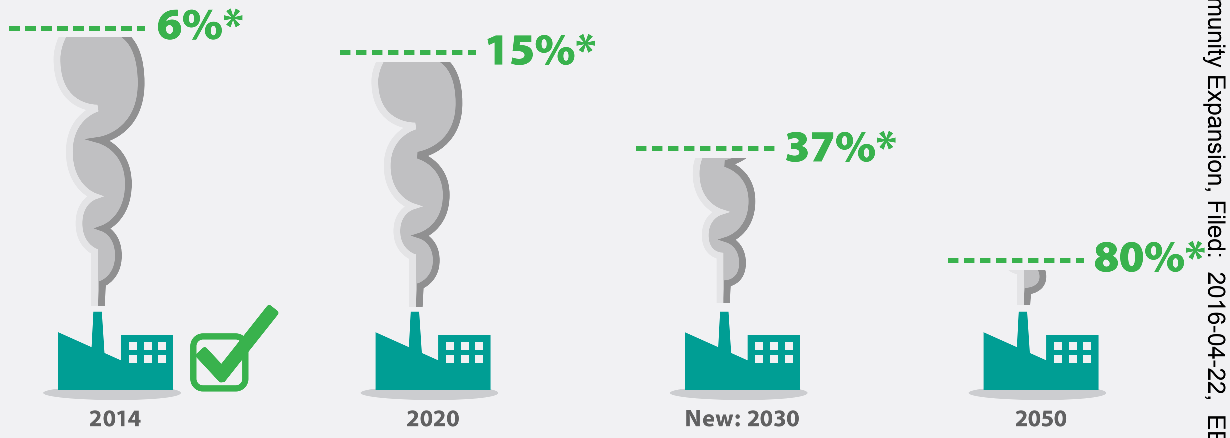
We must continue on this path. If we don't, experts predict Ontario will be a very different place over the coming decades. For example, the average temperature is likely to rise substantially. By 2050, it is estimated that some locations in southern Ontario could experience a 3.5°C rise in mean summer temperature, but it's in winter that temperature increases would be the greatest: parts of southern Ontario could see a 4°C rise and in the province's most northern reaches, winter temperatures could rise by up to 9°C.

Here's what these climate projections could mean for Ontario:

- more days above 30°C in southern Ontario, affecting sensitive populations including seniors
- extreme heat, worsening air quality, new and migrating disease vectors, as well as water and food contamination issues impacting human health
- significantly more variability in weather, including severe wind, ice and rain with potential effects that include flooding, soil erosion, infrastructure damage and power system outages
- winter ice road seasons may shorten, reducing access for remote First Nations communities, and further affecting the cost and availability of foods and other goods
- permafrost in the Hudson Bay Lowlands may melt, altering the unique ecosystems and habitat in the area, and resulting in the release of carbon stored in Far North peatlands
- changed growing seasons and species migration patterns, affecting rural and northern communities and First Nations and Métis communities' livelihoods
- disruption of food production, access and price stability
- changed recreational and tourism opportunities, including a shortened ski season
- plant and animal species ranges are already shifting, and could shift northward by hundreds of kilometres over the next century
- loss of cold water fish species in warming lakes and streams, and the potential arrival in Ontario of invasive species, such as the mountain pine beetle and ticks carrying Lyme disease.

Ontario's greenhouse gas reduction targets



* below 1990 greenhouse gas emission levels

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Our government is committed to minimizing these impacts and ensuring our province, people and environment are prepared for and can cope with global climate change.

To achieve this, Ontario has set a long-term goal: reduce greenhouse gas emissions by 80 per cent below 1990 levels by 2050. To help mark progress and keep on track, we have set two mid-term targets: 15 per cent below 1990 levels by 2020 and 37 per cent below 1990 levels by 2030.

Meeting these goals requires a fresh approach to climate change — one that accounts for the shifting global context, recognizes the opportunities in a low-carbon, high-productivity economy, and enlists the support of all Ontarians to find new solutions.

Ontario uses 1990 as a baseline for its targets, which is common in the international community and aligns with the United Nations Framework Convention on Climate Change.

……

Ontario is already more than two-thirds of the way towards achieving its 2020 target.

First Nations and Métis Communities

Climate change has significant impacts on First Nations and Métis communities that depend on natural ecosystems for food supplies and economic opportunities. We want to work in partnership to address the challenges, and to develop a greater understanding of how traditional knowledge and expertise can be leveraged in efforts to address climate change. Ontario seeks to support the First Nations and Métis communities' unique relationship with the land, to help ensure the survival of Indigenous cultures, values and languages. Through Ontario's Climate Change Strategy, we are committed to an ongoing conversation with First Nations and Métis communities to inform the development of specific actions.

Carbon Pricing: A Cornerstone of Emissions Reduction in Ontario

Globally, there is broad consensus that carbon pricing, such as cap and trade, is the best tool for reducing greenhouse gas emissions and driving a prosperous low-carbon, high-productivity economy.

Billions of tonnes of greenhouse gas pollution are currently being pumped into the atmosphere at almost no cost to emitters. Putting a price on carbon assigns economic value to our atmosphere, our health and our environment.

In April 2015, Ontario announced it will join the cap and trade system under the Western Climate Initiative, Inc., partnering with other jurisdictions, including Quebec and California, and making carbon pricing a cornerstone in Ontario's fight against climate change.

Ontario will join the cap and trade system under the Western Climate Initiative, Inc.

With Ontario's introduction of a cap and trade system, more than 75 per cent of Canadians will live in a province with some form of carbon pricing.

Carbon pricing has many advantages. It reduces greenhouse gas emissions as businesses and households incorporate the cost of emitting carbon into their decisions, encouraging companies and consumers to move away from fossil fuels and towards cleaner and more efficient ways of doing business. Emitters will actively choose to reduce emissions when doing so is cheaper than paying the carbon price.

This improves economic efficiency and inspires economic benefits. As emitters are motivated to lower their carbon footprint, carbon pricing can spur clean technology research and development, as well as growth in the clean technology sector.

Carbon pricing also gives companies the flexibility to reduce emissions in a way that best suits their manufacturing processes and business plans, helping them find the lowest-cost reductions first instead of more traditional approaches that dictate how facilities should reduce their emissions.

Ontario's cap and trade system will set a hard ceiling on the amount of pollution allowed by most sources in the province, and this ceiling will be lowered over time to ensure emissions continue to fall. Ontario's program will cover a wide variety of sectors, including gasoline and natural gas distributors. The initial cap in 2017 would be set to align with the best estimate of emissions in that year, declining at a rate to help ensure the province achieves its 2020 emissions reduction target. This will encourage companies to find new ways to reduce their carbon footprint. It will foster innovation as clean technology becomes more in demand, and as researchers, entrepreneurs and start-ups rise to the challenge.

As of August 2015, 39 national and 23 subnational jurisdictions around the world will have implemented or are scheduled to put a price on carbon.

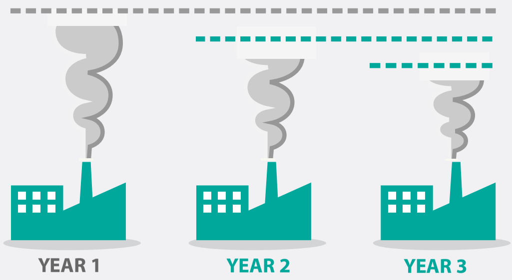
Over time, a cap and trade system can accumulate proceeds as emitters purchase allowances from the government through, for example, auctions. Specifics on how Ontario's cap and trade proceeds will be used are still being worked out. Proceeds will be reinvested in a transparent way back into projects that reduce greenhouse gas pollution and help businesses transition to a low-carbon economy. Projects may include helping families consume less energy through more energy-efficient appliances or housing, building more public

How Does Cap and Trade Work?

Cap and Trade: Reducing Greenhouse Gas Pollution

The "cap" sets a maximum limit on the amount of greenhouse gas pollution industry can produce.

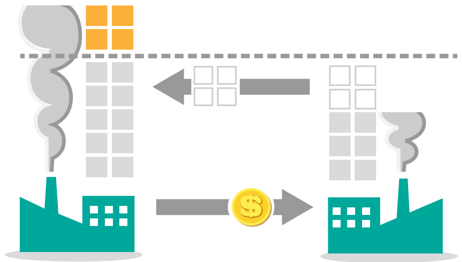
Over time, the cap is lowered, which means less greenhouse gas pollution and improved air quality.



Cap and Trade: Rewarding Innovation

If a company does not emit as much as their cap, they are rewarded with a credit.

If a company emits too much, they need to invest in credits from other companies.



Cap and Trade: Protecting Ontario for Future Generations

The money raised will be reinvested back into projects that reduce greenhouse gas pollution like public transit, and energy retrofits.

Reducing Greenhouse Gas pollution will help to protect the air we breathe, the water we drink and the health of our children and grandchildren

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transit to give people more transportation options, and supporting renewable energy, energy conservation, and building retrofits.

Ontario has been engaging the public, business and environmental leaders on options for its cap and trade program design. We will continue to work with our partners to refine the program before posting a draft cap and trade regulatory proposal on the Regulatory and Environmental Registries for public comment in early 2016.

In most cap and trade systems, emitters are allowed to purchase offset credits to use to fulfill part of their compliance obligation (i.e., to offset their emissions). Forestry and agriculture are sectors from which emitters will be able to purchase offsets to comply with program rules.

