Appendix A

# Executive Summary
## Energy Conservation and Demand Management (ECDM) Plan

The City of Toronto has been committed to reduction of greenhouse gas emissions, generation of renewable energy and improvement in energy efficiency. The City has been successfully investing in energy conservation demand management and renewable generation for more than a decade with a succession of projects across a number of different building types. Average energy use intensity in larger corporate facilities has been reduced by about 15% since 2004. Various renewable energy solutions have been installed in 31 facilities. Further efforts in analysis of building operations, energy efficient upgrades and training across the portfolio of City-owned facilities can further reduce energy consumption by up to 30%. These savings in energy consumption equate to the reduction of over thirty tonnes of greenhouse gas emissions. This plan will upgrade the facilities' infrastructure and energy performance while establishing Toronto as a leader among North American cities in energy efficiency and climate change mitigation.

The plan takes a systematic approach to identifying energy conservation opportunities through operational classification of buildings and energy consumption benchmarking. The results provide a framework for the City to plan its next phase of energy efficiency improvements. The scope of this Energy Conservation and Demand Management (ECDM) plan includes facilities from the City's Agencies, Boards, Commissions and Divisions which together spent over fifty three million dollars on electricity and natural gas in 2012. The 10-year plan, prepared in accordance with Ontario's Green Energy Act Regulation 397/11, projects an investment in capital and operational improvements which will be fully repaid with energy savings and utility company incentives. The analysis projects opportunities to cut facility energy consumption resulting in annual cost savings of over $17 Million with an average payback period of less than 8 years.

Of the 528 facilities covered by this report, 37 are larger than 100,000 square feet in area and account for about 45 per cent of the total area covered by this project. Forty seven facilities with highest energy savings potential account for approximately 57% of the total projected savings. These will proceed with building-level energy audits which will define specific projects and justify the required investment based on associated energy savings. Other facilities will undergo less detailed studies based on their energy savings potential.

# 1 Introduction

The Government of Ontario enacted the Green Energy Act Regulation 397/11 on January 1, 2012. This legislation requires the City of Toronto to develop and publish a five-year Energy Conservation and Demand Management (ECDM) plan by July 1, 2014. Energy & Waste Management Office within the Environment and Energy Division at the City of Toronto led efforts to complete this plan and report.

In July 2007, Toronto City Council adopted the recommendations made by the "Climate Change, Clean Air and Sustainable Energy Action Plan". This plan made a commitment to optimization of energy efficiency at City facilities. In November 2009, Toronto City Council adopted the recommendations made by the Toronto Environment Office in a report entitled “The Power to Live Green”. This report requires City of Toronto to achieve an 80 per cent reduction in greenhouse gas emissions from 1990 levels by 2050. Accordingly, the City of Toronto's obligations under the Green Energy Act are in line with the commitments previously made by the City Council. The Energy Conservation and Demand Management (ECDM) Plan is another step in consolidating the associated conservation efforts within City facilities to meet previously adopted commitments by City Council.

The City of Toronto has a large quantity of facilities under its internal portfolio of buildings and operations. Accordingly, a benchmarking approach to classify opportunities and prioritize future projects was adopted for the development of the ECDM plan. The report is comprised of various building types related to individual divisions. Where sensible, internal and external facilities with similar operations were grouped for analysis and reporting. Comparison of energy consumption enabled this analysis to estimate energy savings based on potential operational improvements and equipment retrofits to achieve top quartile performance in each building category. This approach provides the information necessary for the City of Toronto to prioritize and initially focus efforts on facilities where opportunities yield the highest savings.

This report is the first Energy Conservation and Demand Management plan published by the City of Toronto. It is expected that this report will lead to increased knowledge, investigation and further discussions resulting in more complete revisions of this report in the future.

Given the timing requirements set by Regulation 391/11 of the Green Energy Act, significant effort was invested at all stages associated to the compilation of this report. The Environment and Energy Division recognizes and appreciates the contributions of numerous divisional representatives and team members in project planning, data acquisition, analysis and review of the individual sections contained within this report. We wish to recognize the significant contributions made by Enerlife Consulting in providing analysis and support in completion of this report.

