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December 7, 2012

BY COURIER (2 COPIES) AND EMAIL

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
P.O. Box 2319
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Fax: (416) 440-7656
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Dear Ms. Walli:

Re: Expert Evidence Prepared on Behalf of Environmental Defence
EB-2012-0064 – Toronto Hydro 2012-2014 Rates

Further to *Procedural Order #3*, please find enclosed expert evidence prepared by H.R. (Bob) Bach, P.Eng., on behalf of Environmental Defence relating to the Bremner Station project.

Please do not hesitate to contact me if anything further is required.

Yours truly,

Kent Elson

cc: Applicant and Intervenors

Toronto Hydro-Electric System Limited

EB-2012-0064

Toronto Hydro-Electric System

Conservation and Demand Management

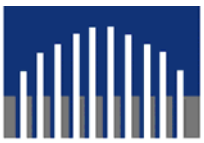
in Downtown Toronto

Prepared By

H.R. (Bob) Bach, P.Eng.

For

Environmental Defence



ENERGY PROFILES LIMITED

December 7, 2012

Please note: This document is formatted for double-sided printing.

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This document was prepared with the assistance of Marjorie Lamb, Writer in Residence Inc.

Table of Contents

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1.0 Terms of Reference and Background

Environmental Defence has requested a report that provides evidence on whether the incremental Conservation and Demand Management (CDM) potential in downtown Toronto significantly exceeds the estimate of 18 MW put forward by the applicant in this proceeding.

According to Navigant Consulting's *Business Case Analysis: Downtown Toronto-Electric Supply Evaluation* (the "Navigant Report"), electricity demand in downtown Toronto will exceed the capacity of the five downtown transformer stations commencing in 2017.

Table 1-1 shows Navigant's forecast of excess electricity demand in downtown Toronto from 2017 to 2026.[1]

Table 1-1: Forecast Electricity Demand in Excess of Existing Transformer Station Capacity in Downtown Toronto (MVA)*

2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2	10	21	35	58	76	99	119	144	162

*Mega Volt-amperes (MVa) can be converted to MW by multiplying by approximately 0.93

Navigant's analysis assumed that the maximum amount of incremental CDM that Toronto Hydro could reasonably achieve in downtown Toronto by 2014 would be 18 MW.[2]

Based on this assumption, the Navigant Report concludes that:

"Current Conservation and Demand Management (CDM) programs will not defer the need for additional station capacity in downtown Toronto. Accelerated efforts and targeted CDM also will not materially defer the need for station capacity in downtown Toronto.[3]"

Environmental Defence thus requested the author to provide evidence on whether the incremental CDM potential in downtown Toronto significantly exceeds 18 MW.

1.1. Area of Expertise and Qualifications

The area of expertise of the author of this report is in energy efficiency, conservation, and demand management for both new and existing buildings. His qualifications are set out in the curriculum vitae, Appendix B of this report. He is a professional engineer and has been working in this field for over 25 years.

[1] EB-2012-0064, Tab 4, Schedule B17, Appendix 3: Navigant Consulting, *Business Case Analysis: Downtown Toronto-Electric Supply Evaluation*, (April 2012), page 10.
[2] *Business Case Analysis*, page 16, Table 6.
[3] *Business Case Analysis*, page 16, Table 6.

2.0 Introduction

This report describes the programs, initiatives, and regulatory actions that will reduce summer peak demand in the Toronto area generally, and will have a specific impact on the downtown area. They are initiatives by the City, the Ontario Power Authority, the Province, and non-government organizations representing building sector owners and managers or other dedicated organizations. Many of these are indicative of a sea change in the attitude of usrs towards the consumption of energy in general, and electricity specifically.

While these initiatives would build on the existing base of electric CDM programs and natural gas DSM programs, the CDM programs require additional focused and targeted effort and investment by Toronto Hydro to move the market. **The net effect will be an overall reduction in electricity consumption, and a consequent reduction in projected peak demand well beyond the modest forecast in the Navigant Report**

3.0 Review of Background Reports

The reports summarized herein describe initiatives undertaken that are having, or will have, a positive effect on the summer peak demand reduction for electricity in the City of Toronto.

3.1. BOMA Toronto CDM Program in Toronto

BOMA Toronto proposed a Conservation and Demand Management program that ran from March 2007 until the end of 2010, at which point the Green Energy and Green Economy Act caused the Ontario Power Authority to transfer program responsibility to Toronto Hydro. The program was directed at large commercial properties and successfully delivered over 600 projects that delivered 50 MW of conservation in a multitude of buildings[4]. BOMA would still be delivering this program if this change had not been mandated.

Figure 3.1-1 shows the history of the BOMA CDM[5] program throughout its duration, summarized as peak demand achieved per quarter. Figure 3.1-2 shows the cumulative effect.

[4] Letter to Ontario Energy Board from Folger, Rubinoff LLP on behalf of BOMA Toronto. January 26, 2012. http://www.ontarioenergyboard.ca/OEB/_Documents/EB-2012-0003/BOMA%20Comments_CDM%20Guidelines.pdf

[5] Information provided by BOMA Toronto

Figure 3.1-1: BOMA CDM Program Demand Reduction per Quarter

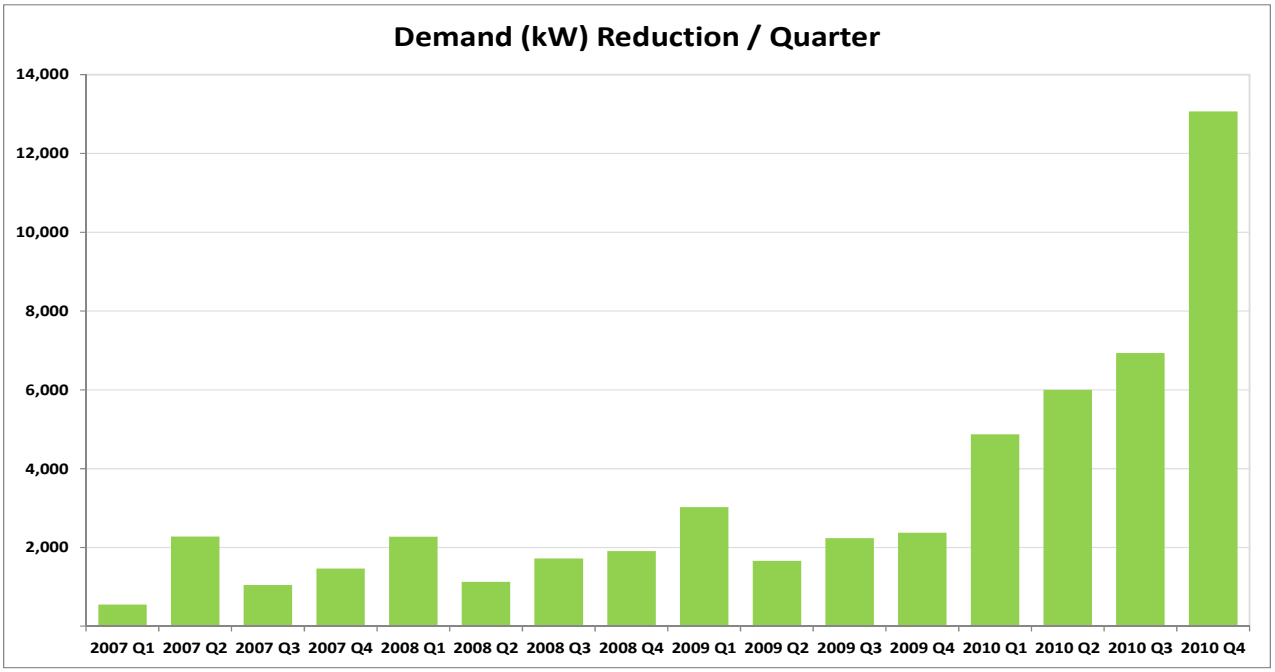
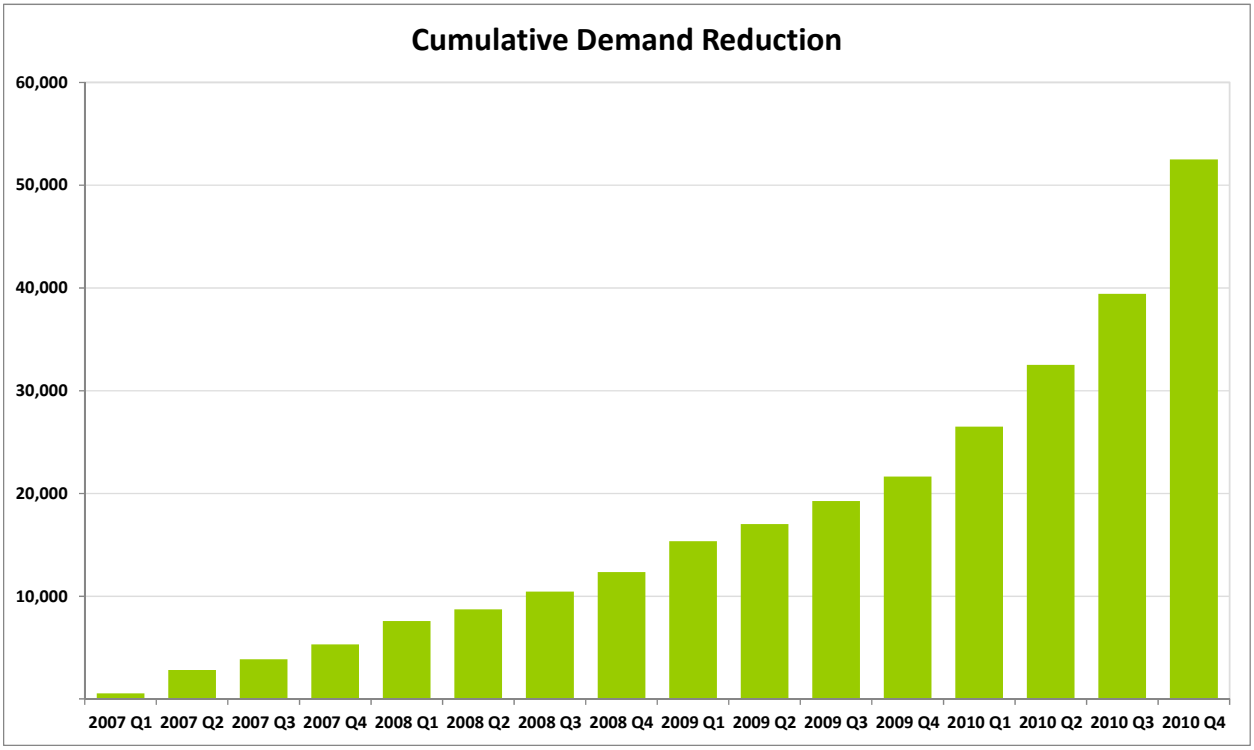


Figure 3.1-2: BOMA CDM Program Cumulative Demand Reduction per Quarter



The project type, number, and peak demand reduction are summarized in Table 3.1-1.

Table 3.1-1: BOMA CDM Program Summary by Project Type

Project Type	Number of Projects	Peak Demand Reduction Reported, kW
Entertainment/Recreational	24	1,262
Hotel	27	2,074
Industrial Building	149	8,314
Mixed Use	74	7,813
Office	362	24,680
Parking Garage	3	129
Private Institution	16	600
Retail Store	106	4,071
Warehouse	14	2,106
Total	775	51,049

The accelerating rate of uptake for the BOMA Toronto program confirms that it takes time for a new CDM program delivered to the business sector to ramp up the penetration of the market. BOMA enjoyed the advantage of being in regular contact with its membership most of whom look to their association for information and guidance in conducting their business activities.

