



Energy Conservation and Demand Management Plan 2015



**Public Works Department
Parks, Buildings and Grounds Services
100 Constellation Crescent, 9th Floor West
Ottawa, Ontario
K2G 6J8**

Alternate formats of this document are available upon request.

Table of Contents

- Energy Conservation and Demand Management Plan 2015 1
 - 1. Overview 3
 - 2. History of Energy Management..... 3
 - 2.1. Leadership in Energy and Environmental Design (LEED) 4
 - 2.2. Streetlighting and Traffic Signals 4
 - 2.3. Solar Panels 5
 - 2.4. Building Automation Systems 5
 - 3. Utility Consumption Data..... 5
 - 3.1. Building Inventory Footprint 5
 - 3.2. Electricity 6
 - 3.3. Natural Gas 6
 - 3.4. Water 6
 - 3.5. Footprint 7
 - 4. Energy Management and Investment Strategy 2015-2019 7
 - 4.1. Building Engineering and Energy Management unit..... 7
 - 4.2. Planned Capital Measures..... 8
 - 4.3. Replacement of Current Street lighting..... 9
 - 4.4. Expansion of the City's integrated Building Automation System (BAS) 10
 - 4.5. Demand Management 10
 - 4.6. Renewable Energy 10
 - 4.7. Monitoring and Auditing 10
 - 4.8. Re-commissioning 11
 - 4.9. Training..... 11
 - 4.10. Annual GEA Report on Consumption and Demand..... 11

1. Overview

The City of Ottawa is committed to energy management as a key component of its operations and has provided leadership in energy conservation since 2001. It understands the social, environmental, and financial implications of energy management and is striving to deliver improvements in a responsible way.

The City of Ottawa is required in compliance with the Green Energy Act to develop and implement an energy conservation and demand management plan effective 2014. This document is the energy conservation and demand management plan for the City of Ottawa. It covers the strategy for conservation for electricity, natural gas, oil, propane, and water for the five-year period 2015 - 2019.

The City of Ottawa's total energy usage for 2012 has remained at a comparable level to that used in 2008, despite the fact that the building inventory has increased significantly and the City's facilities are being used longer. This is largely due to City Council's investment and support of environmental sustainability. In addition, the Public Works department has dedicated a component of its operations, the Building Engineering and Energy Management unit, to the implementation of energy conservation measures with City facilities. A further contribution to the City's energy demand management is its commitment to efficiency in new buildings and in the life cycle replacement of equipment.

Going forward, the document presents plans for investing \$40M in the next four-year period. The majority of this investment will be dedicated to the conversion of 67,000 streetlights to light-emitting diode technology (LED). This investment is expected to reduce the City's energy intensity by close to 1% a year. It should also reduce the electrical use of its street lighting by over 50% over the next 4 years.

2. History of Energy Management

The City of Ottawa has been active in conservation programs since amalgamation with a focused Energy Reduction Program running from 2004 to 2009. The mandate of the program was to reduce the City's environmental footprint of facilities while realizing a 5 year simple payback on investment. Between 2003 and 2008 the City invested \$5.1 million in energy reduction measures and realized \$3.4 million in cumulative savings.

In 2010, environmental sustainability was identified as a key priority for the 2010-2014 Term of Council with a commitment to implement green technology in order to promote energy efficiency. As a result, Council approved a five-year Smart Energy Program that was sponsored by the Service Ottawa Program and delivered by Public Works. Council approved a \$14M investment that has capitalized on the implementation of energy initiatives. The program is expected to exceed its mandated 5-year simple pay back before the end of 2014 at which time, the City will realize \$2M in annual energy savings.

Key initiatives implemented in City facilities over the last 9 years include:

- Development of a powerful Utility Management Accounting System (UMAS) using state-of-the-art third-party software
- Replacement of High Intensity Discharge lamps and Fixtures in arenas with T5HO fluorescent technology (43 ice pads completed) 2007– 2010 (Energy use cut effectively in half)
- Replacement of all the T12 fluorescent lighting technology in the City with T8 technology (2004 – 2012)
- Replacement of oil, propane, and electric heating equipment with equipment using Natural Gas as an energy source
- LED lamps and fixtures installed in transit way stations and parking garages
- Integration of Building Automation System controls
- Replacement of outside building security lighting (wall hung fixtures) with LED style (up to 75% savings)
- Low Flow Toilets and automatic flushing of urinals
- Replacement of old style water-cooled refrigeration equipment with modern air-cooled equipment
- Implementation of controls for Heating Ventilation and Air Conditioning scheduling and optimization
- Converting inlet vanes to Variable Frequency Drives on Variable Air Volume systems
- Occupancy control for lighting and environmental systems using carbon dioxide, proximity, occupancy sensors, and conditional pushbuttons
- Pool Covers on some of the City swimming pools which reduces the amount of water evaporated into the facility