Ontario's Climate Change Strategy

Ontario's government recognizes climate change as a problem, one with solutions and opportunities.

Ontario's Climate Change Strategy sets out the transformative change required to reduce greenhouse gas emissions by 80 per cent below 1990 levels by 2050.

This strategy builds on the foundation already established in Ontario to innovate and invest in a high-productivity economy that values our natural capital.

It shifts Ontario to an economy that will better protect our air, land and water and support growth and prosperity, while leaving a legacy of a healthy world for future generations.

Following consultation and input from Ontarians, our Climate Change Strategy highlights five areas of transformation:

1. A prosperous low-carbon economy with world-leading innovation, science and technology
2. Government collaboration and leadership
3. A resource-efficient, high-productivity society
4. Reducing greenhouse gas emissions across sectors
5. Adapting and thriving in a changing climate

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Ontario's Climate Change Strategy

A High Productivity Low Carbon Economy and Society

A Prosperous Low-Carbon Economy with World-Leading Innovation, Science and Technology
- Investment and Risk Capital Actions
- Research and Innovation Strategy
- Assist Businesses in their Low-Carbon Transition
- Build Green Infrastructure

Adaptation and Risk Awareness
- Climate Change Adaptation and Government Decision-Making Alignment
- Climate Modelling and Risk Assessment Collaborative
- Approach to Assess Carbon Sequestration
- Climate Change and Agricultural Sector Initiatives Alignment

Government Collaboration and Leadership
- Climate Change Legislation
- Climate Change Integrated with Government Decision-Making and Infrastructure Planning
- Aboriginal Implementation Frameworks
- Carbon Neutral Government

A Resource-Efficient, High Productivity Society
- Zero Emission Vehicles Actions
- Goods Movement Actions
- Low Carbon Fuels
- Net-Zero-Energy Buildings Actions
- Create Incentive Programs
- Transportation and Land Use Planning Initiatives

Reducing Greenhouse Gas Emissions Across Key Sectors
- Climate Change in Long-term Energy Plans
- Resource Recovery and Waste Reduction Framework
- Review of Policies and Programs that Incent Fossil Fuel Use and Technology

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The following pages provide an overview of each of these five sections. We are just five years away from reaching our 2020 target of 15 per cent below 1990 levels. This strategy offers a snapshot of where we expect to be in 2030 upon reaching our next target of 37 per cent below 1990 levels. Each section discusses the practical short and long-term actions we will take to get there.

This strategy will be supported by a series of five-year action plans, the first of which will be released in 2016.

SECTION 1

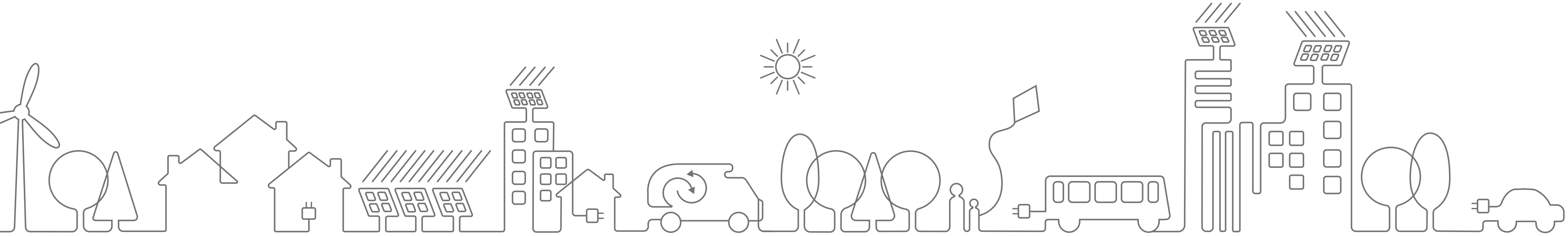
A Prosperous Low-Carbon Economy with World-Leading Innovation, Science and Technology

As governments across the world begin to tackle climate change and work to achieve their greenhouse gas targets, there will be immense global demand for cleaner technologies, energy, infrastructure and low-carbon solutions.

Ontario has already recognized the opportunity. Our Green Energy Act created a stable market for clean energy innovation to thrive. Today, Ontario has the fastest growing clean-tech sector in Canada and is home to 36 per cent of all the nation's clean-tech companies with proprietary technologies. More than 30 wind and solar manufacturing companies, as well as hundreds of global-leading water and wastewater technology firms, are growing and creating jobs in Ontario. Businesses, innovators and researchers are putting their knowledge and talents towards building a greener economy here, and around the world.

In just 10 years, Ontario has become a North American leader in developing, using and manufacturing clean energy. With our highly skilled and diverse workforce, abundance of natural resources, globally competitive tax system, diverse economy, and the world's soundest banking system, Ontario is well-placed to be a leader in the next generation of clean technology solutions that will help the world mitigate and adapt to climate change.

The Toronto Stock Exchange and TSX Venture Exchange are currently home to 116 clean technology and renewable energy companies, with a total market capitalization of $27 billion.



Ontario Clean-Tech Firms: At the Leading Edge

- **Truly Green Farms** of Dresden, Ontario runs a 9-hectare carbon neutral greenhouse using the carbon dioxide emitted by neighbouring ethanol producer Greenfield Ethanol, ensuring 15,000 metric tonnes of planet-warming gases stays out of the atmosphere each year. They are also a leader in North America by utilizing waste heat in production.
- **Pond Biofuels** of St. Marys has developed a technology that captures carbon dioxide from raw stack emissions, and produces algae that can subsequently be converted into biofuels. Investments from the Ontario government ($2.4 million) and federal government ($2.3 million) assisted Pond Biofuels in demonstrating and validating its high-tech CO_2 sequestering process, providing a solid foundation for launching marketing and commercialization efforts.
- **Hydrogenics Corporation** of Mississauga is a leading provider of clean hydrogen generation infrastructure and fuel cell solutions. In 2015, it signed a 10-year exclusive agreement, valued at over $71 million, to supply Alstom Transport with hydrogen fuel cell systems for regional commuter trains in Europe. The Ontario government provided support to the Hydrogenics Corporation through the Innovation Demonstration Fund and the Strategic Jobs and Investment Fund.
- **Ecobee** is a Toronto-based tech company that makes smart thermostats to help people increase home comfort and save energy. The company introduced the world's first Wi-Fi connected thermostat in 2009 and has continued to innovate and invest in energy-saving technologies. An early investment from the Ontario Emerging Technology Fund helped ecobee build its team and the technologies it needed to grow.

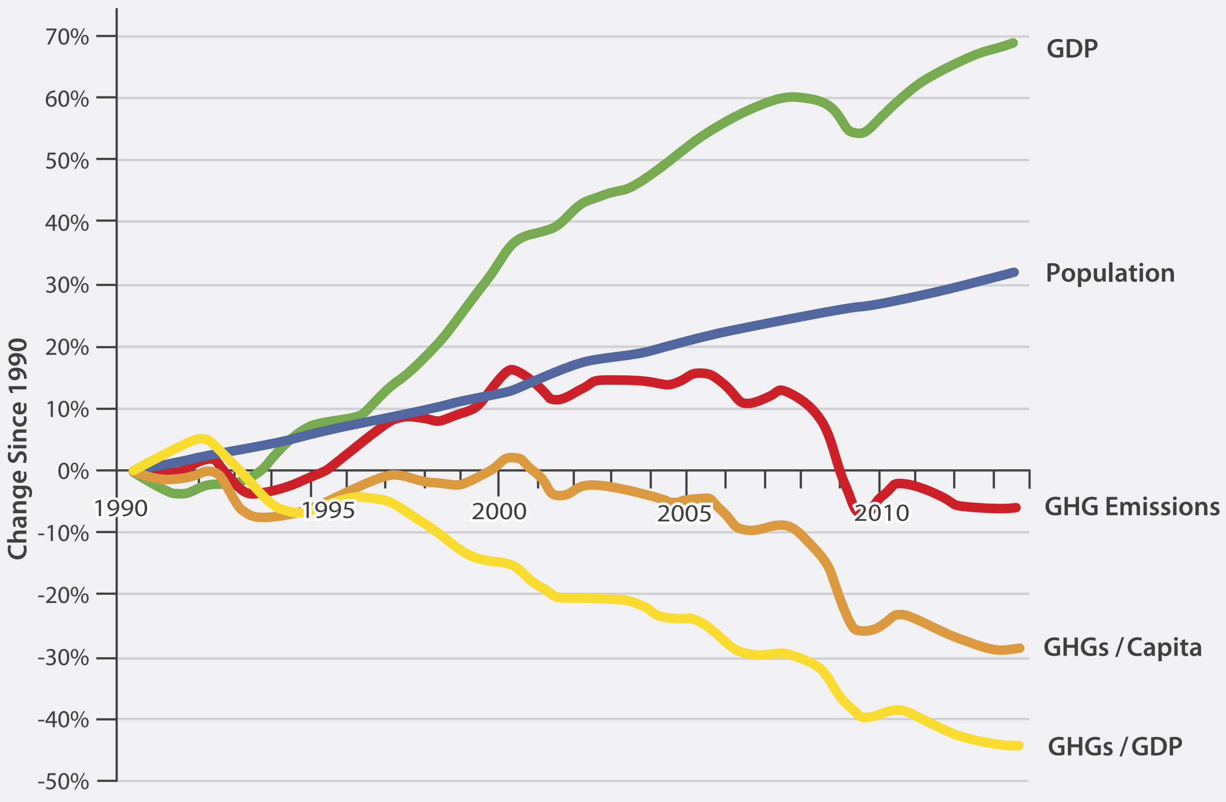
Economic Opportunity

Worldwide, it is estimated that $6 trillion dollars per year will be spent to meet infrastructure needs over 15 years. Making these investments both low-carbon and climate-resilient will require a massive scaling-up of new green technologies, goods and services.