3.2. Demand Response Potential in Toronto

Toronto Hydro Energy Services and Energy Profiles Ltd. collaborated in 2004 on a project for BOMA and the City of Toronto to define the demand management and demand response (DR) potential in the City, and to design a pilot program. This report focused on the Office and Retail sectors, and was initiated in part as a response to the blackout of August 14, 2003, when many gerators failed to start, and those that did ran out of fuel long before power was restored. One key outcome of the report was a change to CSA Standard C282-09, *Emergency electrical power supply for buildings.* This permitted the use of natural gas as either the primary fuel for the engine-generator, or as a secondary fuel for diesel generators.

The report provided the following summary of the potential for Toronto, reproduced here as Table 3.2-1.

Table 3.2-1: Practical Technical SDR/DM/DR Potential in the Toronto Office/Retail Sector

Sector Approach	MW Reduction	MWh Reduction
Sustainable Demand Reduction (SDR via Efficiency Measures)	131	115953
Demand Management (DM via Demand Control Measures)	89	177600
Demand Response (DR via On-site Generator Dispatch)	130	81250 [a]
Maximum Combined Result for: Toronto Office/Retail Sector	**350 MW Reduction**	**374803 MWh Reduction**

[a] Displaced grid electricity with on-site generator

This potential has not been realized. In response to a request by Environmental Defense to the Ontario Power Authority, Table 3.2-2 was provided that lists the resulting demand for each day that demand was curtailed through the OPA's non-residential demand response programs in 2011 in downtown Toronto.[6]

Table 3.2-2: Actual DR Delivered in Downtown Toronto in 2011

Date	Average Event Impact, MW	Average Contracted MW
31-May-11	1.17	1.17
6-Jun-11		
7-Jun-11	1.24	1.41
8-Jun-11		
11-Jul-11		
21-Jul-11	1.25	1.63
22-Jul-11	3.46	1.63
2-Aug-11	1.94	2.04
4-Aug-11		
21-Nov-11	1.83	1.81
22-Nov-11	1.79	1.81

In early 2013, the OPA is expected to release a third tranche under DR3 to add more DR capacity, and aggregators are expected to offer this to both existing and new customers. Contracts are for 5 years. All existing contracts will expire in 2013.

In spite of the potential for DR, there are cost barriers that need to be overcome:

- The Certificate of Authorization issued by the Ministry of the Environment for each standby emergency diesel generator permits operation for one hour per month[7] for test purposes only – operating beyond this requires that the engine emissions be lowered

[6] Letter from Michael Lyle to Kent Elson, November 27, 2012
[7] Healthcare facilities are permitted to test their generator for a period of one hour per week.

significantly, requiring the installation of catalytic converters on the exhaust, a step deemed too expensive by most building operators in proportion to the revenue earned. Also, the extensive application process required to receive approval to make this change is an additional cost.

- The cost of converting the existing engine to bi-fuel operation can be significant, particularly to bring natural gas to a penthouse mounted engine-generator. Also this does not reduce emissions enough to permit operation beyond that of a standby emergency generator.

For new buildings, there has not been a strong demand for natural gas engine-generators for the following reasons:

- Natural gas engines are more expensive than diesel.
- Natural gas engines are slower to come online in an emergency, and cannot meet the requirement to deliver the defined emergency power within 15 seconds as required by the standard unless the engine-generator is oversized for this load. Engine-generators of this type carry two load ratings – standby emergency power and full load power.

There is an initiative by some providers to supply a combined heat and emergency power (CHeP) unit in new and existing buildings. Interest in this approach is growing, but progress has been slower than expected.

There is a new technology that is expected to permit existing diesel engines to run on 100% natural gas with a much lower investment in engine modifications and no emissions control devices such as catalytic convertors required. This should be available in 2013.

These barriers could be addressed through an enhanced CDM program to take advantage of the potential for significant DR, implemented substantially using equipment that already exists.

3.3. District Energy Potential in Toronto

At the request of the City of Toronto Energy Efficiency Office, a report entitled *Preliminary Node Scan of Potential District Energy Implementation in The City of Toronto*[8], dated October 1, 2010, was prepared by Genivar Consultants, and was updated on September 4, 2012.

A total of 27 potential sites for district energy systems (DES) were identified in this report, and these were ranked using a screening matrix designed to assist the City to review and prioritize potential developments for consideration to utilize DES. The study did not report on the basis of potential generation capacity, but the process was described as follows:

- *"Level 1 Screening is a desktop exercise which lacks specific site assessment (conceptual DES plant sizing /location and thermal distribution routing / obstructions)."*
- *"From the Level 1 Screening Matrix assessed for the 27 potential district energy nodes (see Appendix A), the following is the preliminary ranking*
  - *1. Site 19 East Bay Front (Jarvis Street and Queens Quay)*
  - *2. Site 15 Yonge Street and Dundas Street*
  - *3. Site 16 Yonge Street and Bloor Street*
  - *4. Site 25 West Don Lands (Eastern Avenue and Front Street)"*

[8] http://bbptoronto.ca/wp-content/uploads/2012/06/FINAL-GENIVAR-Report-City-of-Toronto-District-Energy-September-4-12.pdf

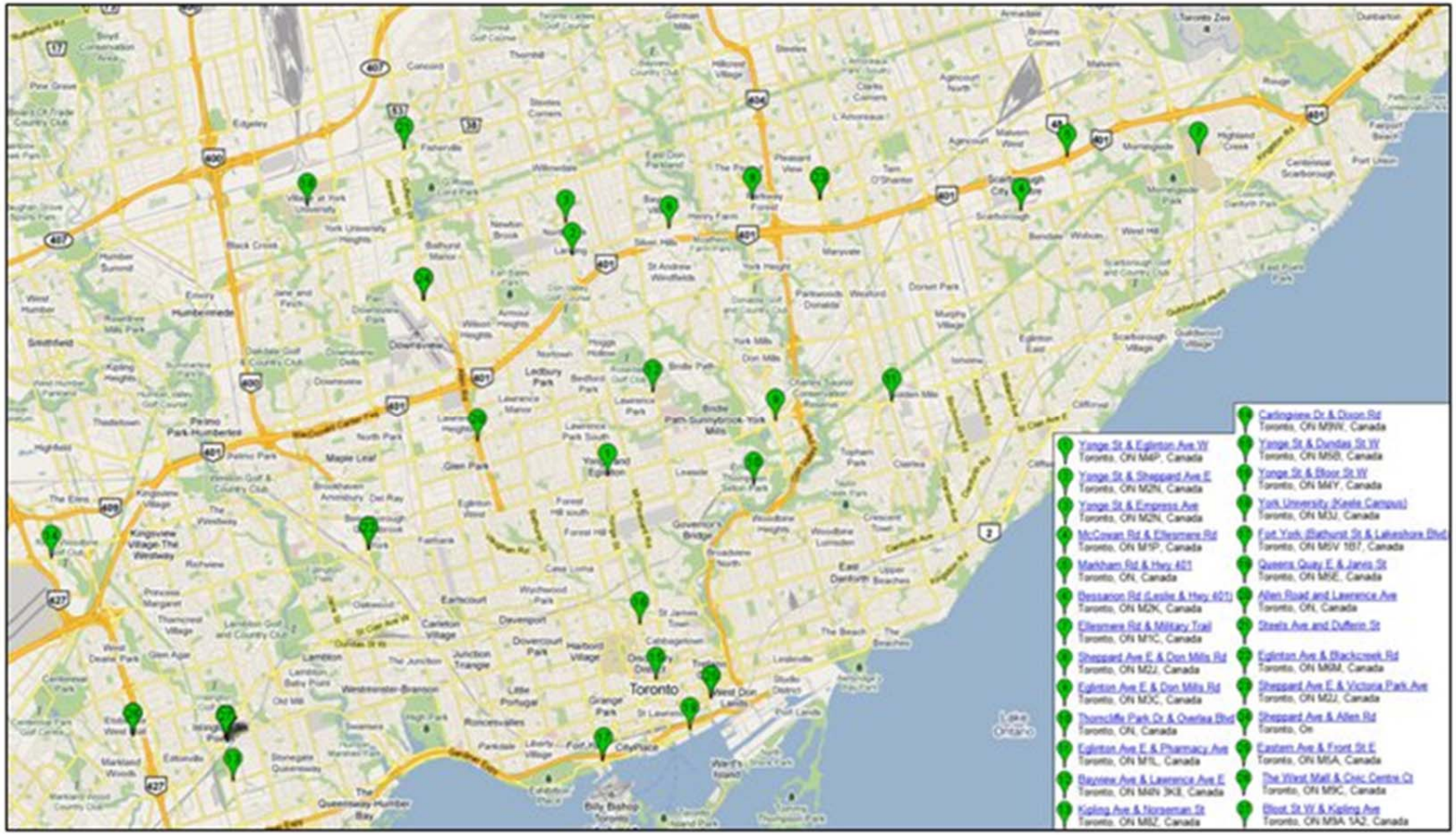
A map of the City showing the recommended site locations is included as Figure 3.3-1.

It is interesting to note the top four sites are located within the area served by the five transformer stations cited in the THESL application.

The City is planning to proceed in 2013 with a DES plant on the grounds of Exhibition Place as part of the new hotel development. Others may proceed over a longer term schedule.

District energy systems providing combined heat and power (CHP) have the potential to reduce peak demand by delivering the electricity directly to nearby customers. The local distribution system capacity is used, but the central transformer station load is reduced. If this system is planned as a tri-gen unit in the same manner as the existing generation unit in the Direct Energy Centre, there will be additional summer peak demand reduction.

Figure 3.3-1: Potential DES Sites in Toronto



3.4. City of Toronto Energy Plan

The Background Report on the Energy Plan for Toronto[9] built on previous work conducted by the City, by providing a review of energy demand forecast scenarios, identifying existing energy efficiency, renewable generation, and other initiatives, analyzing best practices from other jurisdictions, and providing a portfolio of preferred options, along with a feasibility assessment for the short to medium term and program development and plan design templates. The planning horizon for the energy forecasts was from 2006 to 2031.

The task undertaken included the following:

- Develop a baseline for energy use in Toronto, and develop an energy load forecast that will be used as a baseline to measure the cost-benefits of the different initiatives and to monitor the success of energy efficiency programs.
- Identify existing and developing energy efficiency and renewable energy initiatives available in and to Toronto.
- Conduct a jurisdictional scan to identify best practices in energy efficiency and renewable energy.
- Develop a sector analysis, including program design templates that outline program parameters, metrics, administrative guidelines, roles and responsibilities, and cost-benefit comparisons.
- Identify common themes and priorities on which the City can focus its Energy Plan efforts over the short term, medium term, and long term in order to meet its energy efficiency and renewable energy objectives.

Projections for annual electricity consumption for the residential (low-rise and high-rise), and institutional, commercial, and industrial sectors are presented in Figure 3.4-1 and 3.4-2, respectively.