2.1. Leadership in Energy and Environmental Design (LEED)

The City of Ottawa has adopted Leadership in Energy and Environmental Design as a standard for all new facilities that are over 500 square meters in size. This was an attempt to ensure that all new facilities will be energy efficient. The proposal was included as part of the Energy Management and Investment Strategy presented and approved by council in 2008

2.2. Streetlighting and Traffic Signals

There are over 67,000 streetlights in the City using 52.6 Giga Watt-hours (GWh) or 1M kilowatt-hours (KWh) annually. That number grows with every new development built in the City. Streetlighting accounts for a 17% of the electricity used by the City. The streetlighting fixtures use either High-Pressure Sodium or Metal Halide bulbs. New LED technology offers the opportunity to reduce the energy use by over 50%. Since streetlighting cost in 2013 was over \$6.0M, the savings are very significant.

There are 1130 intersections where traffic signals control the flow of traffic. These traffic signals consumed slightly less than 8.0 GWh in 2012. At the end of 2013, approximately

50% of the traffic lights will use LED technology. Traffic light power consumption has been falling since 2008 even though the number of intersections under control has increased. The new technology reduces electrical use by as much as 80%.

2.3. Solar Panels

The City has taken advantage of the Provincial Micro-Fit program by installing solar panels on three facilities. The total installed capacity is 23 kilowatts. The Smart Energy program provided for energy reduction measures and provided the capital required to build energy generation and benefit from the Province's Micro-Fit Program. As a result, the City has earned approximately \$45,000 since 2011 the City also has installed solar panels installed at City Hall, the bus garage on Belfast and at Huron Early Education Centre on Capilano Ave.

Due to limitations with the main Hydro station in Ottawa, large solar projects at Trail Road and 20 large buildings have not proceeded as planned. Recently changes have been completed at the Hawthorne power station that will enable additional power to be uploaded to the grid.

2.4. Building Automation Systems

Building automation systems (BAS) automatically control a large portion of the heating ventilation and air conditioning in many of the City's facilities. Used properly, these systems can allow for optimal efficiency in building operation. The City of Ottawa has approximately 100 separate BAS installations from 14 different vendors. Multiple vendors have historically posed many challenges for facility, maintenance and engineering staff. Each system is unique with different graphics, different computer needs, different security requirements and different methods of accessing the information.

The new 'Integrator' system allows individual systems to be seen through a common front end. This system can now be accessed through any City computer or Blackberry with the right authority. The new 'Integrator' system makes it easier for staff to run their facility from any location. Staff are no longer required to interface through a specific computer to make necessary changes. This newly integrated system it will simplify troubleshooting and, may lead to increased competitive pricing for vendor technical support.

3. Utility Consumption Data

3.1. Building Inventory Footprint

Since 2008, the City's portfolio of facilities has grown by over 600,000 square feet. Many of the new buildings constructed included large surface areas. Examples of these new buildings include the Shenkman Arts Centre, Centrepointe Theatre Expansion, and the James Bartleman Archives and Library Materials Centre.

During this period, programming in many facilities has grown and the number of hours the facility is in use is greater which adds substantially to the electricity usage at the facilities. The total number of programming hours rose from 629,408 in 2008 to 673,447 in 2012 which, is an increase of 6.5%.

3.2. Electricity

The City of Ottawa currently owns and operates over 250 large and very large facilities along with hundreds of smaller facilities. The total electrical energy consumption for 2008 was 309 GWh; while in 2012 it was 313 GWh. One of the main reasons electricity use increased in 2012 was because the Fleet Street pumping station was off-line for major repairs. The Fleet Street pumping station uses hydraulic power and during repairs, the Britannia Water Purification Plant, which runs on electricity, was used as a back-up. During this time, the Britannia Plant used approximately 1.0 GWh more than previously years.

3.3. Natural Gas

Natural gas is a very inexpensive source of energy when compared to other energy sources such as electricity, oil, and propane; it is also relatively clean burning. The City has converted a large number of heating appliances to use high-efficiency natural gas units.

Consequently, the number of accounts in natural gas increased dramatically. In 2003, there were 241 natural gas accounts. By 2012, there were 335 accounts. A portion of the increase in the number of accounts was for the new facilities added in those years. However, a large number of the new accounts were because of conversions to natural gas from oil and other energy sources.