The growing population presents another opportunity. The Organization for Economic Co-operation and Development (OECD) projects that, if current trends continue, per capita consumption will more than triple and the global gross domestic product will almost quadruple as the global population grows, requiring 80 per cent more energy by 2050. Supporting this growth while reducing emissions will only be possible by developing new methods, innovative new products, and a low-carbon, high-productivity global economy.

Ontario is working with the business and science communities to develop and bring to market unique made-in-Ontario ideas, technologies and solutions.

Change in Ontario GDP, Population and GHG Emissions since 1990



Source:
GHGs: Environment Canada, National Inventory Report 2015
GDP: StatsCan (Table 384-0038, Gross domestic product, expenditure-based, provincial and territorial, annual.) - chained 2007 dollars
Population: StatsCan (Table 051-0001, Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual)

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The Bottom Line

Citibank estimates the world will need to invest $192 trillion over the next 25 years to meet global energy demands through conventional, carbon-intensive means. To meet these demands in a low-carbon way will cost an estimated $190.2 trillion.

Ontarians are already paying the price for climate change impacts in terms of damaged homes, businesses, crops and increased insurance costs. The 2013 ice storm in Southern Ontario resulted in $200 million in insurance payments, and severe floods across the Greater Toronto Area caused nearly $1 billion in damages. The National Round Table on the Environment and the Economy estimated that the economic costs of climate change in Canada will rise from about $5 billion annually in 2020 to between $21 and $43 billion by 2050. Since investing in a low-carbon economy would reduce the risk of incurring these costs, mitigate the effects and benefit us all, we have to ask the question: why would we not?

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Reaching 37 Per Cent by 2030

By 2030, we envision that Ontario will be building on existing networks and programs to enhance scientific knowledge, supporting the development and deployment of new low-carbon technologies and solutions, and encouraging the growth of clean-tech companies.

The Toronto Stock Exchange and S&P Dow Jones have launched three new climate change indices for Canada designed to measure the performance of companies relative to their carbon footprint.

We will have put in place financial mechanisms to help innovative start-ups and commercialize products that reduce emissions.

We will have taken key steps towards being a global hub for climate science, low-carbon innovation and technology, and will have captured a significant share of the global clean-technology market. Ontario will focus on the following actions to achieve these goals.

1. **Attract and retain investment and risk capital for low-carbon innovation.** Our strategy supports the growth and strength of Ontario's low-carbon and clean-tech industries. We will provide local entrepreneurs access to capital to help start-ups grow and thrive. We will help bridge the gap between development and commercialization of new technology, nurturing local innovation through all stages of development.

According to the Conference Board of Canada, each $100 million invested in Ontario in climate-related technologies is estimated to generate a gain of $107 million in gross domestic product, and 1,400 new jobs.

Risk capital is a vital component of the innovation economy, especially in the context of helping companies scale up. Ontario's government has introduced several programs to help early stage companies grow. Examples of capital support programs include the Ontario Venture Capital Fund, the Northleaf Venture Catalyst Fund, the Investment Accelerator Fund, and the Scale Up Ventures Fund.

2. **Develop actions and strategies to support innovation, research and development of technologies that can reduce greenhouse gas emissions.** Our strategy recognizes the economic benefits and opportunities in the new global low-carbon economy. We will support innovation, research and development in technologies that reduce greenhouse gas emissions and boost Ontario's global competitiveness.

3. **Develop new ways to reduce greenhouse gas emissions through fuel switching, energy reduction and other measures that foster innovation.** A shift to a low-carbon, high-productivity economy will require greater conservation and efficiency. Our strategy will support new energy and emissions management approaches to help Ontario firms of all sizes be more competitive and efficient.

4. **Build green infrastructure** to restore ecosystems, reduce atmospheric carbon and protect and expand carbon sinks. Green infrastructure is inter-connected networks of green open spaces that provide a wide range of ecosystem services. Benefits of green infrastructure include cooling communities, reducing the urban heat island effect which, in turn, improves air quality and reduces the impacts of heat stress on our health, preserving biodiversity and pollinator health, capturing and filtering rainwater to reduce flood risk and improve water quality, and promoting carbon sequestration to reduce emissions.

The *Cora Building* in Waterloo is a large commercial office building that integrates green infrastructure through bioswales and rainwater collection. Rain water is collected and used to flush toilets and irrigate the grounds. Parking lots are lined with bioswales to hold and clean storm water runoff, bringing nature and vegetation into the space and reducing the impact on municipal storm water infrastructure.

SECTION 2

Government Collaboration and Leadership

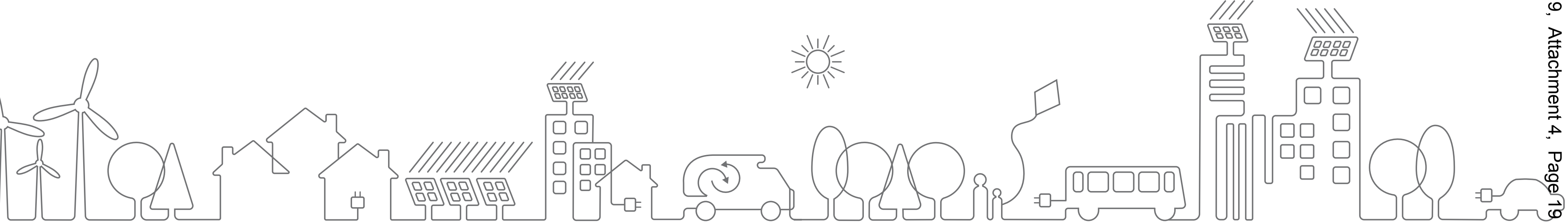
No one nation, group or government can win the fight against climate change on its own. The good news is we won't have to. With scientific evidence and rising awareness comes recognition that taking action is the right thing to do. People are taking a stand and working together.

We could not have met our 2014 emissions reduction target without the collaboration and hard work of municipalities, individuals, organizations, business and industry across the province.

In 2007, the City of Guelph endorsed its Community Energy Initiative with ambitious goals that included using less energy in 25 years, consuming less energy and water per capita than comparable Canadian cities, and producing less greenhouse gas per capita than the global average.

We are equally confident Canada's new federal government recognizes the urgency of the climate change challenge as well as the importance of collaboration with provinces, territories and international partners. Ontario has already made great strides. With a willing partner in Ottawa, we can do so much more and help make Canada a world leader on climate action. Ontario looks forward to working with the new federal government in developing an ambitious Canada-wide approach to climate change that is regionally equitable and provides meaningful support for provincial actions.

A Canada 2020 poll shows that 84 per cent of Canadians believe that prosperous countries such as Canada have an obligation to show international leadership in reducing greenhouse gas emissions.



Collaboration Beyond Borders

Ontario is actively building alliances with leading jurisdictions beyond our borders to improve global and regional action on climate change through greater numbers, and to fortify our efforts at home.

We have signed a Memorandum of Understanding with Quebec on concerted climate change action. We have also signed California's Under 2 MOU which supports the principle of limiting global warming to 2°C to protect the planet from irreparable damage, and sets emission reduction targets for all signatories.

In July 2015, Ontario's Climate Summit of the Americas brought together climate change leaders and delegates from across the Americas. A key achievement was the first-ever Pan-American Climate Action Statement, signed by Ontario and 22 states, regions and municipalities. This signing recognized a growing consensus on the urgency of fighting climate change, and the need to work together to continue to reduce greenhouse gas emissions — including support for carbon pricing.

Leading Change in Ontario

The Ontario government has more than 63,000 employees, more than 3.25 million square metres of owned building space and more than 6,000 vehicles. We have a responsibility to reduce emissions in our own workplaces and operations, and we have taken up that challenge.

The Ontario Public Service Green Transformation Strategy and other initiatives are helping to address climate change issues in government policies, operations and decision-making practices. To date, we've reduced greenhouse gas emissions from the province's vehicle fleet by 18 per cent, from business-related employee air travel by 18 per cent, and from government-owned buildings by 30 per cent, as compared to 2006.

In 2014, Ontario successfully launched a Green Bond program, with an inaugural global Canadian dollar bond of $500 million. As the first Canadian province to issue a green bond, Ontario demonstrated green economy leadership. Market demand for the bond was strong, and the province invested the funds raised in Toronto's Eglinton Crosstown Light Rail Transit Line.

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Since 2007, the Ontario government has relied on Enwave's Deep Lake Water Cooling system to cool its Queen's Park complex in downtown Toronto. Deep lake water cooling technology uses water from Lake Ontario to provide a reliable, efficient and sustainable source of cooling for offices, reducing electricity use by 75 per cent compared to traditional air conditioning.

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Reaching 37 Per Cent by 2030

As Ontario moves towards its second mid-term target of 37 per cent below 1990 levels by 2030, and ultimately to 2050, the government will continue to lead and collaborate, in the province and globally, in the fight against climate change.