[9] http://www.toronto.ca/legdocs/mmis/2007/ex/bgrd/backgroundfile-5057.pdf

Figure 3.4-1: Electricity Projections for Residential Buildings

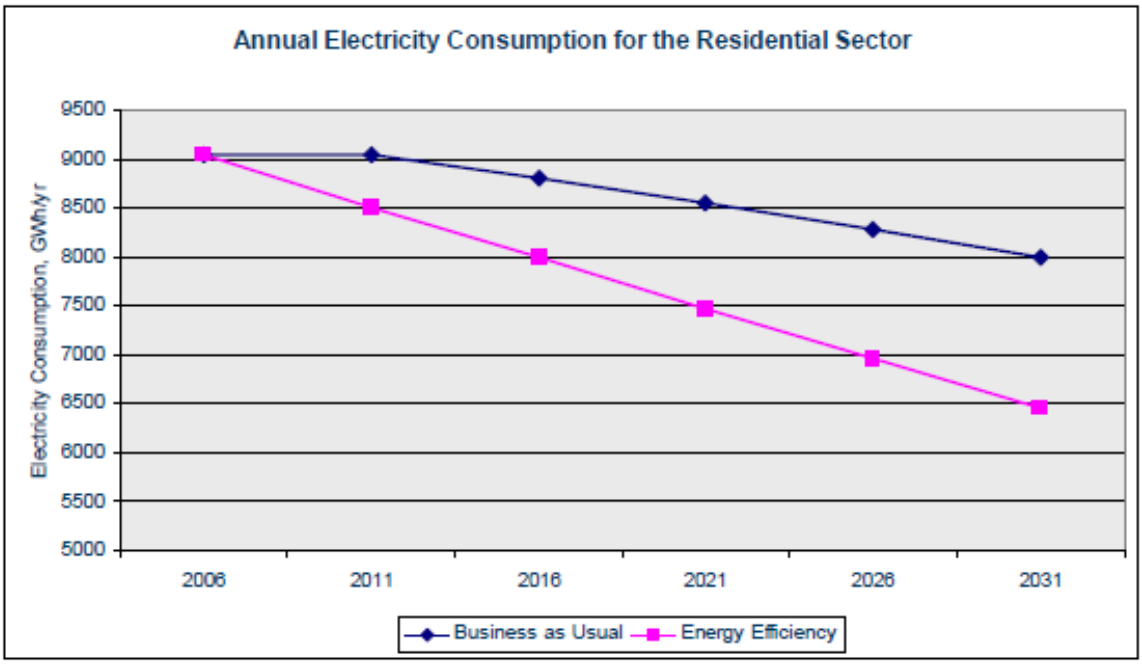
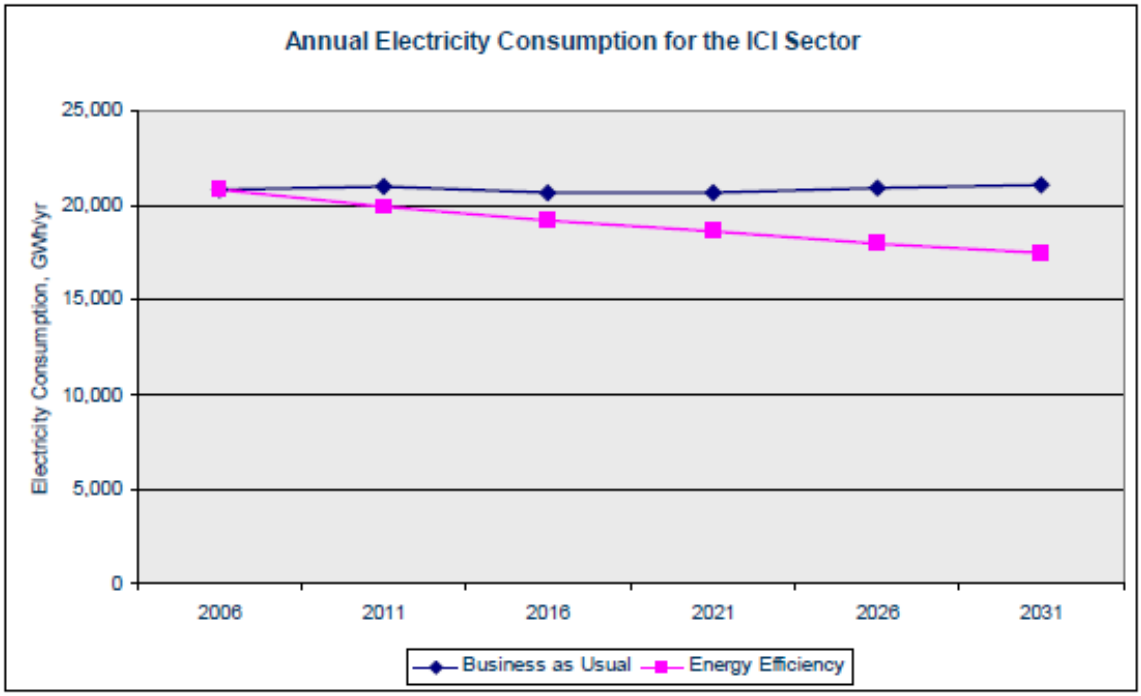


Figure 3.4-1: Electricity Projections for Institutional, Commercial, and Industrial Buildings



The projections include both a business as usual (BAU) case and an energy efficiency (EE) case. Based on the many initiatives that were underway at the time of the report, and have since been initiated, the EE case would seem to be the more reasonable assumption.

For residential buildings (including both low-rise and high-rise), the electricity consumption in the BAU begins to decrease after 2011 and the rate of decrease accelerates from that time, while for the EE case, the decrease begins immediately.

For ICI buildings, projected consumption for the BAU case is almost flat while for the EE case, it decreases somewhat.

The forecasts took into account energy efficient retrofits for existing buildings, continuing improvements in the energy efficiency requirements in the Building Code and other programs and regulations for new buildings, as well as forecasts of new and replacement floorspace in 23 different building types.

3.5. Deep Lake Water Cooling – Proposed System Expansion

The original Deep Lake Water Cooling System, as conceived by Robert T. Tamblyn, would have had a capacity of 250,000 tons of cooling capacity, sufficient to cool all of the buildings in an area bounded by Bloor St. to the north, John St. to the west, Victoria St. to the east, and down to the waterfront. This would have reduced summer peak demand by 250 MW.

The system installed by Enwave originally had a capacity of about 60,000 tons, and this has been expanded to 95,000 tons by adding additional cooling capacity using other sources such as steam absorption chillers during those periods when demand for cooling is at its peak. This represents a reduction in summer peak demand of about 90 MW.

Enwave is now proceeding with an expansion to their DLWC system that will add 18,125 tons of renewable cooling to be operational by 2015. Once connected to customers' buildings, this will reduce summer peak demand by about 18 MW in the downtown area.[10]

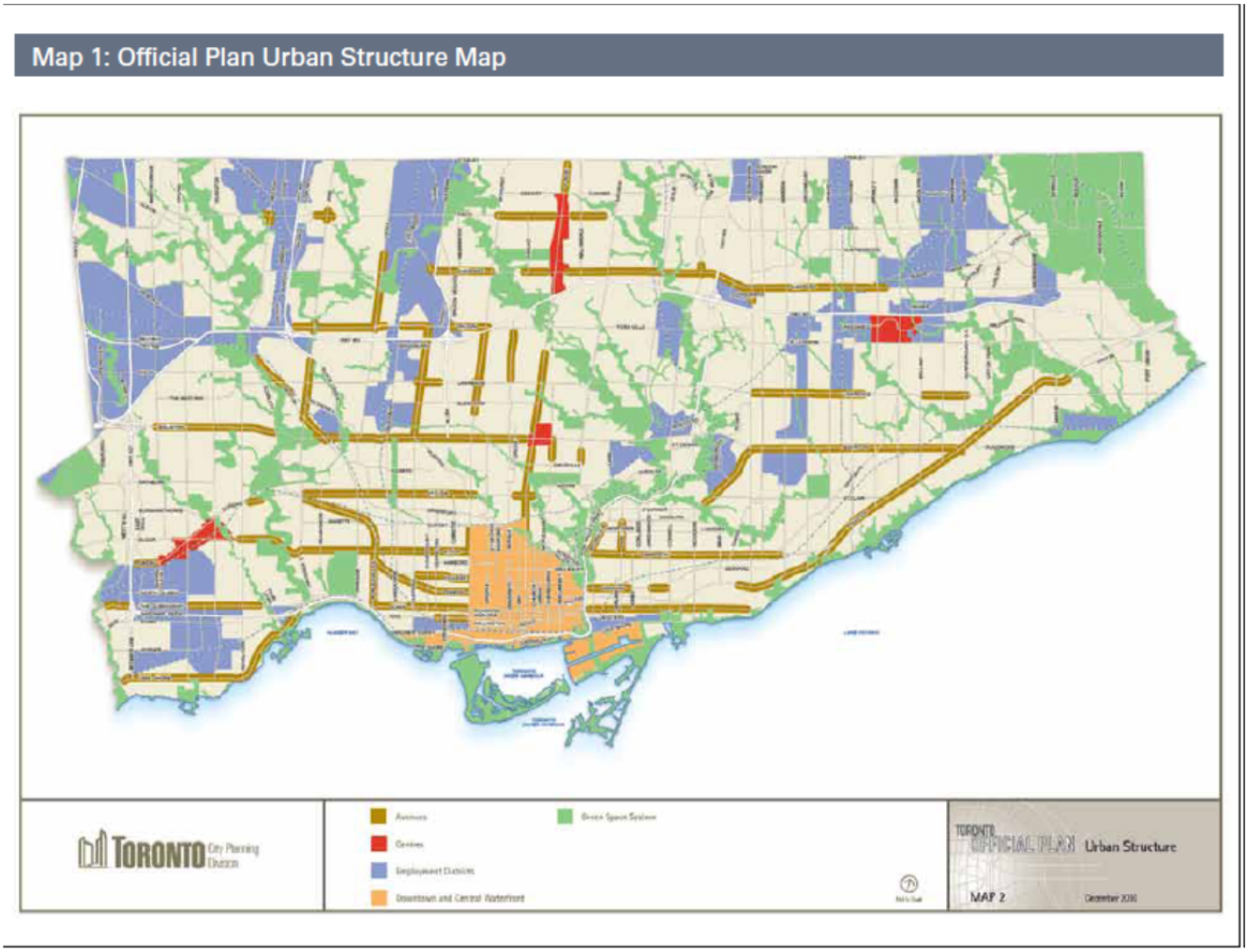
Enwave is also examining the possibility of installing back-pressure steam turbine-generators at their Walton St. Steam Plant that would deliver peak electricity generation capacity of 17 – 17.4 MW in the downtown area. They are also considering the installation of similar generators at their Pearl St. and Queen's Park Steam Plants. This capacity would be distributed through the Toronto Hydro grid.

3.6. City Planning Department Forecast for Growth in Downtown Toronto

In a report entitled *Toronto – How Does the City Grow*[11], City Planning provides an overview of growth in the overall City, and in specific planning areas including the Downtown and Central Waterfront area. These are shown on the map in Figure 3.6-1, taken from the report.