## 2 Goals and Objectives

The City of Toronto has been actively addressing climate change through environmental leadership for some time. Initiatives such as the Better Buildings Partnership and the City's Energy Retrofit Program have implemented over $100 million of energy-related projects in City and local facilities. The installation of wind, solar, hydrogen and tri-generation facilities at Exhibition Place, the Enwave Deep Lake Water Cooling system and policies such as the Toronto Green Standard are examples the City of Toronto's leadership in reducing greenhouse gas emissions. In July 2007, Toronto City Council adopted the "Climate Change, Clean Air and Sustainable Energy Action Plan" which committed to optimize energy efficiency at City facilities. In November 2009, "The Power to Live Green" report was adopted by City Council which proposes an 80% reduction in greenhouse gas emissions from 1990 levels by 2050.

This experience and broader City goals are in line with the Energy Conservation and Demand Management plan. The plan aims to establish a performance-based approach to energy conservation and renewable energy for City facilities, which includes:

- Establishing and verifying energy reduction targets for City facilities
- Reducing energy consumption by up to 30%, while generating approximately $17 million in energy savings and avoiding nearly thirty two thousand tonnes of greenhouse gas emissions
- Improving the City's facility infrastructure as well as operating and maintenance practices
- Supporting established greenhouse gas emissions reduction goals

## 3 2012 Energy Use and Costs

The facilities addressed in this plan cover a total area of over 19 million square feet. Of the 528 facilities covered by this report, 37 are larger than 100,000 square feet in area and account for about 45 per cent of the total area covered by this project.

These facilities spent over $53 million on electricity and natural gas (including buildings served by Enwave Deep Lake Water Cooling and steam) in 2012. Energy consumed by the facilities included over 326 thousand megawatt hours of electricity and nearly 30 million cubic metres of gas, resulting in nearly 92 thousand tonnes of GHG emissions.[1]

[1] Electricity includes chilled water use and natural gas includes steam use in a few buildings.