By 2030, Ontario will have enhanced emissions reductions in government facilities and operations. The public sector — including municipalities, hospitals, schools and universities — will have started to significantly reduce their carbon emissions.

Ontario will have established collaborative partnerships with First Nations, Métis, business, academic and other non-governmental partners to facilitate sharing, learning and collective action towards a low-carbon, high-productivity economy.

Partnerships with other jurisdictions will help reduce emissions globally, and will boost innovation and competitiveness at home.

Ontario will take the following actions to achieve these goals:

1. **Introduce climate legislation that, if passed, would establish a long-term framework for action.** Legislation provides structure and direction for future policy delivery, and would establish a commitment to act. It will also enshrine in law Ontario's cap and trade program.
2. **Integrate climate change mitigation and adaptation considerations into government decision-making and infrastructure planning.** The fight against climate change crosses many sectors and falls under the purview of all ministries. Our climate change strategy will ensure an all-of-government approach so decisions made will take climate change considerations, including adaptation, into account. For example, upon proclamation of the Infrastructure for Jobs and Prosperity Act, the province and the broader public sector would be required to consider environmental impacts and climate change resiliency in making infrastructure decisions. This will also guide the province's next long-term infrastructure plan and support Ontario's historic investment of $130 billion in public infrastructure over 10 years.
3. **Introduce changes to government operations, procurement, employee training, building retrofits and in other areas to help government move towards carbon neutrality.** As a major employer, energy user and purchaser of goods and services, the Ontario government has the responsibility and opportunity to lead by example in making provincial operations carbon neutral. Further, the government can utilize procurement, policy and regulatory measures to help drive the transformative change needed across the economy.
4. **Work with First Nations and Métis communities to help implement the climate change strategy and to inform development of the action plan.** Our strategy recognizes that impacts of climate change are keenly felt in First Nations and Métis communities. We will work in partnership to address the challenges, and to develop a greater understanding of the key role First Nations and Métis communities can play in advancing our broader climate change approach using traditional knowledge, while recognizing the sovereignty and autonomy of First Nations and Métis communities.

SECTION 3

A Resource-Efficient, High-Productivity Society

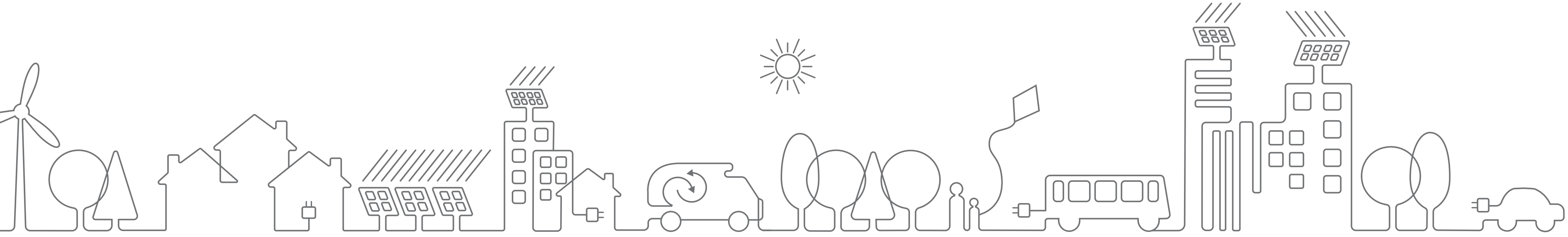
Making better and more productive use of all natural resources, including energy, water and land, is crucial to addressing climate change.

Ontario has already come a long way in this regard. In 2014, about 90 per cent of Ontario's electricity generation came from low-carbon sources, including nuclear, hydro, wind, biomass and solar.

The province has some of the most advanced energy conservation programs in North America. Smart meters and consumer demand response programs let Ontarians control and understand their electricity consumption better, while smart grid technologies are helping utilities operate more advanced, more efficient, modern grids. Improvements in residential, commercial and industrial electricity intensity mean that while economic activity is increasing, demand for electricity remains relatively flat.

Further, individuals and businesses increasingly understand the benefits of a circular economy: one that effectively manages and recycles products and materials, runs on renewable energy, and grows and creates jobs with the least possible negative effects on human life or the ecosystem.

By 2025, 20,000 megawatts of renewable energy is expected to be online, representing about half of Ontario's installed capacity.



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The Challenge

While we've made significant progress in the electricity sector to make our energy cleaner, energy use in other parts of Ontario's economy — including for buildings, heating, transportation and powering our industries — continues to be an issue.

That's because energy in these areas is primarily derived from combustion of fossil fuels, which accounts for 80 per cent of all energy consumption in Ontario. Our greatest challenge to reaching our greenhouse gas emission targets lies in reducing our dependence on fossil fuels.

Geothermal heating and cooling systems, often called geoexchange or ground source heat pumps (GSHPs), are an efficient way to heat buildings. When paired with low-carbon electricity, this technology can be virtually emissions free. Switzerland, for example, has more than 25,000 GSHP systems in operation, and is estimated to have the highest installed density in the world. Swiss public utilities have used a system called energy contracting to effectively provide an incentive for the adoption of GSHPs, which involves planning, installing, operating, and maintaining GSHP systems at their own cost and selling the heat (or cold) to the property owner at a contracted price in cents per kilowatt hour.

Reaching 37 Per Cent by 2030

Improved resource efficiency must include conservation, awareness and ensuring the right signals get into the marketplace.

By 2030, we envision that Ontario's cap and trade program will have helped to adjust the economic signals that favour fossil-fuel based energy. We will have moved further towards a low-carbon, high-productivity economy where economic growth is separated from greenhouse gas emissions.

We will have a reliable, cost-effective, low-emissions electricity system that can accommodate new demand as the economy shifts from fossil-fuel energy to low-carbon electricity. Industry and consumers will be using energy more efficiently, with increasing access to a variety of low-carbon energy sources. Energy conservations measures will have expanded across sectors.

Ontario will take the following actions to achieve these goals:

1. **Establish greenhouse gas reductions as a priority in the next Long-Term Energy Plan.** Ontario's 2013 Long-Term Energy Plan is the roadmap for our electricity system and other sources, establishing renewable energy targets to 2025 and conservation targets to 2032. Our climate change strategy will ensure a continuation of the positive trends of the electricity sector, as well as continued improvement in conservation, efficiency and clean energy use to achieve deeper, long-term greenhouse gas emissions/reductions.
2. **Review and make recommendations regarding existing policies and programs that support fossil fuel use and fossil fuel intensive technologies.** Our strategy recognizes the negative impact of fossil fuels on the climate. We will look at removing existing initiatives that support fossil fuel use, which could free up funds to better support sustainable development and clean technologies and energy. We will communicate to users that moving away from fossil fuels makes financial sense since the cost of renewable energies such as solar and wind is dropping significantly.
3. **Implement a resource recovery and waste reduction framework to assist Ontario's shift to a circular economy.** The spinoff effects of a circular economy cross all sectors of Ontario's economy. Our strategy's goal of increasing waste prevention and recovery of resources will help to reduce the greenhouse gas emissions that result from landfilling, as well as from various stages of production, including extraction and processing of resources, and transport and packaging of products.
4. **Develop data and metrics to measure GHG impacts of projects and programs including progress towards GHG reduction targets.** Develop tools to assess climate change risk to food production, human health, vital infrastructure, and the economy.

Every year in Canada, approximately $1 billion worth of recoverable materials are lost to landfill. Recovering just 60 per cent of waste materials could create almost 13,000 jobs and contribute $1.5 billion to Ontario's GDP.

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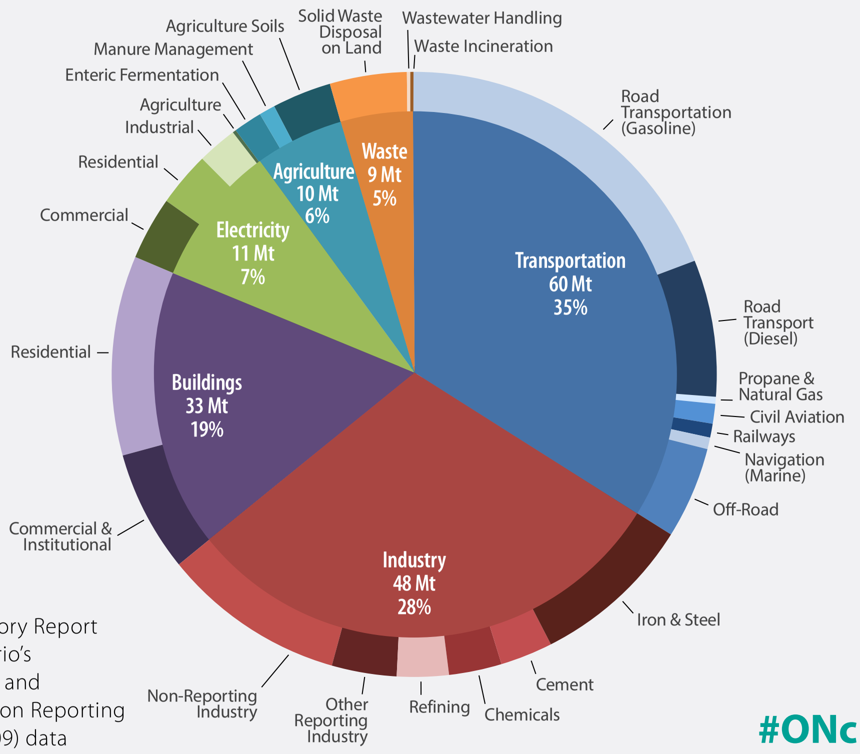
The International Energy Agency highlights fossil fuel subsidy reform as a key component of meeting the global target to keep global temperatures from rising above 2°C.