[10] Memo from Yianni Soumalias of Enwave to Jack Gibbons of Ontario Clean Air Alliance, dated November 21, 2012.
[11] http://www.toronto.ca/opreview/pdf/how_does_city_grow.pdf

Figure 3.6-1: City Planning Districts



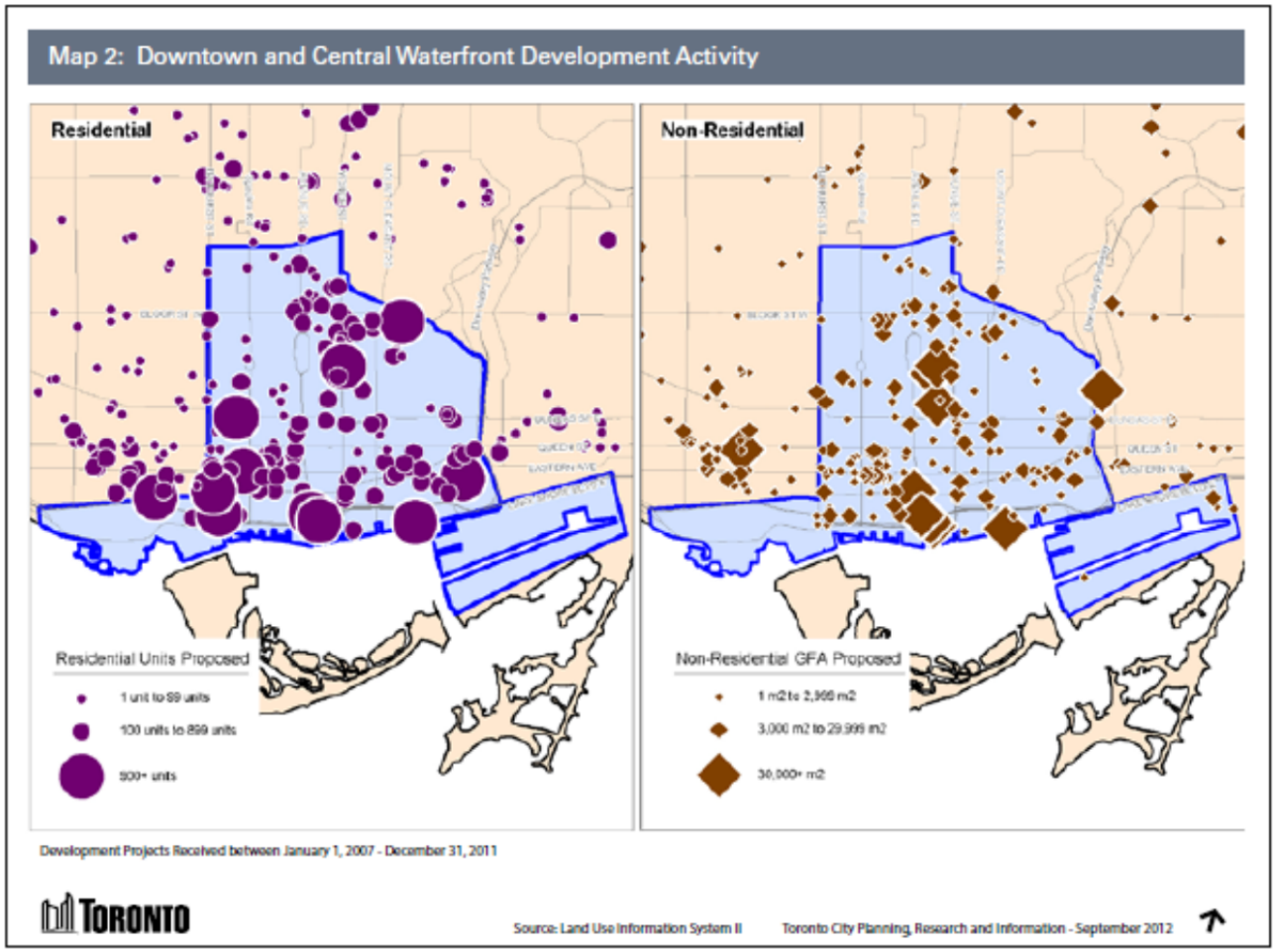
Information from the report for the City and for the Downtown and Central Waterfront area were merged to present a reasonably accurate estimate of development in the near term. This is presented in Table 3.6-1.

Table 3.6-1: Forecast of Growth in Downtown Toronto

Item	Total No. of Projects Proposed	Projects Submitted (not approved)	Projects Approved (no permits issued)	Projects with Permits Issued
No. of Projects	223	65	52	106
Proposed Residential Units	67,726	32,034	15,103	20,656
Proposed Non-Residential GFA. m^2	1,282,572	469,421	310,382	502,768

More specific location information is presented in Figure 3.6-2, taken from the report.

Figure 3.6-2: Downtown and Central Waterfront Planning Activity



Information on specific growth in new building additions is key to understanding future electricity system growth, and is readily available in much more details from City Planning.

4.0 Current Industry Benchmarking and Reporting Initiatives

Benchmarking and reporting initiatives offer owners and property managers the opportunity to compare the performance of their building to other similar buildings in their region, and in other parts of the country, using a normalization procedure that takes into account weather and some other loads that are in some but not all office buildings, such as parking garages, retail areas, and data centres. Where a certification process is involved, there may also be an independent audit required to ensure the accuracy of the results. Having access to reports of this kind is a common request by prospective tenants who want to not only compare operating costs of similar buildings, but are also interested in overall energy and environmental performance before committing to an extended lease.

One of the most interesting aspects of these initiatives is that they bring the building tenants and occupants into a partnership with the building owner/manager to collectively improve the energy

performance and overall sustainability of the facility, for the benefit of everyone involved with the building.

Implementation of an Environmental Management System such as ISO 14001 or an Energy Management System such as ISO 50001 would require that the building owner/property manager implement a policy of continual improvement in environmental and energy performance.

4.1. BOMA BESt Program

BOMA BESt is a national building assessment and certification program, and is based on the internationally recognized and accepted Green Globes™ environmental assessment platform. It is delivered through 11 local BOMA associations across the Canada, including BOMA Toronto. Since its launch in 2005, BOMA BESt has seen tremendous uptake, with over 3,500 buildings representing nearly one billion square feet of Canadian commercial real estate participating. It is a unique, voluntary, national program designed to assess environmental performance and management of existing buildings, and is offered by the Building Owners and Managers Association of Canada (BOMA Canada) as a service to all commercial building owners and managers across Canada.

Vision Statement: **Creating a sustainable environment one building at a time.**

Mission Statement: **Transforming buildings into environmentally responsible assets.**

Program Objective: Provide a framework for green building management and, through the recognition certification provides, help move the commercial real estate industry toward better building operations and management, thereby creating a more sustainable environment.

The Program provides a consistent framework for owners and managers to critically assess six key areas of environmental performance and management:

- **Energy**
- **Water**
- **Waste Reduction and Site**
- **Emissions and Effluents**
- **Indoor Environment**
- **Environmental Management System**

BESt Practices establish minimum requirements for certification (14 in total). The Program currently offers tailored assessment modules for these building types:

- **Office**
- **Open Air Retail**
- **Light Industrial**
- **Shopping Centres**
- **Multi-Unit Residential Buildings**

BOMA BESt Assessment Modules include comprehensive on-line questionnaires specific to building types (about 175 questions), which assess energy and environmental performance and management of building(s). The BESt Practices are included within the larger questionnaires, as well as helpful tips and recommendations. The BOMA BESt assessment modules are used to achieve higher levels of certification.

Third party verification, including an on-site tour of the assessed building conducted by a highly-qualified independent verifier, is mandatory for all buildings seeking certification.

There are four levels of certification:

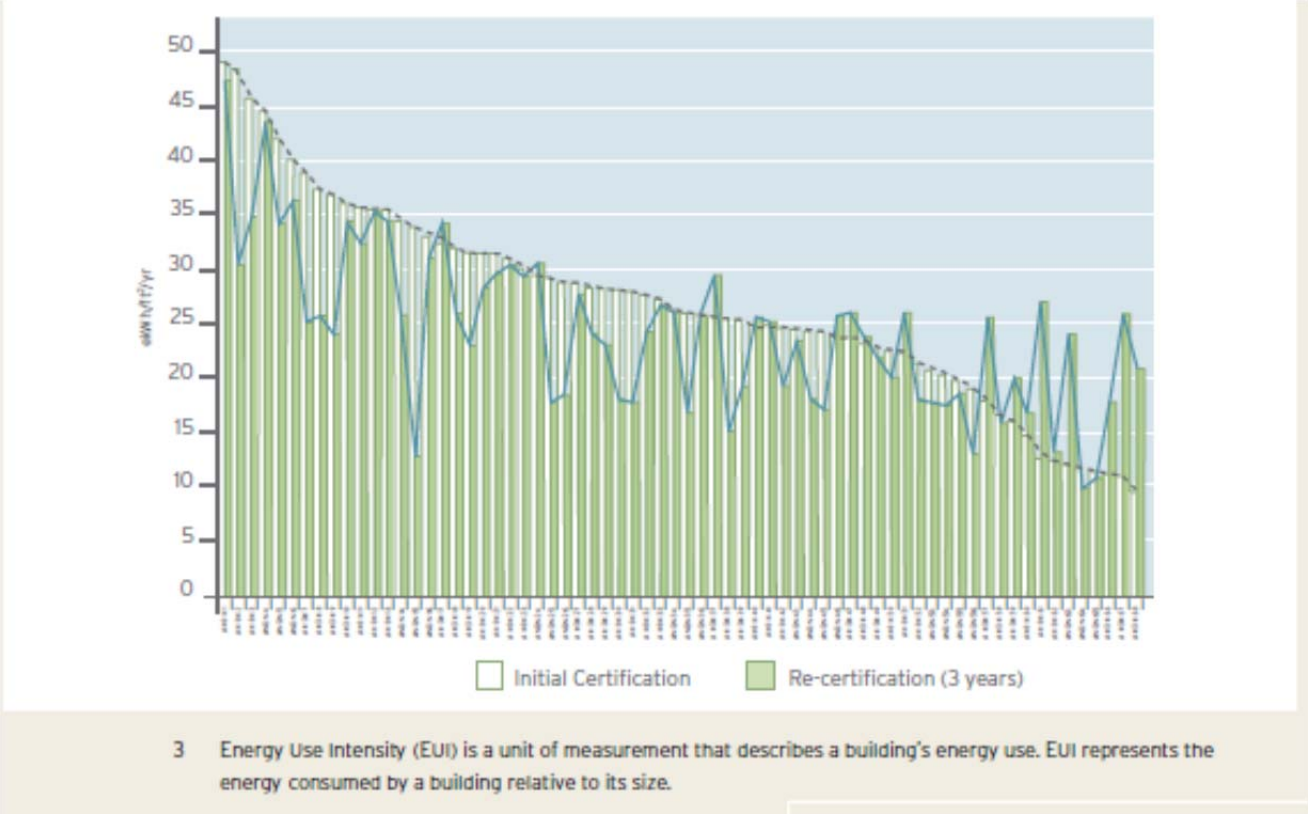
- Level 1: All 14 BOMA BESt Practices must be achieved
- Level 2: BOMA BESt Practices plus a score of 70 – 79% on full assessment.
- Level 3: BOMA BESt Practices plus a score of 80 – 89% on full assessment.
- Level 4: BOMA BESt Practices plus a score of 90 – 99% on full assessment.

Out of a total of 1440 BOMA BESt Certified Buildings, 163 are located in Toronto, and the majority of those are located in the downtown area.

Progress Report[12]

BOMA Canada provides an annual report on BOMA BEST that shows the progress since the program was launched in 2005. Figure 4.1-1 presents the reduction in energy utilization intensity (EUI - ekWh/ft^2/yr) for re-certified buildings, many for the second time. The X-axis shows individual buildings (as Anon 1, etc.), and the Y-axis is EUI.

Figure 4.1-1: Reduction in Energy Utilization Intensity for Re-certified Buildings



3 Energy Use Intensity (EUI) is a unit of measurement that describes a building's energy use. EUI represents the energy consumed by a building relative to its size.