The amount of natural gas used by the City from 2008-2012 has also decreased, despite the increase in City owned and operated squared footage. In 2008, the City used over 17.8 million cubic meters of natural gas. In 2012, consumption was 17.0 million cubic meters. The 2008 figures do not include the oil and propane use that has been converted to natural gas.

Natural gas usage varies from winter to winter depending on the weather. In a colder winter, the consumption of natural gas will increase. While in a mild winter, such as that experienced in Ottawa in 2009-2010, the usage will fall.

3.4. Water

Fresh water is a valuable resource and perhaps the most important resource on the planet therefore; it is important that the City play a role in using it responsibly. The City has implemented several measures in various facilities specifically designed to reduce water use. Staff have replaced old toilets in many City facilities with low flow style units. Virtually all the urinals in City facilities are now automatic flush that reduces water use considerably. A significant amount of water-cooled refrigeration equipment was replaced with more cost effective air-cooled equipment. The recent conservation measures have reduced the rate per unit floor area has reduced by 15% in the past five years.

3.5. Footprint

Energy use has stayed consistent and water use in the City has dropped by 15% in the last 5 years while the area we maintain has increased by 8% and programs are being run longer. The effective decrease in energy and water consumption highlights the positive impact that the energy reduction program has had on city facilities since the inception of the Smart Energy Program.

The program does not focus solely on the technology side of energy management. The program also addresses human factors by including training of maintenance and operations staff as well as providing staff with feedback on the energy use of their individual facilities.

One method to evaluate the City's performance with its energy reduction program is to assess the total energy used and divide it by the total area of the buildings the City has in its inventory. This provides a clear number for the energy consumption of the entire City rather than focusing solely on the energy used within individual City buildings. This figure is referred to as average energy intensity and it establishes the total energy used per 1 million square feet of floor space. In 2008, the City's average electrical intensity was 24.75 GWh per million square feet. The intensity rate fell to 23.38 in 2012; a 6% decrease over 5 years.

This translates to an equivalent reduction of approximately 2,065,000 kilograms of equivalent CO₂ (eCO₂) of Green House Gas (GHG), emissions based on 2012 Ontario Provincial emission factors.

4. Energy Management and Investment Strategy 2015-2019

4.1. Building Engineering and Energy Management unit

The Building Engineering and Energy Management Unit is part of the Parks, Buildings and Grounds Services branch within the Public Works department. This unit's mandate is "*Optimizing tomorrow's energy use today*" and as such, is responsible for aligning the City's energy demand with opportunities to capitalize on conservation measures. Some of the unit's key responsibilities are:

- identify, develop and implement energy saving opportunities on behalf of the City of Ottawa;
- support the Parks, Buildings and Grounds branch on technical issues such as energy, HVAC, lighting, water, legislative codes and environmental issues;
- maintain the Utility Management and Accounting System (UMAS) that includes gathering and uploading data, retrieving and analyzing results, developing and implementing tools, and supplying information to help all City departments with historical and budget information;
- undertake Natural gas procurement on behalf of the City;
- establish energy performance standards for equipment used in all construction projects within the City;
- capitalize on energy efficiency incentive programs on behalf of the City
- analyze energy and water use in individual facilities and provide feedback if the rate of use climbs unexpectedly;
- upgrade and develop the use of Building Automation Systems (BAS) to improve the performance of City facilities;
- assist with ensuring facilities are safe and efficiently operated; and
- provide support and guidance to other City departments with respect to energy used and environmentally sustainable initiatives.

The Building Engineering and Energy Management unit will also be responsible for delivering the commitments contained within this plan as well as updated and presenting the subsequent plans with each new term of Council.

4.2. Planned Capital Measures

Each year of the program, the Building Engineering and Energy Management Unit will implement approximately 40 capital measures within existing City facilities and associated infrastructure. The annual investment is \$2M. This investment will result in a 5.5-year simple payback obtained through the savings incurred in the associated energy or water reduction. The measures shall include but are not limited to

- Lighting upgrades (mainly to LED)
- Heat source conversions from electricity and oil to equipment using natural gas
- Increases in equipment efficiency
- Water Measures
- Controls upgrade
- Heating Ventilation and Air Conditioning upgrades to more efficient equipment
- Replace inlet vanes with Variable Frequency Drives on Variable Air Volume air handling units
- Building envelop improvements

The annual project plan will be developed in the fourth quarter of the previous year and the project will yield an average 5.5-year simple pay back. This will result in a reduction

of close to 1% of current facility utility costs or an estimated \$1.45M in total annual savings after four (4) years.