SECTION 4

Reducing Greenhouse Gas Emissions Across Key Sectors

Ontario's 2013 GHG Emissions by Sector



Source: National Inventory Report 2015 (2013 data), Ontario's Long-Term Energy Plan and Greenhouse Gas Emission Reporting regulation (O.Reg 452.09) data

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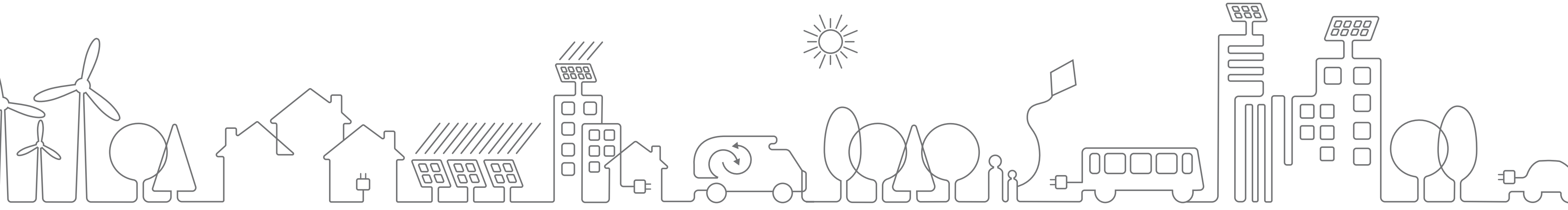

Most of Ontario's greenhouse gas emissions come from the transportation, industry and buildings sectors. A low-carbon, high-productivity economy must be one that pollutes less, wastes less, and makes more efficient use of energy, waste and resources.

Complementary, sector-specific actions and technology innovation are critical to achieving greenhouse gas targets. Ontario's cap and trade system will be a foundation of all efforts through 2030 and beyond.

Transportation: At 35 per cent, transportation emissions are the single-largest source of emissions in the province. In fact, emissions from passenger car trips alone (well over 10 million per day) are greater than the emissions from Ontario's iron, steel, cement, chemicals sectors combined. This highlights the important role that transit can play in getting people out of cars. However, existing land use patterns and the location of suburban employment centres means that transit alone will not serve the majority of Ontarians' day-to-day needs. More transit will help alleviate congestion and serve to offer our rapidly growing population a viable low-carbon transportation alternative.

Ontario's approach to reducing transportation emissions will recognize the emission reduction potential of different technology and mode choices. Ontario must transition as many existing drivers as possible to transit, cycling and walking. New communities need to be built alongside transit with sustainable densities. Ontario also recognizes that millions of passenger trips per day will be made by automobile. That is why our strategy will focus on helping households shift to affordable and viable ultra-low and zero-emission vehicles, including multi-vehicle households where second, third or fourth cars are often used primarily for commuting.

In 2011, single-occupant vehicles in the Greater Toronto and Hamilton Area accounted for 46 per cent of all trips made in the province.

Before 2008, there were fewer than 1,000 public electric vehicle charging stations in all of Norway. In 2009, programs were launched simultaneously by Transnova nationally and locally in Oslo to increase the availability of EV infrastructure. As of 2014, there were nearly 6,000 public charging stations across Norway, mostly using regular alternating current outlets.

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Industry: Ontario's industrial emissions, the second-largest source of emissions overall, dropped by 21 per cent between 1990 and 2012. In many cases, this was due to the implementation of energy efficiency measures. This was also due to shifts in the economy from a predominance of low-value-added manufacturing to a more diversified economy. There is also a decreasing trend in carbon intensity of manufacturing industries, measured as emissions per dollar of manufacturing GDP, which was 34 per cent lower in 2012 than in 1990. In other cases, emissions reductions have been due to contraction and shifts in the manufacturing sector, including slowdowns in key industries such as forestry.

In 2014, the industrial sector represented 14.4 per cent of Ontario's economy, contributing $104 billion to the province's GDP.

Buildings: Ontario's third-largest source of emissions — the buildings sector — represents about 19 per cent of the province's total greenhouse gas emissions. This number rises to about 24 per cent if electricity used by equipment and appliances in buildings is taken into account.

Measures such as conservation and retrofits have meant a significant improvement in emissions intensity in the buildings sector — about 32 per cent between 1990 and 2012. However, emissions caused by buildings overall are rising due to population and economic growth, and the associated increase in buildings and floor space.

Since 2009, Toronto's Eco-Roof Incentive Program has helped fund the installation of more than 100 green and cool roofs on buildings across the city. Green and cool roofs help reduce urban heat and associated energy use. Green roofs also help manage storm water runoff, enhance biodiversity and improve air quality

The one-quarter acre Rooftop Urban Farm at Ryerson University in Toronto produced more than 3,500 kg of fresh vegetables for consumption on campus over one summer, while also reducing associated greenhouse gas emissions from transportation of agriculture, cooling the campus and saving energy.

Agriculture: Agriculture has a complex relationship with emissions. Some farming activities — raising livestock, using on-farm equipment such as tractors or food processing — add emissions. Plants and vegetation, on the other hand, absorb carbon dioxide, a key greenhouse gas, and store it in plant material and the soil, thereby reducing atmospheric carbon. Land use planning that helps protect agricultural land — which is fundamental to Ontario's capacity to produce food — climate-smart farming practices, and energy efficiency all help ensure the right balance for the agri-food sector's success, the health, security and productivity of fertile lands, and the effective management of emissions.

Reaching 37 Per Cent by 2030

All sectors of the province's economy, including the transportation, industrial and building sectors, are vital to creating jobs and ensuring a good quality of life in a thriving Ontario. Our strategy will support the continuing strength and growth of all sectors as we work together to decrease emissions, transform the buildings in which we work and live, and change how people move from place to place.

By 2030, we envision that Ontario will have started to build the framework to minimize energy use and to use renewable energy in buildings. We will have put in place buildings-science expertise, production capacity for buildings materials, and the technologies and workforce to maintain and build near-net-zero buildings. Our commitment to resilient buildings will help communities cope with and withstand the impacts of climate change.

We will have progressed further in our ongoing work to improve access to more sustainable transportation modes such as walking, cycling and transit. Passenger and freight travel demands will be filled via road or rail vehicles powered by more efficient, low-carbon technologies.

Further, we'll be achieving emissions reductions in the industrial sector through our cap and trade program, and will have set the groundwork for an industrial sector that is a global leader in resource efficiency, and continues to be innovative, productive, and internationally competitive.

Ontario will take the following actions to achieve these goals:

1. **Reduce emissions from transportation by promoting the uptake of zero emission and plug-in hybrid vehicles.** A shift to low- and zero-emission vehicles is vital to the fight against climate change, as well as an important opportunity for technological innovation. As vehicle manufacturers offer more options for zero-emissions vehicles, our strategy will ensure access to affordable and fast public charging, charging at workplaces, apartments, condominiums and public institutions, a modernized vehicle price incentive, making the green plate program permanent, and reducing emissions through use of automated vehicles.

2. **Reduce emissions from goods movement.** Meeting our targets requires us to reduce emissions from the movement of goods. Our strategy will focus on measures that support the use of natural gas and low-carbon fuels in goods movement, and the electrification of goods movement where possible. We will also work to identify other emissions reductions opportunities in goods movement generally.

3. **Explore additional low-carbon fuel opportunities.** While broad-based electrification of the transportation sector will help achieve significant emissions reductions in the long-term, short-term reductions will occur by reducing carbon-intensity of transportation fossil fuels sold in Ontario. Low-carbon fuels will also allow modes of transportation like long- and heavy-haul trucking and marine transport that are not easily electrified to be part of Ontario's sustainable transportation future.

The Lexus RX 450h, the hybrid-electric version of the Lexus, is produced at Toyota's Cambridge, Ontario plant. It is the first luxury hybrid vehicle to be manufactured in Canada.

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4. **Develop a coordinated approach to reduce emissions from new and existing buildings.** A net-zero energy building is a highly energy-efficient residential or commercial building that uses renewable technology to produce as much energy as it consumes. Our strategy will support net-zero buildings across the province through updates to Ontario's Building Code, incentive programs, removal of regulatory barriers, and encouraging the transition to lower carbon fuels and to building materials that store carbon.

The Mapdwell Solar System is an interactive online rooftop solar mapping tool that allows users to precisely estimate rooftop solar electric potential for almost every building in a given city by a simple click or by inputting an address. The tool uses three-dimensional elevation data to create a surface model of the sample terrain that accounts for the shape of building rooftops and structures, existing infrastructure, and tree foliage.

5. **Establish reducing greenhouse gas emissions as an important factor in transportation and land use planning initiatives.** Provincial frameworks guide transportation, land use planning and urban design. Establishing emissions reduction as a priority will embed smart design in long-term decision-making and help Ontario move towards net-zero emission communities. This includes integrated transit planning to maximize GHG reductions and ensure transit-supportive land use planning.