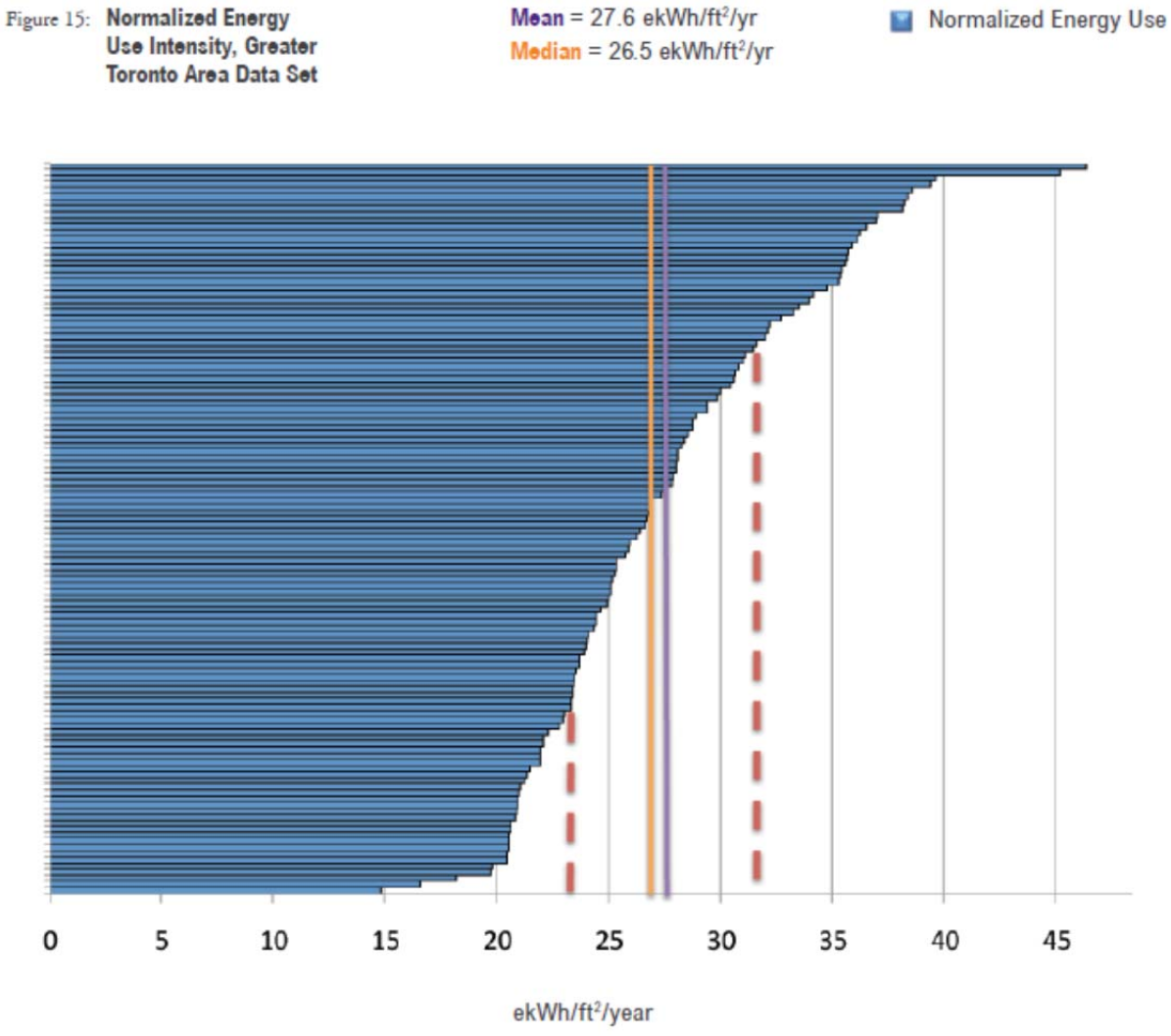
[12] BOMA BESt Energy and Environmental Report 2011. http://www.bomabest.com/wp-content/uploads/BBEER-2011-FINAL.pdf

4.2. REALpac 20 by 15 Energy Benchmarking Program

Commencing in September 2009, the Real Property Association of Canada (REALpac), in collaboration with the Canada Green Building Council ("CaGBC") and the Building Owners and Managers Association of Canada ("BOMA Canada"), adopted an energy utilization intensity (EUI) target for office buildings of 20 equivalent kilowatt-hours of energy use per square foot of building area per year ("20 ekWh/ft^2/year"), to be achieved by 2015, thus "20 by '15". The "normalization" of building energy consumption ensures the comparability between office buildings regardless of tenant mix or climactic zone. This compares with the national average, as reported by NRCan, of 33 ekWh/ft^2/yr.

Figure 4.2-1 presents the results of the survey for 2010, and is based on 120 buildings in the Greater Toronto Area.

Figure 4.2-1: REALpac 20 by 15 Report Summary for Toronto Area



This chart shows the GTA data set of annual normalized building energy intensity with a mean normalized energy use intensity of 27.6 ekWh/ft^2/yr. The median annual normalized energy use intensity is lower than the mean at 26.5 ekWh/ft2/yr. The top 25th percentile of the GTA data set begins at 23.2 ekWh/ft^2/yr and the bottom 75th percentile begins at 31.5 ekWh/ft^2/yr (as indicated by the dashed lines in Figure 3.2-1).

REALpac will be releasing their 2011 Report on the 20 by 15 program in January 2013. In a very recent discussion with a REALpac representative, it was confirmed that the results for the GTA will show a reduction in mean and median EUI. Collection of similar data over time is key to REALpac ensuring that their target will be met.

4.3. ENERGY STAR Portfolio Manager – Canadian Version

Natural Resources Canada began an initiative in 2006 to establish a label describing building energy performance, and after some research, settled on a label similar to the European Union that was identified under the EnerGuide banner. After significant consultation, they undertook a pilot in the institutional sector, the results of which were not made public, except for their report that more than 300 labels were issued to pilot program participants.

This initiative has now focused on adopting the US-EPA ENERGY STAR for Buildings program to Canada. At the April 2012 Green Real Estate Forum, NRCan and EPA announced that they had reached an agreement to “Canadianize” the US program by:

- including benchmark data developed by NRCan for a statistically valid sample of Canadian buildings,
- weather normalizing Canadian buildings using their postal codes and Environment Canada weather data,
- developing GHG emissions based on provincial electricity data,
- adopting metrification of the data,
- using the Portfolio Manager tool on the same basis as US-based users, which includes recommendations for improving building performance.

This system will include baseline performance comparisons for all building types, and is expected to be operational in 2013. The basic output is a rating that compares the energy performance of the building to a benchmark for similar buildings, but the output can also be presented in a variety of forms. NRCan has also held recent discussions with BOMA Canada and REALpac to find a basis on which BOMA BESt and the REALpac 20 by 15 programs can collaborate.

4.4. LEED for Existing Buildings – Operations and Maintenance

The LEED Canada Green Building Rating System for Existing Buildings: Operations and Maintenance is a set of performance standards for certifying the operations and maintenance of existing commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. The intent is to promote high-performance, healthful, durable, affordable, and environmentally sound practices in existing buildings.

Prerequisites and credits in the *LEED Canada for Existing Buildings: Operations and Maintenance Rating System* address seven topics:

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy & Atmosphere (EA)
- Materials & Resources (MR)
- Indoor Environmental Quality (EQ)
- Innovation in Operations (IO)
- Regional Priority.

The EA topic area establishes a minimum level of operating energy efficiency performance at least 19% better than average relative to typical buildings of similar type to reduce environmental impacts associated with excessive energy use.

A growing number of buildings in downtown Toronto have applied for LEED-EB (O&M) registration at one of four levels: Certified, Silver, Gold, or Platinum. This has become a significant factor in the downtown Toronto market for attracting and/or retaining tenants. As a result, the energy performance of these buildings is improving significantly.

4.5. Greater Toronto CivicAction Alliance Race to Reduce

The Race to Reduce is a four-year challenge aimed at reducing total energy use in participating office buildings by 10%. It is open to all landlords and tenants of office buildings across the Toronto region, and represents an unprecedented collaboration between office building landlords and tenants. It recognizes participants with annual awards celebrating successes of landlords and tenants working together to achieve economic and environmental benefits, and is easy to join and simple to manage with free resources and support from experts.

Race to Reduce is a plan of action and a tool kit of technical advice and case study intelligence and know-how that will guide organizations in:

- increasing awareness of their energy use
- measuring and monitoring their energy use
- changing the way they operate or changing the equipment they use to reduce their energy use and increase their energy efficiency.

The Race to Reduce is supported by core utility providers Toronto Hydro and Enbridge Gas, as well as a leading landlord partner, Oxford Properties, and industry partners Building Owner and Managers Association (BOMA) Toronto, Canada Green Building Council and Real Property Association of Canada (REALpac).

With over 600 landlords and tenants in 150 buildings now participating in the *Race to Reduce*, 61 were recognized and celebrated at the annual awards event that attracted leaders from the region's commercial real estate community. These participants occupy over **63.3** million square feet of office space – about **31** per cent of the total office space across the Toronto region.

On Nov. 29, 2012, Steve Smith, real estate executive, Co-Chair of the Commercial Building Energy Leadership Council, and member of CivicAction's Greening Greater Toronto Task Force, noted, "With a 2.0 per cent reduction in the first year of the *Race* we're on track to achieving the 2014 target. The potential is immense – a collective 10 per cent reduction over four years equals 37,000 tonnes of carbon emissions saved, or nearly 27,000 cars off the road. Participants will enjoy a collective savings of over $25.6 million in energy costs over four years, and $12.8 million annually in perpetuity."

5.0 Current and Future Regulatory Requirements for New Buildings

5.1. Ontario Building Code 2012 and 2017

The Ontario Building Code established significantly more demanding requirements for both low-rise housing and for small and large buildings effective January 1, 2012, resulting in an overall reduction of energy use in new houses and buildings of approximately 10%. This has challenged owners, developers, and design teams to achieve significant gains in the energy performance of their buildings, including the building envelope, heating, ventilating, and air conditioning (HVAC) systems, lighting systems, and service water heating systems, thereby reducing consumption and peak demand for electricity and natural gas. These requirements are now stated in Supplementary Standard SB-12 for housing and SB-10 for buildings, and these documents will be revised on a 5-year cycle.

On November 4, 2012, the Ministry of Municipal Affairs and Housing issued a press release announcing the new building code will be designated as a 2012 code, and will take effect on January 1, 2014. This code will include two new sub-objectives to the objective for Resource Conservation, as follows:

- OR2.1: An objective of this Code is to limit the probability that, as a result of the design or construction of a building, the capacity of the infrastructure supporting the use, treatment or disposal of a resource will be exposed to an unacceptable risk of being exceeded due to excessive demand on the infrastructure.
- OE1.1: An objective of this Code is to limit the probability that, as a result of the design or construction of a building, the natural environment will be exposed to an unacceptable risk of degradation due to emissions of greenhouse gases into the air.

The first sub-objective is intended to limit energy peak demand, while the second one is to limit GHG emissions. Both of these objectives will be adopted into the Building Code as regulations in Supplementary Standard SB-10, due to be revised on or before the end of 2013, and both will require designers to take them into consideration in their building designs.

The information issued with the press release also stated that by January 1, 2017, the energy efficiency required for low-rise housing will exceed the current code requirements by 15%, and for buildings by 13%.

5.2. Toronto Green Standard

The Toronto Green Standard (TGS) was introduced on a voluntary basis in 2006, and became mandatory in 2009. Requirements are defined as Tier 1 (mandatory) and Tier 2 (voluntary, with an incentive of 20% of development charges refunded).

Prior to January 1, 2012, the energy efficiency requirements in the TGS exceeded the Building Code by approximately 8% for Tier 1, and 18% for Tier 2. It is interesting to note that some new buildings, particularly new high-rise condominiums, applied to meet the Tier 2 requirements prior to 2012.

The Tier 1 requirement currently matches that found in the Building Code, however Toronto City Planning is proposing to raise the Tier 1 requirements to exceed the code by 5% initially, rising to 15% after an introductory period, and for Tier 2 by 15%, rising to 25% in the same timeframe. They are expecting to be in a position to mandate these by mid-2013.