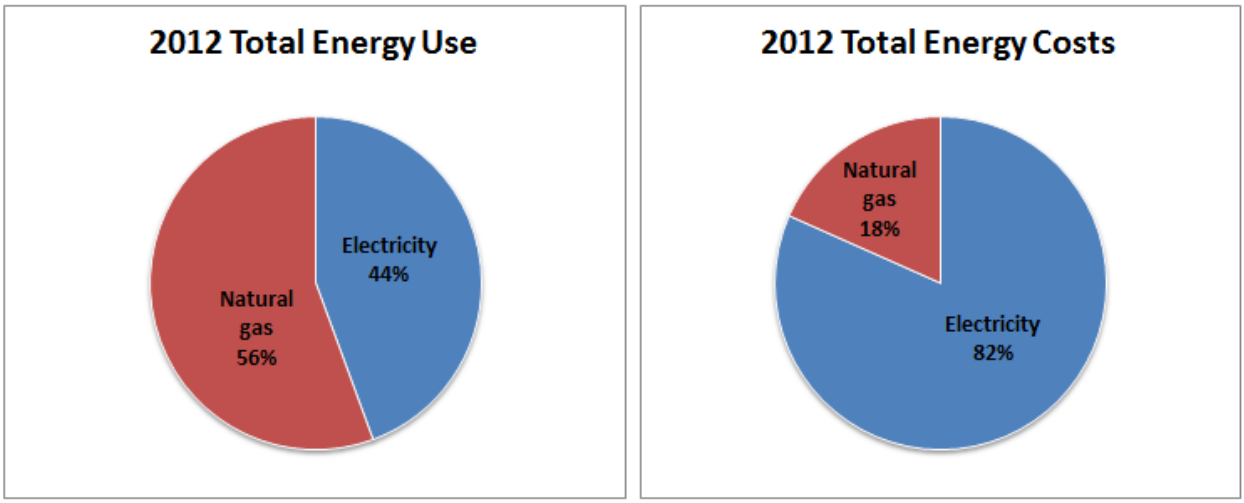


Figure 1: Total Energy Use and Costs

2012 Annual Energy Use by Facility Type

| Facility Type | # of facilities | Total Indoor Area ($ft^2$) | Electricity | | Natural Gas | | Total Energy | | GHG emissions (tonnes) |
|---|---|---|---|---|---|---|---|---|---|
| | | | (MWh) | ($) | (x1000 $m^3$) | ($) | (eMWh) | ($) | |
| Administrative offices and related facilities | 51 | 4,846,672 | 89,648 | $ 12,550,716 | 5,120 | $ 1,331,253 | 142,642 | $13,881,969 | 19,482 |
| Ambulance stations and associated facilities | 24 | 216,311 | 5,150 | $ 720,941 | 404 | $ 105,076 | 9,332 | $ 826,017 | 1,326 |
| Children's Services | 9 | 64,186 | 973 | $ 136,214 | 150 | $ 38,905 | 2,522 | $ 175,118 | 388 |
| Community centres | 70 | 2,033,543 | 31,524 | $ 4,413,348 | 3,272 | $ 850,709 | 65,389 | $ 5,264,057 | 9,616 |
| Cultural facilities | 20 | 596,553 | 9,016 | $ 1,262,197 | 748 | $ 194,479 | 16,757 | $ 1,456,676 | 2,397 |
| Fire stations and associated facilities | 88 | 836,816 | 9,693 | $ 1,357,069 | 1,716 | $ 446,172 | 27,454 | $ 1,803,241 | 4,291 |
| Indoor recreational facilities | 46 | 1,477,712 | 32,122 | $ 4,497,088 | 3,783 | $ 983,636 | 71,278 | $ 5,480,724 | 10,642 |
| Indoor sports arenas | 27 | 862,996 | 19,947 | $ 2,792,519 | 1,490 | $ 387,434 | 35,369 | $ 3,179,954 | 4,994 |
| Indoor swimming pools | 7 | 214,077 | 4,213 | $ 589,783 | 996 | $ 258,854 | 14,517 | $ 848,637 | 2,334 |
| Long-Term Care Homes and Services | 10 | 1,622,285 | 29,095 | $ 4,073,310 | 3,452 | $ 897,539 | 64,824 | $ 4,970,849 | 9,687 |
| Performing arts facilities | 3 | 430,370 | 6,061 | $ 848,554 | 271 | $ 70,567 | 8,870 | $ 919,121 | 1,177 |
| Police services facilities | 39 | 2,589,421 | 38,388 | $ 5,374,327 | 2,622 | $ 681,774 | 65,528 | $ 6,056,101 | 9,150 |
| Public libraries | 73 | 1,548,904 | 28,795 | $ 4,031,287 | 1,823 | $ 473,963 | 47,662 | $ 4,505,251 | 6,593 |
| Service Yards & Storage Facilities | 50 | 1,740,016 | 17,760 | $ 2,486,411 | 3,127 | $ 813,148 | 50,130 | $ 3,299,559 | 7,830 |
| Shelter, Support and Housing Administration | 11 | 280,617 | 4,280 | $ 599,157 | 860 | $ 223,699 | 13,185 | $ 822,856 | 2,087 |
| TOTAL | 528 | 19,360,480 | 326,664 | $ 45,732,922 | 29,835 | $ 7,757,209 | 635,460 | $53,490,130 | 91,994 |

Utility rates: $0.14 per kWh of electricity and $0.26 per $m^3$ of natural gas

GHG emission factors: 110 g GHG / kWh of electricity, 1879 g GHG / $m^3$ of natural gas

Figure 2: 2012 Annual Energy Use by Facility Type

# 4 Methodology

The plan has been developed using the principles of performance-based conservation. This data-driven approach relies on benchmarking large data sets of comparable buildings to identify the energy efficient buildings of each type. Target setting methodology used for the ECDM report was based on building energy consumption from top-quartile energy performers under individual building types. The corresponding result was used to set energy performance targets for the remaining 75 percent of the buildings within the group. The target-setting methodology breaks down potential savings into year-round and seasonal (winter or summer) electricity and gas use, which help narrow down measures most likely to be appropriate for each scenario. Measurement and verification of actual savings finalizes the

process, validating the actions taken and guiding continuous improvement. The details of the process are outlined in the diagram below.