6. **Create incentive programs.** Ontario will develop, through the action planning process, energy retrofit programs targeted at the residential, small- and mid-sized businesses and large emitting industries.

Panasonic is developing reusable products that harness solar energy. By combining the convenience of dry cells with the cost-efficiency of rechargeable batteries, its Eneloop Solar Storage system offers small-scale, sustainable energy and lighting solutions to people in non-electrified regions and elsewhere.

Leaving a Smaller Carbon Footprint

- **On The Go Mimico** is a residential condominium project that will offer residents regional transit at their doorstep, with access to Mimico GO station from its property. This complex integrates geoexchange and cogeneration technology that takes energy from the earth in the winter and puts it back in the summer, redirecting and recycling where needed.
- **The Village at Riverbend** is a state-of-the-art community being built in London, Ontario on an energy-producing smart grid designed to let the buildings generate and share all the energy the community will need for everyday life and work activities. Advanced technology will allow unused energy to be stored for future use.

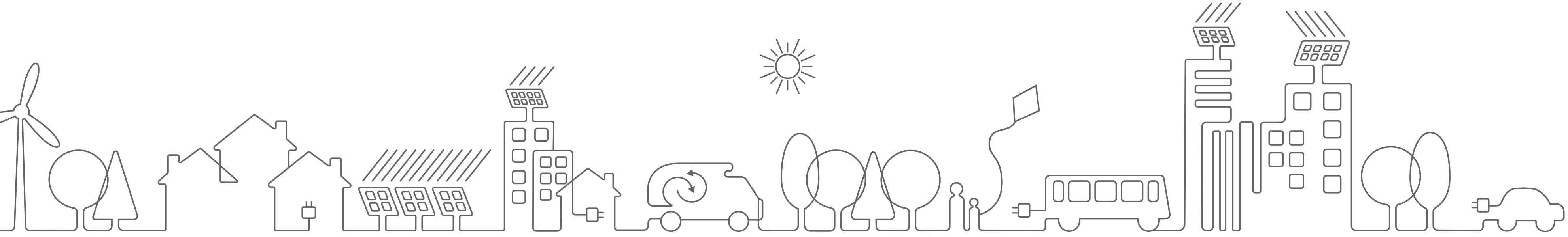
SECTION 5

Adapting and Thriving in a Changing Climate

Climate change requires a shift in thinking and behaviour. There are costs to inaction and there are risks if we don't plan ahead. Ontario must consider vulnerabilities caused by changing weather patterns in areas such as public safety and emergency response, roads and other infrastructure, buildings and homes. There will be impacts on Ontario businesses, remote communities and potential disruptions of Ontario's food supply. Ontario also needs to consider vulnerabilities to biodiversity and natural resources in the province

Adapting and managing risk must be considered side-by-side with reducing greenhouse gas emissions as Ontario plans and invests for the future.

In 2011, in response to the growing climate change challenge, Ontario appointed an expert panel on climate change adaptation. Its recommendations formed the basis of Climate Ready, Ontario's first-ever adaptation strategy and action plan. This living document continues to guide Ontario's path forward in managing risk in a changing climate.



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Infrastructure: Ontario's infrastructure is vulnerable to climate change in ways that increase the risk of disruption to our economy, workplaces, food supplies and more. For example, power plants that generate electricity are vulnerable to severe weather. Power lines and substations that distribute electricity can be stressed by increased demand for electricity as temperatures rise. Highways, roads and bridges can experience freeze-thaw fluctuations that can shorten their life cycles. Buildings also need to be energy efficient and resilient to climate change.

The Canadian Mortgage and Housing Corporation has established a method for establishing the long-term costs of alternative planning approaches. The Life Cycle Costing Tool for Community Infrastructure Planning helps assess and quantify the costs of numerous infrastructure options at the earliest possible stage, and demonstrates their long-term financial effectiveness. One use, for example, would be to determine if a project could make use of different green infrastructure alternatives.

Communities: Ontario is actively working to curb urban sprawl and to plan and create healthy, walkable, higher-density and transit-supportive communities that are more energy efficient and, therefore, produce less greenhouse gas emissions. We are also encouraging municipalities to plan resilient communities, for example, by directing development away from flood-prone areas.

The Federation of Canadian Municipalities' Green Municipal Fund supports sustainable community development through initiatives that support air, water, and soil, and mitigate the impacts of climate change. The fund champions initiatives that can generate new lessons and models for municipalities of all sizes and types in all regions.

Agriculture: Ontario agriculture is vulnerable to climate change impacts such as more frequent and more violent storms that flatten crops and cause flooding. Drought and erratic weather patterns brought on by climate change — unseasonal warming followed by frosts, for example — reduce crop yields and hurt the rural economy. These impacts are occurring around the world and will affect food processing, food prices and food availability in Ontario, challenging our food security.

Farmers are particularly vulnerable to extreme weather events and gradual changes in weather patterns, both of which directly affect their home and livelihood. While agriculture has been able to adapt to recent changes in climate, increased innovation and tools to support farmers will be needed to ensure the rate of adaptation in agriculture can keep pace with the changing climate over the next 25 years. Working with the farming community will be critical to ensuring the resilience of the sector.

Forestry: Ontario's public lands cover 932,000 square kilometres, an area two times the size of California, of which more than 270,000 square kilometres are publicly managed forests. Ongoing sustainable forest management helps our forests' continuing and long-term contribution to climate change mitigation by absorbing and storing carbon dioxide — while also conserving natural ecosystems, providing habitat for fish and wildlife, sustaining timber and biomass resources, and underpinning our forest industry and jobs.

Natural resources and ecosystems: A changing climate with changing patterns of warmer, wetter, and drier conditions also affects the natural environment and threatens biodiversity. For example, climate change could have negative impacts on the lifecycle of both wild and managed pollinator species like bees and butterflies, upon which about 75 per cent of all flowering plants depend. By conserving nature, restoring ecosystems and adapting natural resource management, we reduce vulnerability and increase resilience to impacts. In addition, natural systems provide low-cost adaptation solutions. For example, wetlands can provide effective storm water management services and help mitigate the impacts of extreme weather on infrastructure such as storm sewers.

Government initiatives, including the Greenbelt Plan and Ontario's 50 Million Tree Program, help to sequester and store carbon on lands in southern Ontario that are increasingly being affected by urbanization and deforestation. Ontario's Greenbelt protects nearly two million acres of valuable land and water across the Greater Golden Horseshoe by curbing urban sprawl and preserving our agricultural lands and natural heritage.

A Climate Resilient Ontario by 2030

Ontario recognizes the need to plan, prepare and adapt to changing weather. We will help municipalities, public utilities and the broader public sector identify their vulnerabilities and prioritize their response to the risks posed by climate change. The strategy will be to bring together the necessary scientific information, as well as clear land use planning policies to enable decisions and action to adapt to, manage the risks of, and build resilience to a changing climate.

By 2030, we envision that Ontario will be better prepared for the impacts of climate change. As part of infrastructure planning principles, consideration will have been given to investing in infrastructure that can stand up to the test of a changing climate. We will have made strides in keeping Ontarians healthy and safe both from the impacts of extreme weather and on-going changes to seasonal weather patterns.

Corktown Common is an ecologically diverse urban park in the core of Toronto that combines a park, a prairie, and a wetland with a playground and greenspace. This green infrastructure provides benefits that include flood control, recreational opportunities, storm water management features, and improved biodiversity and wildlife habitat.

FoodShare is a non-profit organization that, since 1985, has worked with communities and schools to deliver healthy food and food education. Foodshare believes everyone deserves access to affordable high-quality fresh food. Since 1985, FoodShare has pioneered innovative programs like the Good Food Box, impacted what kids eat in school, and improved the way people eat and grow food across Toronto every day. Every year FoodShare distributes over 16,000 cups of nutritious, vegetable-based soups across Toronto. FoodShare supports healthy school food programs and hands-on education to teach students food skills, inspire healthy eating, and connect to where food comes from.

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We will be actively planning and building resilient, low-carbon, mixed-use, healthy and walkable communities with convenient access to transit, and a higher proportion of green space.

Food systems and agricultural lands will be proactively protected and resilient. Agri-food policies and programs will be more oriented to climate-smart agriculture and energy efficient food production. Biodiversity will be conserved and natural resources and ecosystems will be managed for resilience.

By 2030, we will have improved our understanding of the roles of forests, peatlands, wetlands and grasslands in climate change mitigation and adaptation. This knowledge will enable us to manage our lands in a sustainable way and design green infrastructure in the built environment to better support the absorption and storage of carbon.

Ontario will take the following actions to achieve these goals:

1. **Integrate climate change adaptation considerations in infrastructure decision-making.** The province will guide infrastructure decision-making and investments so that these decisions properly consider the potential impacts of a changing climate.
2. **Align climate change objectives with agriculture and natural systems.** Our strategy will ensure pollinator and soil health and food security, as well as help the agricultural sector adapt to climate impacts. The agricultural sector will be able to capitalize on new opportunities associated with low-carbon food production while remaining healthy, productive, safe and sustainable for Ontarians. Ontario will continue to take action to reduce the vulnerabilities and strengthen the resilience of natural systems. The strategy will build on existing measures such as managing and restoring wetlands, increasing green spaces and managing diverse forests.
3. **Develop an approach to assess emissions and absorption from agriculture, forestry and other land uses.** Understanding how to measure the flow of carbon in agriculture, wetlands, forests and wood products will help us identify ways to mitigate climate change and better understand how our actions impact nature's ability to pull carbon from the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC) provides requirements and methods for quantifying how agriculture, wetlands, forests and wood products absorb, store and release carbon. Ontario will consider international best practices and accounting standards such as IPCC guidance to develop an approach to estimate, monitor and report the net effect on greenhouse gas levels in the atmosphere.