5.3. Waterfront Toronto

Waterfront Toronto published a set of Mandatory Green Building Requirements (MGBR) in 2010 that required owners and developers to exceed the Building Code energy efficiency requirements by at least 15%. They have under development MGBR-Version 2 that will establish higher energy efficiency requirements.

5.4. The Waterfront Archetype Condominium Project

Sustainable Buildings Canada, with participation from Waterfront Toronto and City Planning, support from Enbridge Gas Distribution, very recently undertook a project to demonstrate how innovative approaches to the design of a condominium building will assist owners, developers and design teams to meet the 2012 Building Code requirements, and also how to improve the overall energy performance of their building by increments of 5%, 15% and 25% better than the Building Code. This report, entitled The Archetype Condo13, will shortly be available on the SBC website.

6.0 Current Programs for New Building Design

6.1. Better Buildings Partnership - New Construction Programs

The Better Buildings New Construction Program (BBP - NC) has the goal of achieving improved energy efficiency in new building construction. To help achieve this goal, the BBP - NC provides an incentive where it can be demonstrated that a new building will use less energy than a similar building designed to the minimum requirements of the Ontario Building Code. This program is designed and funded by the OPA, and is a continuation of the Phase 1 program that expired in 2011.

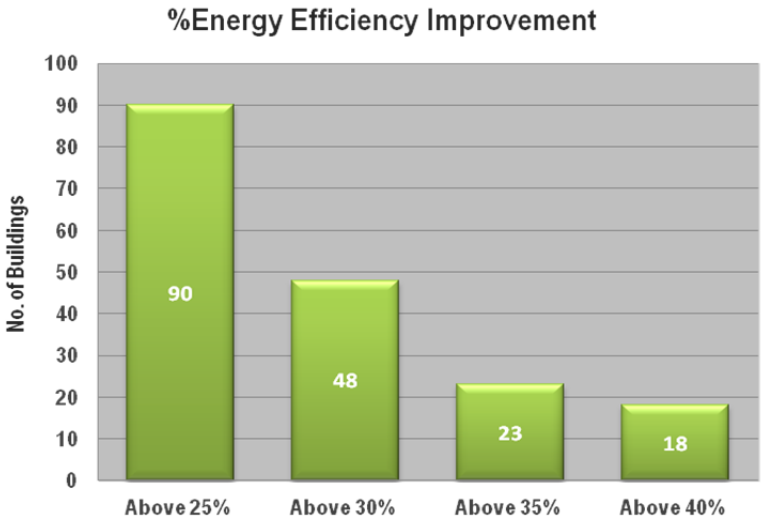
The incentive has two aspects:

- A design assistance incentive of $2,000 plus $0.20/m^2 of gross floor area to a maximum of $7,000 to enable the design team to establish the projected energy savings and peak demand reduction.
- An incentive of $350/kW of projected peak demand reduction or $0.04/kWh of projected annual electricity savings.

This program has been in operation since 2007, and was revised in 2012. Figure 6.1-1 shows information about the first phase program results.

[13] http://www.sbcanada.org/about.html

Figure 6.1-1: BBP-NC Program Results Summary



Of a total of 179 buildings in Toronto that applied under the program, 90 (50%) achieved a performance level of 25% above the Building Code, 48 (27%) a level of 30% above, 23 (13%) a level of 35% above, and 18 (10%) a level of 40% above the Building Code.

This program continues to be offered in Toronto by the Energy Efficiency Office under contract to Toronto Hydro, and supports other initiatives such as the Toronto Green Standard and Waterfront Toronto MGBR.

6.2. Enbridge Savings By Design Program

The Enbridge Savings By Design program, launched at the beginning of 2012, is a program that introduces owners, developers, and design teams to the Integrated Design Process, and rewards proponents who achieve an energy performance level of 25% better than the current Building Code. Incentives include 1-1/2 days of facilitation and consultation to assist proponents to meet the energy performance requirement, and to also assist them to improve the overall sustainability of their projects. Incentives offered for low-rise residential projects are $5,000/house to a maximum of $50,000 per developer, and for buildings, an incentive of $0.20/$m^3$ for projected natural gas savings to a maximum of $50,000 per project. Also for buildings, there is an incentive to commission the building when construction is completed.

To date there have been 15 low-rise and 5 high-rise proponents who have participated, although none are in Toronto – this is expected to change in 2013 and beyond..

7.0 Longer Term Initiatives

The two initiatives described in this section have very aggressive goals, and while they seemed almost unreachable when they were conceived and announced, in the ensuing 5 or 6 years, a great deal of progress has been made.

7.1. Architecture 2030

Architecture 2030 issued a challenge in 2006, that is currently stated in this manner:

"Buildings are the major source of global demand for energy and materials that produce by-product greenhouse gases (GHG). Slowing the growth rate of GHG emissions and then reversing it is the key to addressing climate change and keeping global average temperature below 2°C above pre-industrial levels.

To accomplish this, Architecture 2030 issued The 2030 Challenge asking the global architecture and building community to adopt the following targets:

- *All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 60% below the regional (or country) average/median for that building type.*
- *At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 60% of the regional (or country) average for that building type.*
- *The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:*
    - *70% in 2015*
    - *80% in 2020*
    - *90% in 2025*
    - *Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).*

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy."

Several organizations have signed an agreement to accept this challenge, including the Royal Architectural Institute of Canada (RAIC), Ontario Association of Architects (OAA), and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). In addition, a number of major architectural firms in Canada have accepted this challenge, and must report regularly on their progress.

Ed Mazria, the founder of Architecture 2030, spoke in Toronto on October 11, 2012, at the Green Building Festival. He described a relatively new initiative entitled Architecture 2030 Districts. To date, Seattle, Pittsburgh, and Cleveland have committed to this challenge, stated by Seattle as follows:

"The Seattle 2030 District is an interdisciplinary public-private collaborative working to create a ground-breaking high-performance building district in downtown Seattle. With the Architecture 2030 Challenge for Planning providing our performance goals, we seek to develop realistic, measurable, and innovative strategies to assist district property owners, managers, and tenants in meeting aggressive goals that reduce environmental impacts of facility construction and operations.

These collective efforts will establish the District as an example of a financially viable, sustainability focused, private sector driven effort that maximizes profitability and prosperity for

all involved. Through collaboration among diverse stakeholders, leverage of existing and development of new incentives and financing mechanisms, and development and communication of shared resources, the 2030 District seeks to prove the business case for sustainability. Property owners will not be required to achieve the goals of the District by legislative mandates, or as individuals. Rather, this type of goal achievement requires sharing of resources and ongoing collaboration to make high-performance buildings the most profitable building type in Seattle.

Achieving the 2030 Challenge targets at a district scale, and focusing on existing medium to large buildings that are privately owned, will provide a working model that other cities and regions can use to reduce emissions and impacts. While individual buildings will have specific opportunities for energy reductions, a district approach will provide the opportunity for district-wide heat recovery, distributed generation, and other district energy efficiencies that can reduce the demand for resources. The 2030 District will provide members a roadmap to own, manage, and develop high performance buildings by leveraging existing market resources and by creating new tools and partnerships to overcome current market barriers. This type of collaborative action is a strategic undertaking to help the City of Seattle meet its goal of carbon neutrality by 2030 and represents a major investment in Seattle's future."

Preliminary discussions have been held on the possibility of establishing a similar district in Toronto. This would require a collaboration between the City and associations such as BOMA and REALpac, as well as participation by property owners and managers. Support from Toronto Hydro and Enbridge would also be significant.

7.2. The Living Building Challenge

The **Living Building Challenge** (LBC) is a philosophy, advocacy tool and certification program that promotes the most advanced measurement of sustainability in the built environment possible today. It can be applied to development at all scales, from buildings – both new construction and renovation – to infrastructure, landscapes, and neighborhoods. Living Building Challenge comprises seven performance areas: site, water, energy, health, materials, equity, and beauty. These are subdivided into a total of twenty Imperatives, each of which focuses on a specific sphere of influence. The objective is to design and construct a building which gives back more than it takes from the environment, substantially raising the bar for true sustainability.

There are currently over 150 building projects that have registered to meet the LBC. This requires that the building operates for a year and demonstrates that it has met the challenge in all respects, or that it has met individual performance areas. There are currently at least 7 projects in Canada that have accepted this challenge.

Jason F. McLennan, one of the founders and creators of LBC, spoke in Toronto on October 11, 2012, at the Green Building Festival, and described the many initiatives underway by the International Living Building Institute, based in Seattle. He also informed the audience that he was born in Sudbury, ON.

8.0 Comments on Toronto Hydro-Electric System Limited

8.1. Toronto Hydro CDM Program Recent Experience

Toronto Hydro, in their 2008 Conservation and Demand Management Annual Report[14], noted the following:

- *A key lesson learned from the powerWISE Business Incentive Program (now the Business Incentive Program) is that it takes significant and direct interaction with commercial customers for this type of program to flourish.*
- *CDM program development does take time. It requires extensive research of industry and market best practices as well as environmental issues, which must be thoroughly addressed up front in order to ensure long-term sustainable conservation success.*

In their 2011 Conservation and Demand Management Report[15], the following comments were included:

- *The schedules relating to the Business Program were finalized in early 2011 but required time for customers, contractors and supply chain stakeholders to acclimatize to the new rules and learn new processes. As a result, uptake of new initiatives was gradual and required significant outreach efforts to educate the customer and supply chain network.*

The slow start and accelerating rate of uptake for the BOMA Toronto CDM program confirms the 2008 experience of THESL, and in many respects, the organization is still in the early part of this market readiness and penetration curve even up to the present time.

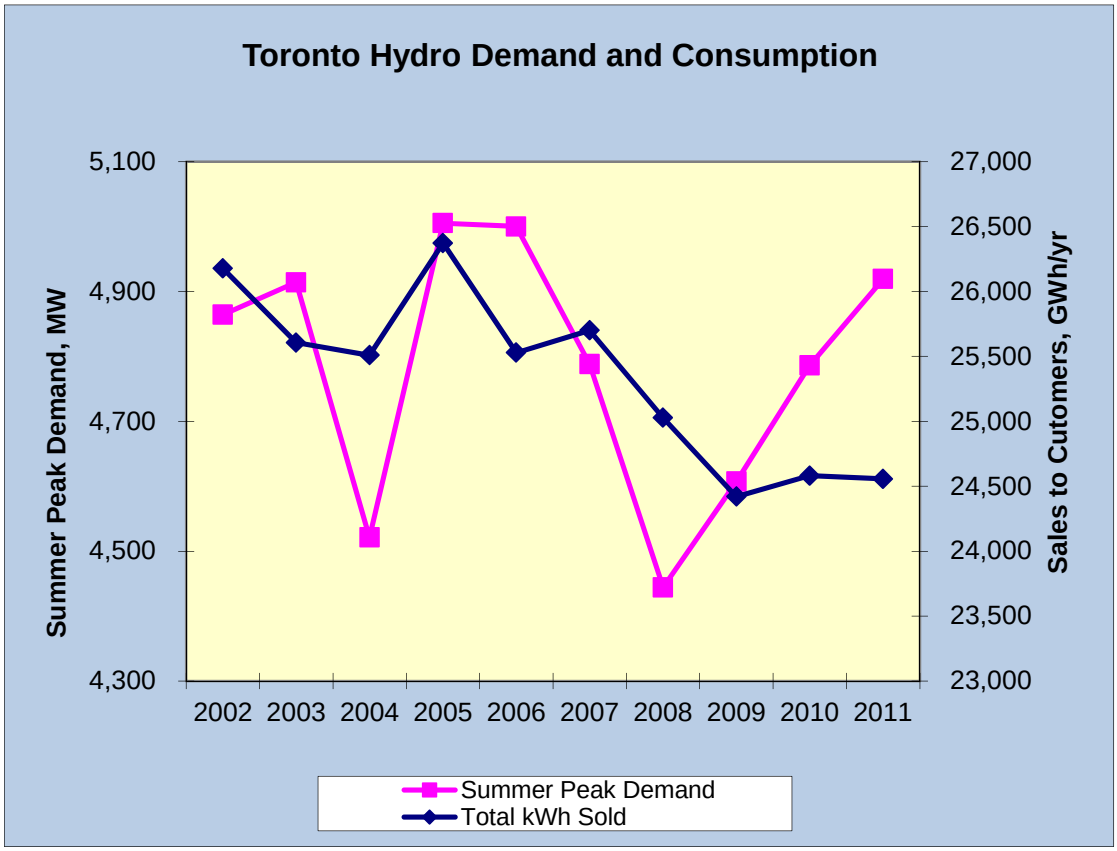
When CDM programs in Ontario experience a break such as occurred in 2011 whereby, from the commercial, institutional and industrial (ICI) market perspectives, the programs were not consistently available, ICI sector clients have short memories and do not actively search out programs. In addition, much of the delivery channel changed, so new contacts and relationships had to be developed. Once disappointed by a program's disappearance, they are not easily convinced that they should reconsider participating.