An initial set of possible energy conservation measures has been included in individual reports, customized to each building type. These measures have been organized by type (mechanical, lighting, electrical, envelope and process) and categorized as behavioural, operational or retrofit/capital. Other factors such as ease of implementation, savings potential and suggested timeline have been also accounted for.

Performance based conservation is particularly well suited to large portfolios of buildings, providing a basis for estimation of financial opportunities and implementation strategies for maximizing economic and environmental benefits. This plan sets the stage for application of this methodology across the largest part of the City's portfolio.

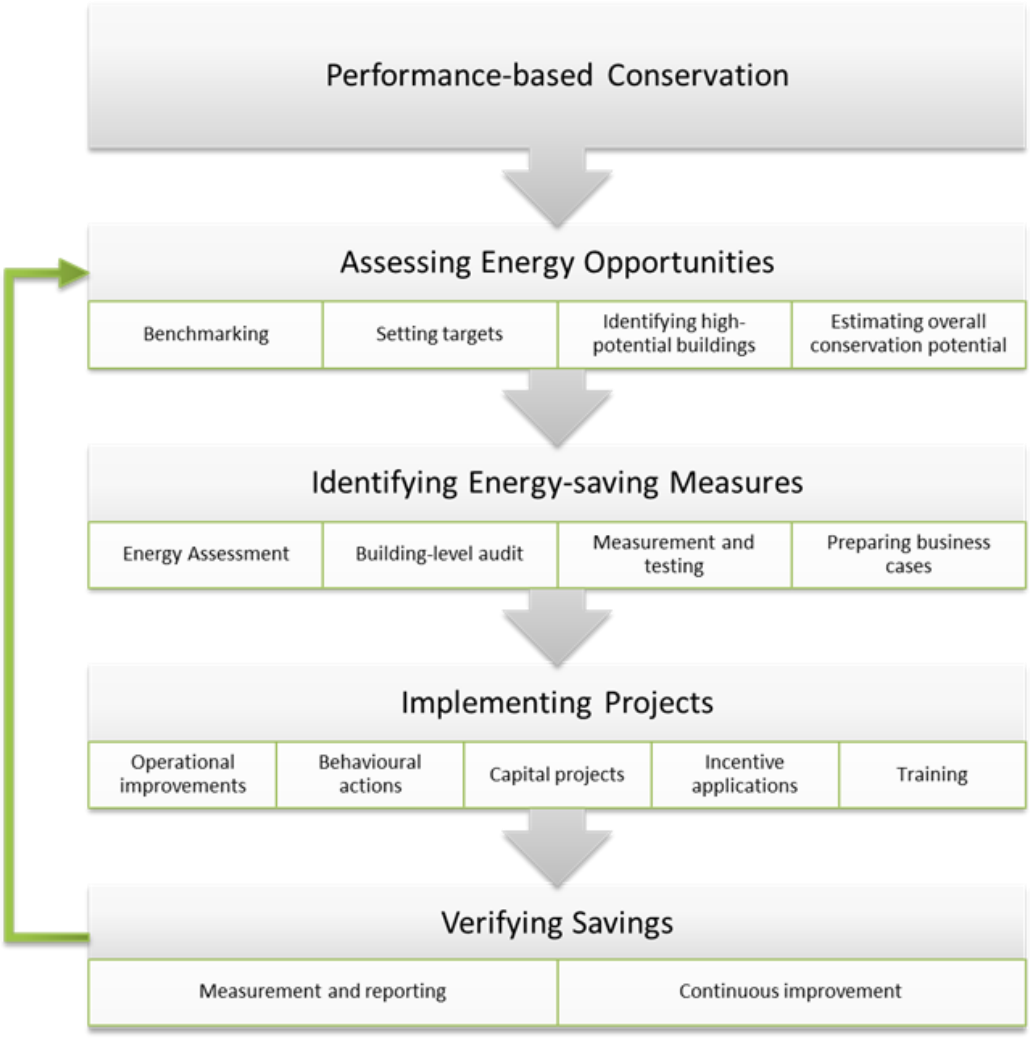


**Figure 3: Performance-based Conservation Methodology for the ECDM Plan**

# 5 Energy Targets and Potential Savings

Within each building type there is a range of energy intensities, from low (highly efficient) to high (inefficient). The most efficient compare favourably with the best performers from other Canadian municipalities. For example, Metro Hall is now among the energy performance leaders in Toronto & Region Conservation's (TRCA's) national Town Hall Challenge. Toronto City Hall has recently moved into the top quartile of Canadian city and town halls through a 20% reduction in energy consumption. Toronto City Hall won the Race to Reduce 2012 Award for greatest energy reduction from 2010 – 2011 in a facility over three hundred thousand square feet. The City's Thistletown Community Centre and Firehall 425 are also leaders in TRCA's national database of municipal building energy efficiency.

The measures taken to achieve high levels of energy efficiency in many of the City's facilities can be extended to similar facilities. An energy use target has been established for each of the 16 building types, based on achievement of top-quartile energy performance. The targets do not presume that all buildings can be top performing. However, based on experience and on average, facilities can reach an energy intensity level which has already been achieved by the top 25% of facilities in their group. To ensure fair comparison individual building targets were adjusted for significant, site-specific differences such as data centres, pools, ice rinks, and renewable energy. The target-setting methodology and results for each building type are described fully in Appendix B of the individual reports.

The initial targeted savings potentials for each building type are summarized below. Natural gas savings create the largest energy and emissions reductions, while electricity accounts for 78% of the targeted cost savings because of higher prices relative to gas.