4. **Establish a climate change modeling collaborative for climate data.** Our strategy will establish a one-window source for climate data. This will ensure open access to standardized and wide-ranging climate information. It will help both public and private sectors make informed and evidence-based decisions regarding adapting to climate change and increasing resilience.

Raising Public Awareness:

We All Have a Role to Play

Along with this strategy, our government is launching a multi-media public awareness and education campaign to make Ontarians more aware of climate change, how it affects us, and what we can do to mitigate it.

You might ask, "what could I possibly do that could change the weather?"

But step-by-step, decision-by-decision, our choices do have an impact: turning off the lights when we leave a room, taking transit or walking or cycling, buying high-efficiency appliances, conserving water. They all mean less energy needs to be produced which means fewer emissions are launched into the air. And all these individual acts, all these separate decisions, add to a significant whole.

And they can make a measureable, often personal, difference. Our government's decision to close coal plants and reduce greenhouse gas emissions, for example, has had a direct impact on Ontario's air quality. In 2005, Ontario had 53 smog days. In 2014, there were none. Zero. Now, imagine what a difference that has made to the elderly people walking down your street, your daughter with asthma, your growing baby just strengthening his lungs.

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Generational change is equally important. Our attitudes towards energy conservation, sustainable forest management, preserving and protecting the environment form at an early age. Parents, teachers and mentors directly influence the behaviours of children and youth, and are crucial to inspiring the next generation to continue to fight climate change.

Ontario's Stewardship Youth Ranger Program gives youth the chance to spend eight weeks working outdoors on natural resource management projects such as creating habitat for species at risk, rehabilitating wetlands and monitoring the health of the forest.

There's a lot to be done and the transformation to a low-carbon economy and society will come with costs. But the costs of inaction are far greater. Climate change affects our weather, our economy, our health and society. It impacts our ability to preserve and protect our environment: our forests and lakes, lands and wildlife. It impacts the ability of First Nations and Métis communities to exercise their Aboriginal and Treaty Rights regarding their lands and resources. It affects our future, our children's future, and the future of this planet.

That's why it is so important that every person in Ontario take up this fight. It depends on each of us being aware of the problem, finding solutions, and taking steps, large and small, to conserve energy and reduce emissions to combat climate change and prepare for its impacts.

We all have a role to play.

> "The good news is we have everything we need now to respond to the challenge of global warming. We have all the technologies we need, more are being developed. But we should not wait. We cannot wait. We must not wait."
>
> **Al Gore**
> Founder and Chairman, Climate Reality Project
> Former U.S. Vice-President

The Action Plan to Come…

Climate change is a massive global concern. But we are not powerless. The world knows what has to be done, and it is beginning to take the practical steps to get there.

With this strategy, our government is setting out the path that Ontario will travel as a responsible global citizen and a leader in the fight against global warming.

In 2016, we will release a detailed five-year action plan with specific commitments to meet our near-term 2020 emissions reduction target, and establish the framework necessary to meet our targets for 2030 and 2050. Actions will be implemented after further consultation, where appropriate, and will focus on all areas of the economy, including transportation, buildings, industry, energy, waste, agriculture, forestry, and government.

Ontario will report on, and renew, its action plan every five years.

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Taking Responsibility, Making a Difference

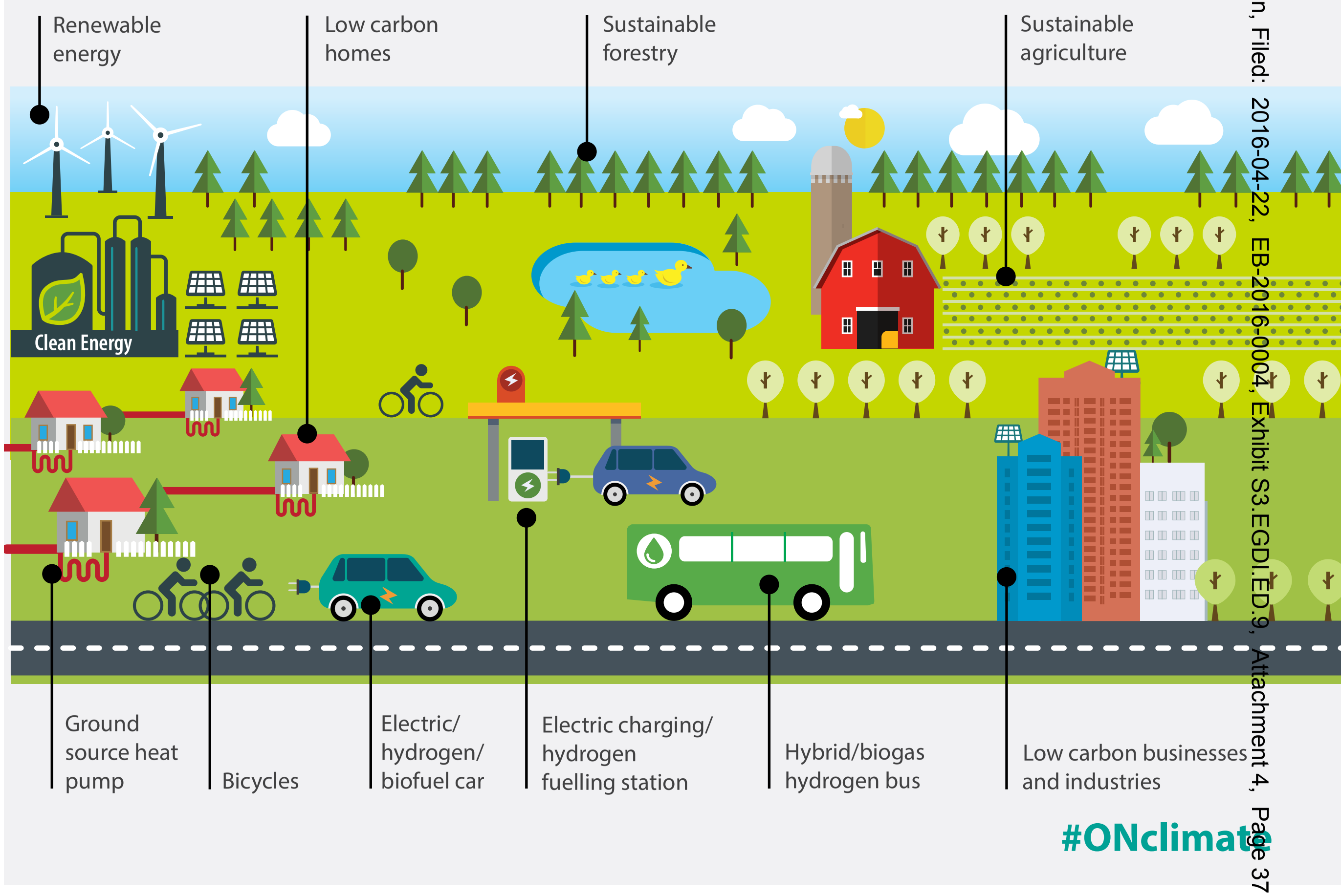
Our government is committed to a healthy and prosperous Ontario. It is our responsibility to be excellent stewards of the air, land and water entrusted to our care.

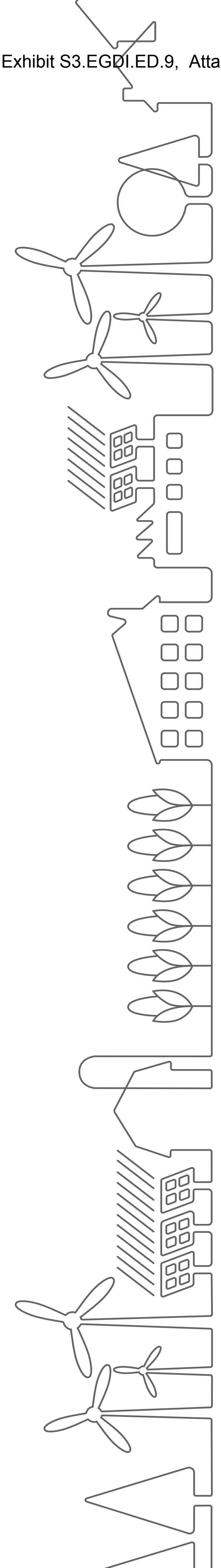
Fighting climate change is part of that responsibility, and it's a responsibility we call upon everyone to share.