8.2. Toronto Hydro Sales and Demand Profile

The annual peak demand and sales of electricity to customers are presented in Figure 8.2-1. This is based on information taken from the OEB Yearbook of Electricity Distributors.

[14] Ontario Energy Board File No. RP-2004-0203/EB-2004-0485. March 31, 2009
[15] Ontario Energy Board File No. EB-2010-0215.October 1, 2012

Figure 8.2-1: Toronto Hydro Annual Peak Demand and Sales to Consumers



From 2005 to 2008, peak demand dropped significantly and consumption reduced but at a lower rate. Since 2008, peak demand has risen from 4,444 MW to 4,919 MW while consumption has decreased by 2%.

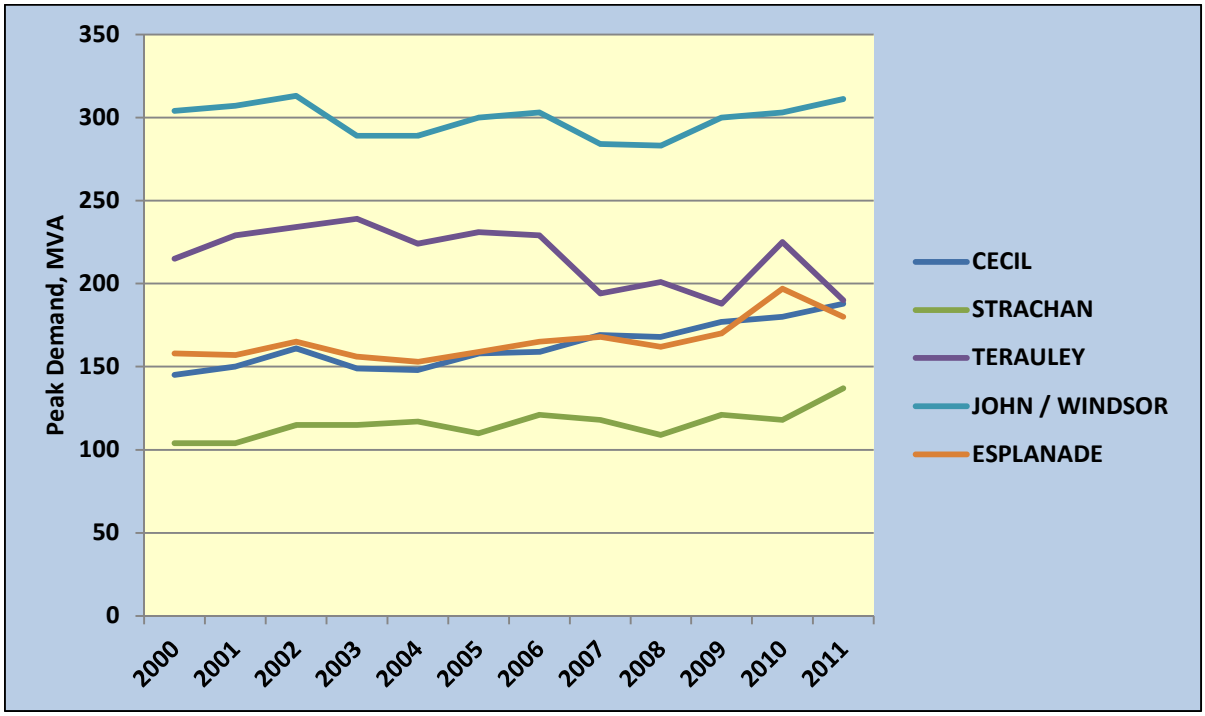
This strongly suggests that Toronto Hydro should focus their CDM efforts in the downtown area on loads such as air conditioning and lighting as well as demand response to counter this trend.

8.3. Toronto Hydro Peak Demand Profile - Downtown Stations

Information provided by Toronto Hydro in response to the interrogatories submitted by Pollution Probe[16] was used to prepare Figure 8.3-1. This chart shows the peak demand for each transformer station from 2000 to 2011.

[16] Toronto Hydro-Electric System Limited. EB-2012-0064, Tab 6F, Schedule 9-1. Filed: 2012 Oct 5

Figure 8.3-1: Toronto Hydro Transformer Stations Non-coincident Peak Demand for Five Downtown Toronto Stations (MVa): 2000 – 2011



It is also interesting to note that the peak summer temperature in 2010 was 36.0 °C, while in 2011 it was 38.0 °C.

8.4. Toronto Hydro Recent CDM Program Record

In their 2011 CDM report, Toronto Hydro noted that there are 80,274 general service accounts and large users within the THESL jurisdiction. Table 8.3-1 summarizes the number of projects for the BOMA Toronto CDM program for 2007 to 2010, and the equivalent Toronto Hydro CDM information for 2011.

Table 8.3-1: BOMA Toronto &Toronto Hydro CDM Program Record

Program	Year	Number of Projects	Peak Demand Reduction, kW
BOMA Toronto CDM	2007 - 2010	775	51,049
THESL Business Programs			
Equipment Replacement Incentive	2011	614	8,049
Direct Install Lighting	2011	3,946	4,903
Existing Building Commissioning Incentive	2011	0	0
New Construction & Major Renovation Incentive	2011	0	0
Energy Audit	2011	60	N/A
Pre-2011 Programs Completed in 2011	2011	684	17,727
Total - THESL 2011 Business Programs		5,304	30,679
THESL Industrial Programs			
Process & System Upgrades Initiative	2011	0	0
Moitoring and Targeting	2011	0	0
Energy Manager	2011	0	N/A
Demand Response 1*	2011	0	N/A
Demand Response 3*	2011	43	11,939
Total - THESL 2011 Industrial Programs		43	11,939

* Program delivered by DR aggregators

The combined efforts of BOMA Toronto and Toronto Hydro resulted in 6,122 projects being supported through their CDM programs. This represents about 8% of a total of 80,274 Toronto Hydro customers, suggesting that considerably more CDM potential remains to be harvested.

9.0 Advanced System Planning with DSM/CDM

The following extract is taken from a paper entitled *Con Edison's Targeted Demand Side Management Program: Replacing Distribution Infrastructure with Load Reduction*[17].

> In 2003, with several electric distribution networks within its service territory approaching capacity, Con Edison was facing large capital expenditures to reinforce its distribution system. With much of this network underground, building new infrastructure represented a difficult and expensive endeavor.
>
> Instead, Con Edison embarked on a large-scale Targeted Demand Side Management Program, developing a pilot effort to achieve 47 MW of load reduction over a four-year period, primarily from commercial and industrial customers in several affected daytime peaking networks. The company contracted with ESCOs (who acted as aggregators to recruit customers) to provide guaranteed, long-term savings, with the first tranche to be in place in Spring 2005. To ensure the load reductions were achieved and precisely determine the actual savings, Con Edison instituted substantial liquidated damages for shortfalls and contracted with ICF International to perform stringent measurement and verification, requiring 100% inspection of every site before and after installation of the load reduction measures.
>
> The program was subsequently expanded to 149 MW and extended to cover a much

[17] Presented at the 2010 ACEEE Summer Study on Energy Efficiency in Buildings, Chris Gazze, Steven Mysholowsky, and Rebecca Craft, Consolidated Edison Company of New York, & Bruce Appelbaum, ICF International

larger portion of the company's service territory, including residential customers in certain nighttime peaking networks. To date, over 47,000 customers have participated, generating 89 MW of load reduction (through May 2010). Con Edison estimates that the program will ultimately achieve a benefit/cost ratio of 2.8 and avoid $223 million in capital expenditures.

10.0 Summary

The nineteen activities described in this document each on their own have only a limited impact, but the total effect on electricity consumption and summer peak demand is large and growing significantly. Historical measures of peak demand growth are not truly representative of what is currently occurring in downtown Toronto. Toronto Hydro has a tremendous opportunity to build on these initiatives to avoid or delay investments in the distribution system. Like Con Ed, it can enhance these initiatives in specific areas such as downtown Toronto to maintain reliability at a lower cost.

Each new building currently being designed and constructed must meet significantly more stringent energy efficiency requirements than those in the previous Building Code, and the current performance levels will ratchet higher as the code and regulations are updated. In addition the Building Code proposes to regulate peak demand commencing in 2014.

Most existing buildings in the downtown core face an increasingly more sophisticated condo buyer or office space lessor, and their owners and owners and managers know they must deliver better energy and environmental performance. Monitoring and tracking initiatives assist and motivate them to do so.

From the descriptions and analysis in this report, we are confident that there remains much more CDM potential than is described in the Toronto Hydro application and business case.

> *Christiana Figueres, Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC), "There are so many proven technologies we know exist that are tried and true that have not been used to their maximum potential. To begin with, the simplest is energy efficiency."*[18]

[18] Scientific American. Dec. 2, 2012

Appendix A: Acronyms and Abbreviations used in this Document

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
BAU	Business as usual
BBP - NC	Better Buildings Partnership New Construction (Program)
BOMA	Building Owners and Managers Association
CaGBC	Canada Green Building Council
CDM	Conservation and demand management
CHeP	Combined heat and emergency power
CHP	Combined heat and power
DES	District energy systems
DLWC	Deep Lake Water Cooling
DR	Demand response
EE	Energy efficiency
ekWh	Equivalent kilowatt hours
EUI	Energy utilization intensity
HVAC	Heating, ventilating, and air conditioning
ICI	Industrial, commercial, institutional
kW	Kilowatt
kWh	Kilowatt hour
LEED®	Leadership in Energy and Environmental Design
MGBR	(Waterfront Toronto) Minimum Green Building Requirements
MVa	Mega Volt-amperes
SBC	Sustainable Buildings Canada
SBD	Savings By Design (Enbridge program)
TGS	Toronto Green Standard (City of Toronto Planning Department)
THESL	Toronto Hydro Electric Services Limited
TWGDS	Toronto Waterfront Green Development Standard

Appendix B: Bob Bach *Curriculum Vitae*

Please see the following five pages for the author's c.v.

H. R. (Bob) Bach, P.Eng, Energy Profiles Limited

ENERGY PROFILES LIMITED

Independence.
Impartiality.
Accountability.

I. Education and Work Experience

BA Sc., Mechanical Engineering (Honours), University of Toronto. Graduate Thesis Title "Collecting Heat from the Sun"

Senior Associate, Energy Profiles Limited. Responsible for Sustainable Building programs, DSM and Municipal Energy and Water Efficiency programs, New Building Design Energy Codes and Standards, and Energy Efficiency Training program development and delivery.