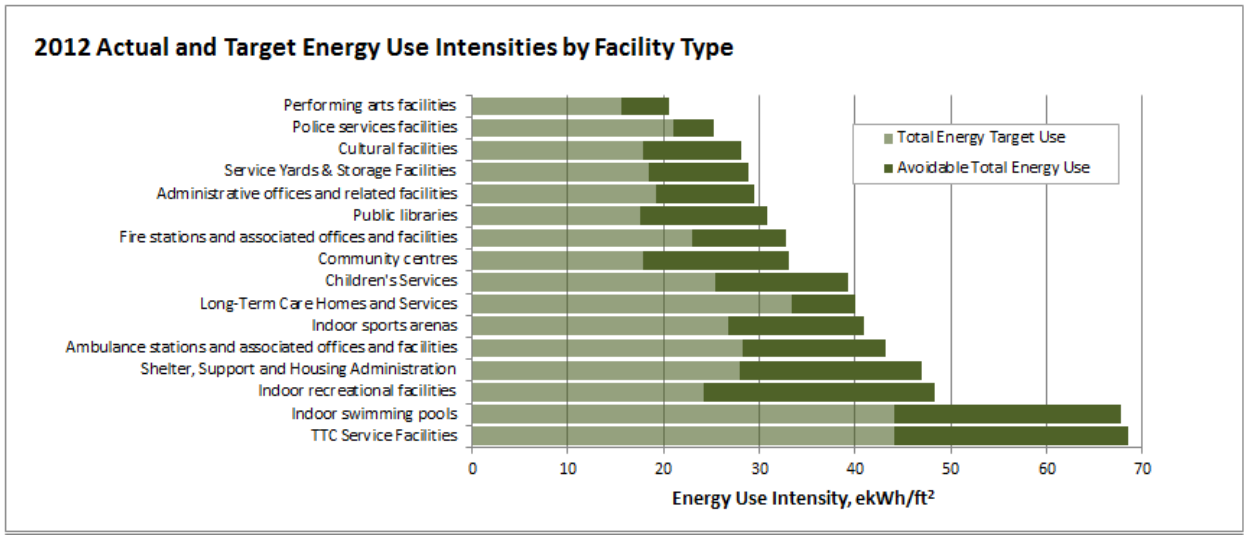


**Figure 4: Actual and Target Energy Use Intensities**

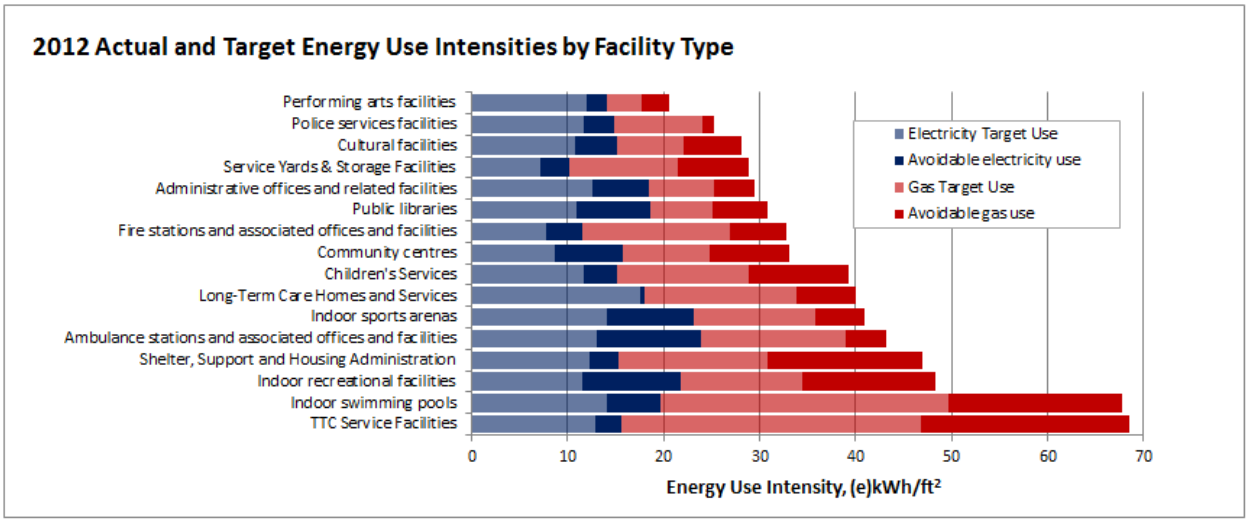


Figure 5: Actual and Target Energy Use Intensities with Electricity and Gas Targets

# 6 Operational, Behavioural and Retrofit Measures

A set of energy conservation measures is presented in the individual, customized reports for each building type. At a minimum, this set of opportunities will be considered for individual buildings based on their particular energy savings profile. The high-potential facilities have very large savings and justify significant project investment, while other facilities are already relatively efficient and require little further improvement. The target-setting methodology breaks down potential savings into year-round and seasonal (winter or summer) electricity and gas use, which helps to further narrow down those measures and projects most likely to be appropriate for each facility.

The measures for each building type are laid out in “Proposed Energy Efficiency Measures” section in the individual reports. Energy saving measures are organized by type (mechanical, lighting, electrical, envelope and process) and categorized as behavioural, operational or retrofit/capital. Measures are sorted by ease of implementation, savings potential and suggested timeline for implementation.

# 7 Renewable Energy

The City has implemented 31 renewable energy generation installations across multiple facilities covered by this report. In addition to solar and geothermal renewable energy, deep lake water cooling is employed at 4 facilities. Details of existing and proposed future installations are summarized in the appendix section of the ECDM report.

# 8 Forecast Costs and Return on Investment

Past project costs combined with implementation information were used to establish preliminary timelines and budgetary financial analysis. The budgets allow for saving measures such as:

- Lighting retrofits and associated controls
- Mechanical system modifications and efficiency improvements
- Appliance replacement and controls

- Localized efficiency measures for the building envelope

Estimated project costs also include energy audits, staff training, measurement and verification of actual savings as well as additional maintenance costs associated with incorporation of new technology and operating practices. Projected borrowing costs and inflation have also been accounted for in cash flow analyses presented throughout the report.

Financing of the capital costs are provided for based on an interest rate of 4%. Energy cost savings will fully repay the capital costs and financing of the necessary work. An annual inflation factor of 2% is applied to costs and 5% annual escalation is applied to utility cost savings. Accordingly, the overall ECDM project cost is estimated at just over $142 million.