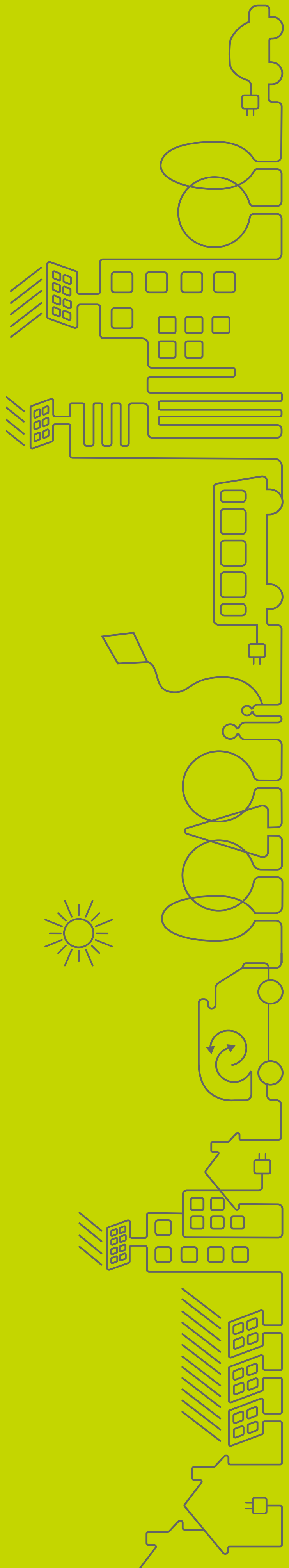
Ontarians are already taking a stand. They're changing their habits. They're acting individually and collectively to conserve energy and reduce emissions. But so much more can be done.

So let's do it. Let's work together to build this legacy of hope and optimism for our children and grandchildren. Let's work together to fight climate change, build a stronger Ontario, and make a difference to our future — and the future of our planet.

What Will Ontario Look Like in 2050?







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Ontario.ca/climatechange

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #10

Reference: Page 33

(a) Please provide a copy of the natural gas price forecast figures used to calculate the net present value ("NPV") of anticipated customer fuel savings.
(b) Please provide a copy of the natural gas price forecast figures used to calculate the Total Resource Cost in Enbridge's EB-2015-0029/EB-2015-0049.
(c) If the figures in response to (a) are lower than the figures in response to (b), please (i) recalculate NPV figures on page 33 of Enbridge's evidence and (ii) recalculate the benefit-cost ratio calculated in response to interrogatory # 3 above based on the natural gas price forecast figures in (b) above.

RESPONSE

(a) Please see the Company's response to CCC Interrogatory #8 at Exhibit S3.EGDI.CCC.8.

(b) With respect to the natural gas price forecast figures used to calculate the Total Resource Cost in Enbridge's EB-2015-0029/EB-2015-0049 please see EB-2015-0049, Exhibit I.T9.EGDI.GEC.44 which is attached to this response for ease of reference.

(c) The Company declines to recalculate NPV figures and the benefit-cost ratio provided in its evidence as this treatment would be inconsistent with the provisions of EBO 188 which requires all revenue calculations for the purpose of feasibility testing to be based on the Company's at the time current rates. (reference: Appendix B, Ontario Energy Board Guidelines for assessing and reporting on Natural Gas System Expansion in Ontario/ line #286).

GEC INTERROGATORY #44

INTERROGATORY

Topic 9 – Avoided Costs

Ref: Exh. B/T2/S3

a. Please provide all forecasts of gas commodity prices at hubs relevant to the pricing of EGDI's marginal gas sources produced since January 2014 and in the possession of EGDI.

b. For each pricing point for which EGDI has access to futures or forward prices, please provide the most recent futures or forward prices for natural gas available to EGDI for each exchange or broker for which EGDI has such data.

c. Please provide the most recent futures or forward prices for natural gas basis from major trading points to trading hubs relevant to EGDI, for each exchange or broker for which EGDI has such futures or forward prices.

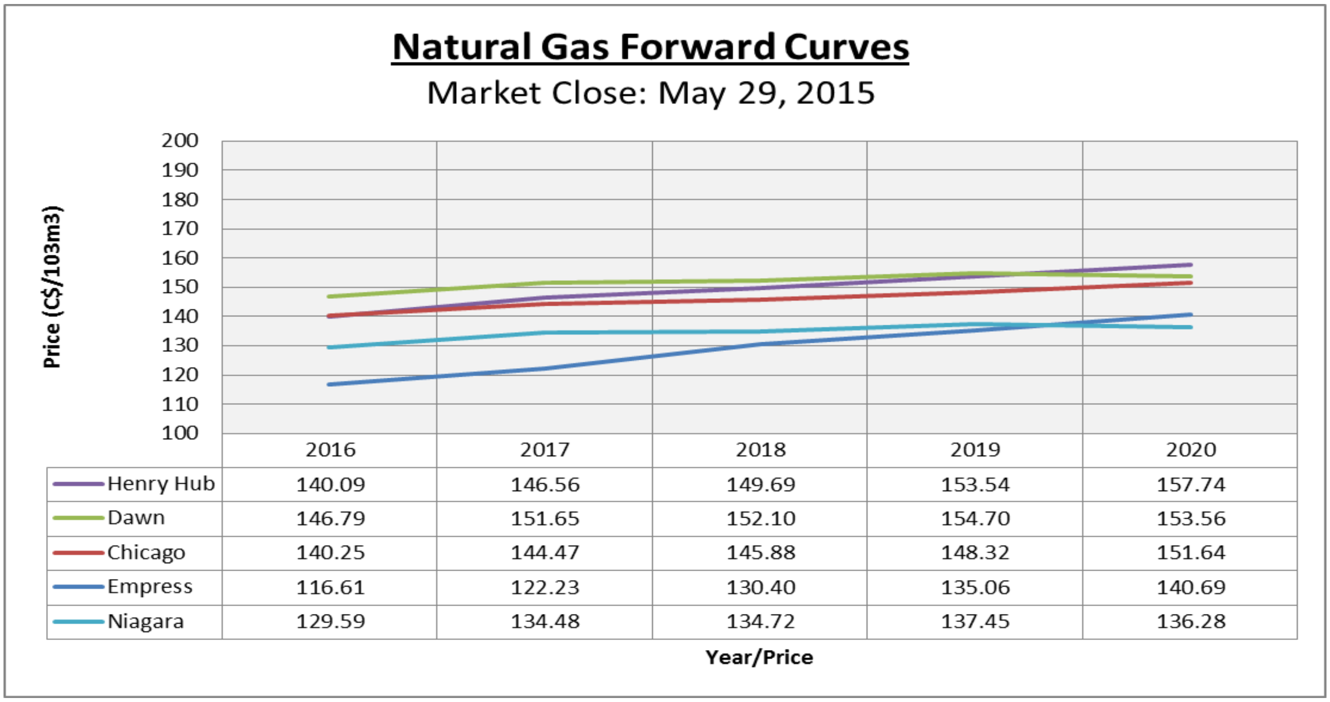
RESPONSE

a. Enbridge obtains its commodity price forecasts under a contract with the PIRA Energy Group. This Contract does not allow the Company to publicly disclose the forecasts as requested absent there being an order from the Board requiring the information to be treated confidentially and not disclosed publicly. The Company is therefore not at liberty to provide the information requested. As noted in evidence, given that its avoided costs are in the process of being updated with the intent of filing an update with the Board in Q4 of 2015, the Company questions the appropriateness and relevance of making a formal request for confidential treatment of the PIRA commodity price forecasts at the various hubs for the purposes of this proceeding.

b. Please note that these futures curves are not a function of the avoided gas cost calculation that Enbridge uses for the purposes of cost effectiveness screening of its DSM offers. However in an effort to accommodate this request Enbridge has supplied the requested information.

The table below contains natural gas forward curves for the Empress, Dawn, Chicago, Henry Hub/NYMEX, and Niagara pricing points based on a collection of actual market trades from independent third party companies such as NGX and Kiodex. Each curve is the annual average of the average monthly price for the 21 most recent daily closing prices for market close: May 29, 2015. A 21 day average is provided as this is consistent with the manner in which the Company calculates commodity prices for the purpose of determining gas costs pursuant to the Quarterly Rate Adjustment Mechanism ("QRAM") methodology.

Five years of forward curves are provided because Kiodex and NGX report five years of forward curves data to the Company. For forward curves beyond 2020, the forward curves will require interpolation.



Natural Gas Forward Curves

Market Close: May 29, 2015

	2016	2017	2018	2019	2020
Henry Hub	140.09	146.56	149.69	153.54	157.74
Dawn	146.79	151.65	152.10	154.70	153.56
Chicago	140.25	144.47	145.88	148.32	151.64
Empress	116.61	122.23	130.40	135.06	140.69
Niagara	129.59	134.48	134.72	137.45	136.28

c. A forecast of natural gas basis can be calculated utilizing the forward pricing curve data provided in the response above.

Witnesses: S. Mills
S. Moffat
F. Oliver-Glasford

ENBRIDGE GAS DISTRIBUTION INC. (ENBRIDGE)
RESPONSES TO INTERROGATORIES OF ED

INTERROGATORY #11

Reference: Page 33

(a) Has Enbridge compared the stage 2 benefits that would flow from a dollar of spending on the community expansion projects it is considering and:
   a. The stage 2 benefits that would flow from a dollar of DSM spending; and
   b. The stage 2 benefits that would flow from a dollar of spending on renewable energy spending, such as investment in heat pumps?

If yes, please provide the comparison.

(b) Has Enbridge compared the stage 3 benefits that would flow from a dollar of spending on the community expansion projects it is considering and:
   a. The stage 3 benefits that would flow from a dollar of DSM spending; and
   b. The stage 3 benefits that would flow from a dollar of spending on renewable energy spending, such as investment in heat pumps?

If yes, please provide the comparison.

RESPONSE

(a) No.

(b) No.