Senior Consultant, Engineering Interface Ltd. Responsible for Sustainable Building programs, DSM and Municipal Energy and Water Efficiency programs, New Building Design Energy Codes and Standards, and Building Environmental Management Systems

Manager, Engineering, Tescor Energy Services Inc., Energy performance contractor specializing in commercial buildings

President and Owner, Service Canada Inc.

President, HRAI Technical Services Division Inc., subsidiary of the Heating, Refrigerating and Air Conditioning Institute of Canada, formed to managed the R2000 ventilation and Residential HVAC energy efficiency programs.

President and Owner, Atlas Air Conditioning Company, Toronto based HVAC design/build contractor.

Partner, Solatherm Solar Energy Systems Inc., solar energy installation contractor.

Construction Manager, Cluva S.A., Leysin, Switzerland, Year round hotel complex in the Swiss Alps.

Product Marketing Supervisor, Steam and Gas Turbines, Westinghouse Canada Ltd.

II. Significant Projects

Demand-Side-Management & Energy Conservation Program Development & Evaluation

Member of the Sustainable Buildings Canada project team responsible for the design and delivery of the Enbridge Savings By Design program. This program offers incentives for achieving an energy efficiency level of 25% better than the Building Code, and brings the Integrated Design Process to low-rise housing and high-rise building developers and constructors to assist them to meet this target. SBC for Enbridge Gas Distribution.

Member of the project team responsible for determining rates for free ridership and spillover for Enbridge Gas Distribution and Union Gas Limited DSM programs in the commercial and industrial sectors. Assisted in the development of a survey instrument, on-site surveys of 90 program participant organizations in the industrial, commercial, and multi-family sectors, and a review of EGD energy savings calculation methodologies. Summit Blue Consulting for Enbridge Gas Distribution and Union Gas Limited.

Project manager and principal researcher for development of a Design Advisory Program to offer a skilled facilitator and building energy consultant to new building design teams to assist them in improving and optimising the energy performance of their new building design. Reviewed similar programs, developed a preliminary program design, piloted the program, finalized the design, and assisted in the selection and training of facilitators. Enbridge Gas Distribution.

Project manager and principal researcher for "Development and Implementation of an Industry Sponsored Comparative Energy Rating/Labelling System for HVAC Products." Responsibilities included program design and obtaining industry participation. Reached over 90% of suppliers who adopted the "EnerGuide for HVAC" label. Heating, Refrigerating and Air Conditioning Institute of Canada and Natural Resources Canada.

Contract advisor to the Ontario Power Authority to provide engineering and technical expertise on CDM programs and measurement and verification methods, 2011 to 2012.

Municipal Projects

Member of the project team and energy code expert on preparation of "The Waterfront Toronto Archetype Condo Report". This project determined the design challenges for new condominiums to achieve energy efficiency levels of 5%, 15% and 25% better than the 2012 Building Code, representing levels proposed for both Waterfront Toronto Minimum Green Building Standards and City of Toronto Planning Department updates to the Toronto Green Standard. Sustainable Buildings Canada for Waterfront Toronto, Enbridge Gas Distribution, and the Building and Land Development Institute.

Project manager and principal researcher for a project to establish recommendations for the Toronto Green Standard to adopt in order to maintain a higher energy efficiency standard that the Building Code. Recommendations will be considered by City Council early in 2013. A second research project determined the cost-benefit of the recommendations. Sustainable Buildings Canada for City of Toronto Planning Department, with funding by the Toronto Atmospheric Fund.

Project manager for a "Net Zero Electricity Plan for Exhibition Place". Analysis of hourly loads on the campus and forecast of future loads, development of energy efficiency initiatives for all buildings owned and operated by ExPlace, review of potential options for on-site renewable generation, and recommendations for renewable and non-renewable generation and energy efficiency initiatives. ExPlace is in the implementation phase. Board of Governors of Exhibition Place and City of Toronto Energy Efficiency Office.

Member of the project team for the development of a "Background Report on the Energy Plan for the City of Toronto". Review of current programs, determination of all fossil fuel and electricity loads by building type and floor space for 23 categories, 25-year forecasts of all energy use by load category, recommendations for action to be taken. With Price Waterhouse Coopers for City of Toronto Energy Efficiency Office.

Consultant to Exhibition Place and the City of Toronto for the 100 kW solar PV installation located on the roof of the Horse Palace designed as a pilot and monitored for a year, and a 142 kW solar PV installation on the roof of the Coliseum. The former was the largest solar PV installation in Canada when completed in the spring of 2006. Board of Governors of Exhibition Place.

Training

Member of the project team for development of thirteen initiatives to be undertaken by the

Ontario Power Authority to build capability in delivery of energy conservation by energy managers, building operators, HVAC installers, and energy evaluators. Reviewed size of the existing workforce, skills gap, training options available, and selected the optimum training solution. With SeeLine Group Ltd, for the Ontario Power Authority.

Project manager responsible for the development and delivery of a training program for architects and engineers on designing new buildings to exceed ASHRAE/IES 90.1 energy efficiency levels. Program provided examples of energy efficient measures that could be applied to offices and multi-unit residential buildings, with cost/benefits defined. Enbridge Gas Distribution and Union Gas.

Project manager responsible for development and delivery of training on ASHRAE/IES 90.1, “Energy Efficient Design of New Buildings except Low-rise Residential Buildings” and the O/H New Building Construction Program to over 800 architects, engineers, and building officials across Ontario. Developed a Compliance Review and Inspection Manual to assist municipalities in determining compliance with Standard 90.1. Ontario Hydro.

Project manager and principal researcher for development and delivery of a training program for architects on ASHRAE/IES 90.1. Program design, delivery of a train-the-trainer program for architect-trainers. Ontario Association of Architects.

Project manager responsible for development and delivery of a one-day training program for electrical, mechanical, and building envelope contractors, in the identification, development, and delivery of energy efficiency as a business opportunity to be delivered to their small and medium enterprise customers. Energy Efficiency Contractors Network and the Ontario Power Authority.

Energy Technology Review and Evaluation

Project Manager and principal researcher for a technology review and investment study on fuel cells for power generation and for transportation. Literature review, interviews with industry players, evaluation of technology development needs, time to market, and environmental, social, and economic impacts. Obtained feedback and buy-in from key industry stakeholders. The final investment overview report assisted the client to evaluate a variety of renewable energy technologies, including wind, solar P-V and biomass, on a comparative basis. Sustainable Development Technology Canada (SDTC).

Project Manager and principal researcher for a technology review and investment study on hydrogen production and purification. Literature review, interviews with industry players, evaluation of technology development needs, time to market, and environmental social and economic impacts. Obtained feedback and buy-in from key industry stakeholders. The final investment overview report assisted the client to evaluate a variety of energy sources on a comparative basis. SDTC.

Green Building and Energy Code Programs and Projects

Team Captain of the Canadian Team for Green Building Challenge 2005 (Tokyo), 2008 (Melbourne), and 2011 (Helsinki), and member of the Canadian Team for 2000 (Maastricht), 2002 (Oslo). Selected recently designed and constructed Canadian advanced environmental performance buildings for evaluation of energy and environmental performance, assessed against a comprehensive set of criteria adjusted for local conditions.

Member of the project team for development of the C-2000 Commercial Building Program Technical Criteria. Defined the benchmarks for advanced technology Office and Multi-

Unit Residential buildings under four categories: environmental performance, indoor environmental performance, longevity and adaptability, and functional performance. Directly responsible for energy and environmental performance criteria. Natural Resources Canada.

Member of the project team responsible for mechanical and electrical systems for a study entitled “Building Adaptability: A Survey of Systems and Components” which defined the factors affecting the adaptability of buildings for re-use, with the intent of influencing new building design. With Young & Wright Architects Inc., for Canada Mortgage and Housing and Natural Resources Canada.

Project manager and principal researcher for the development of documents entitled “Guide to the Implementation of an Environmental Management System based on ISO14001” for five commercial/institutional sectors: Offices, Hospitals, Municipalities, Schools, and Colleges and Universities. This required forming advisory committees from each sector who reviewed the draft document and provided valuable comments for their guide. Each sector association endorsed their guide and assisted in the distribution to their members and others. Ontario Ministry of the Environment.

Project Manager and Principal Researcher for a study entitled “Market Viability of Integrated Appliances For Multifamily Markets In Canada” which included a study of multifamily and related markets and market potential, load ranges, application issues, and a survey of stakeholders. Gas Technologies Canada.

Emissions Evaluation and Reduction Projects

Project Manager and principal researcher for development of a greenhouse gas and criteria air contaminants calculator for commercial, institutional, and industrial organizations to use to evaluate their emissions from direct fuel use, electricity use, and transportation, within the province of Ontario. Ontario Ministry of the Environment.

Member of project team and chiller specialist for a project to examine all costs of owning and operating an electric centrifugal chiller in an office or multi-residential building operating in a deregulated electricity market. This required an evaluation of electricity consumption on an hour-by-hour basis, matched with electricity cost on the same basis. Emissions trading potential within the current Ontario regulation was also evaluated. Energy Profiles Ltd., for Enwave District Energy Ltd.

International Projects

Project Member for a project to review energy efficiency activity in The Czech Republic and other economies in transition, and to develop a framework and model which would use energy efficiency intermediaries (ESCOs and others) to assemble and report data which could be used to evaluate emissions reductions, particularly from a number of smaller projects, with a view to developing potential trades under the Kyoto mechanisms. Project included a site visit to interview participants in the energy conservation sector, and to review plans to be implemented by the state government. Final report was accepted, published and widely distributed by the client. With Cumming Coburn Ltd. for the World Bank.

Member of the project team responsible for the preparation and delivery of a series of lectures on Sustainable Building Design to the faculty of the School of Architecture, Design and Urbanism, University of Buenos Aires, Argentina (Universidad de Buenos Aires Facultad de Arquitectura, Diseño y Urbanismo). With Nils Larsson, International Initiative for a Sustainable Built Environment.

Project consultant on building HVAC systems and energy use for a study entitled "Russia's Housing Market: A Beginner's Guide." This manual was designed to acquaint Canadian companies interested in retrofitting multi-family buildings for energy efficiency with market potential and specific business practices and conditions. With the Titan Group, for Canada Mortgage and Housing Corporation.

III. Other Activities

Founding Co-chair of the Building Code Energy Advisory Council formed in 2010, responsible for advising the Minister of Municipal Affairs and Housing on energy and water conservation in the Ontario Building Code. Council was recently renamed the Building Code Conservation Advisory Council, and the position changed to Vice-chair, Energy.

Founding Director and current Treasurer of Sustainable Buildings Canada (SBC), formed to assist in the transformation of new building design towards more environmentally sustainable practices.

Captain of the Canadian Team for the World Sustainable Building Conference 2005 (Tokyo) & 2008 (Melbourne); team member since 1999.

Chair of the Mechanical Services Advisory Committee, subcommittee of the Toronto Area Chief Building Officials Committee, 2003 to 2011.

Past President of the Toronto Chapter of the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE).

Member of Professional Engineers of Ontario (PEO), and Life Member of ASHRAE.

Consultant to the ASHRAE 90.1 Committee, HVAC Panel, responsible for the revision and upgrading of ASHRAE/IES 90.1.

Former Director and Contractor Division Chairman, Heating, Refrigerating and Air Conditioning Institute of Canada (HRAI). Winner of the Merit Award.

Former commercial pilot with accreditation on corporate jet aircraft.

Active participant in skiing, speed skating and squash.

IV. Contact

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