- Annual Investment: \$2.0 M
- Return on Investment: 5.5-year simple payback
- Percentage Electrical Measures = 80%
- Percentage Gas Measures = 10%
- Percentage Water Measures= 10%
- Estimated reduction in kWh: 250,000 kWh
- Estimated reduction in Natural Gas: 125,000 m³
- Estimated reduction in Water: 15,000 m³
- Schedule: There are approximately 40 measures implemented annually. Preliminary identification of program details will be prepared by the start of the fourth quarter of the previous year.

4.3. Replacement of Current Street lighting

The City has 67,000 streetlighting fixtures in its vast network. The current streetlights use a mixture of Metal Halide (MH) and High Pressure Sodium (HPS) technologies. Significant improvements in Light-emitting Diode (LED) technology over the last few years have made it an attractive replacement to the City's existing equipment. These improvements include efficiency in output and costs and, the ability to include automated controls and monitoring. This initiative is expected to reduce energy consumption by a minimum of 50% and, reduce the associated maintenance costs by a minimum of 50%. This translates in an anticipated \$1.6M in savings. Additionally, the fixtures will have an improved colour-rendering index (CRI) that will climb from 22 to approximately 70. The CRI is an indication of how well a person can read signs and distinguish facial features. In addition, there will be a system to provide notification when the light in a fixture fails, much more precise utility consumption data, and better control that reduces trespass light. The implementation period would be 4 years.

- Investment: \$32M
- Return: \$5.3M annually (including maintenance savings)
- Potential reduction in kWh = 29,000,000
- Schedule: Over 15,000 fixtures converted per year (commencing 2015).

Currently the Building Engineering and Energy Management unit is implementing a location specific LED conversion project that will realize the conversion of 700 metal halide and high pressure sodium fixtures to energy efficient LED on one of the City's major arterial roads. This project will commence in Q2 of 2014.

4.4. Expansion of the City's integrated Building Automation System (BAS)

The BAS Integration system will allow the City to quickly review individual systems from a central location. This can help facility and maintenance staff to identify equipment or control issues. It can also identify opportunities for facility staff to reduce energy use without impacting programming.

In order to optimize the operation of the system, staff estimate an annual maintenance cost of \$50,000 would be required. It is estimated that approximately 2% of individual facility utility costs are in wasted energy. BAS provides the opportunity to reduce, and in some cases eliminate, these wasted costs through the early identification of facility system issues.

4.5. Demand Management

The City has a large natural gas back-up generator that can power the Britannia water treatment site in the event of a total blackout; as experienced in 2003. The City is currently engineering changes in the system that should allow it to take part in the utilities Demand Management program.

The City will continue to investigate other demand management opportunities.

4.6. Renewable Energy

The City will continue to investigate opportunities to install additional solar and renewable energy projects subject to the availability of incentive programs.

4.7. Monitoring and Auditing

As part of the monitoring program, the City performs benchmarking exercises that compare energy intensity of individual types of facilities. This can identify facilities that are in need of review, have opportunities to correct problems, that require modifications to existing controls, or are in need of replacement equipment in order to reduce energy and water use.

An annual report is generated that compares three years worth of electricity, natural gas, and water use of many of the City's facilities. These buildings are the top 200 largest facilities in the City's inventory. The report highlights increases in energy and water use and can uncover opportunities to correct problems, modify control, or replace equipment and reduce energy and water use.

Several times a year, facilities are audited to see what measures could be implemented to reduce energy and water use in that facility. This audit is done with the facility

supervisor or his delegate. Many opportunities are discovered during these audits and they can take between one hour to two days to complete depending on the complexity and size of the facility. Prior to commencing work, a concept report is written indicating how much energy will be saved and at what cost.

4.8. Re-commissioning

A re-commissioning project includes a comprehensive optimization process that improves a building's overall performance by implementing energy efficient design features and addressing equipment performance and system integration issues. The City of Ottawa underwent a pilot project to re-commission one of its facilities in 2012 which, resulted in significant energy savings. Because of this success, the City plans to continue re-commissioning with an additional number of facilities in the next years.

4.9. Training

The City of Ottawa offers an internal course that teaches facility and maintenance staff on BAS, HVAC theory, energy concepts, and troubleshooting HVAC and control problems. This is done as part of the program that teaches the proper use of the Integrator software. The training has been very well received with more than half of the operating staff having attended at least one of the four sessions.

4.10. Annual GEA Report on Consumption and Demand

The Building Engineering and Energy Management unit generates the energy consumption data for all the facilities and reports on them by July 1 of each year as part of the City's commitment to the Green Energy Act. The data for 2011 has been on the City's Internet and Intra-net site since June 2013.

By July 1, 2014 the City will report on the same sites for the energy consumption data for 2012 along with any new large sites that were added in 2011 to the City's inventory.