The 10-year summary of total program costs, accumulated savings and payback period is provided below.

| Facility Type | No. of Facilities | Total Indoor Area (Square feet) | Current Utility Costs | Potential Cost Savings | Current GHG Emissions (Tonnes) |
|---|---|---|---|---|---|
| Administrative offices and related facilities | 51 | 4,846,672 | $13,881,969 | $ 4,549,000 | 6,868 |
| Ambulance stations and associated facilities | 24 | 216,311 | $ 826,017 | $ 347,000 | 421 |
| Children's Services | 9 | 64,186 | $ 175,118 | $ 48,000 | 146 |
| Community centres | 70 | 2,033,543 | $ 5,264,057 | $ 2,348,000 | 4,365 |
| Cultural facilities | 20 | 596,553 | $ 1,456,676 | $ 448,000 | 926 |
| Fire stations and associated facilities | 88 | 836,816 | $ 1,803,241 | $ 581,000 | 1,250 |
| Indoor recreational facilities | 46 | 1,477,712 | $ 5,480,724 | $ 2,585,000 | 5,022 |
| Indoor sports arenas | 27 | 862,996 | $ 3,179,954 | $ 1,210,000 | 1,672 |
| Indoor swimming pools | 7 | 214,077 | $ 848,637 | $ 267,000 | 854 |
| Long-Term Care Homes and Services | 10 | 1,622,285 | $ 4,970,849 | $ 335,000 | 1,877 |
| Performing arts facilities | 3 | 430,370 | $ 919,121 | $ 155,000 | 323 |
| Police services facilities | 39 | 2,589,421 | $ 6,056,101 | $ 1,200,000 | 1,467 |
| Public libraries | 73 | 1,548,904 | $ 4,505,251 | $ 1,879,000 | 2,887 |
| Service Yards & Storage Facilities | 50 | 1,740,016 | $ 3,299,559 | $ 1,059,000 | 2,904 |
| Shelter, Support and Housing Administration | 11 | 280,617 | $ 822,856 | $ 228,000 | 911 |
| **TOTAL** | 528 | 19,360,480 | $53,490,130 | $17,239,000 | 31,893 |

Figure 6: 10-Year Financial Picture

# 9 Program Implementation

## 9.1 Strategy

The starting point of the implementation strategy is the energy savings potential for each building. Approximately 9% of the facilities were categorized as those with high savings potential based on annual savings of more than one hundred thousand dollars. These buildings will be focused on first as they are associated to over 57% of the projected energy savings. Medium potential was based on annual savings between five to one hundred thousand dollars. Facilities with medium savings potential constitute about 50% of the buildings in this plan and account for about 41% of total projected savings. The remaining

facilities, each with potential annual savings of less than five thousand dollars, contribute just 2% of total potential savings.

### 9.1.1 High-Potential Facilities

For facilities with target annual savings of more than one hundred thousand dollars, the step-by-step approach to validating and delivering the potential savings is as follows:

i) **Verification of Building Information**
This will confirm the building area, percentages of electric heating and cooling, and other parameters used to set the energy target for the building.

ii) **In-Depth Energy Assessment**
More sophisticated analysis of actual energy billing data for the past 3 years will refine the high-level energy metrics used for setting the energy target, and provide a range of diagnostic indicators which clearly point to specific conservation opportunities.

iii) **Building-level Energy Audits**
Detailed studies on operational and retrofit opportunities along with the required analysis and engineering to assess technical and financial benefits.

iv) **Divisional Review**
This will include finalizing project selection, designing and specifying measures, and preparing tender packages for the work.

v) **Procurement and implementation**

vi) **Measurement and Verification of Performance and Energy Savings**

vii) **Engagement**
Engage operators and occupants in operational changes and energy efficient maintenance practices.

### 9.1.2 Medium-Potential Facilities

The implementation process for these facilities, with target annual savings between five thousand and one hundred thousand dollars, is similar to that outlined above for higher potential facilities. However, it is simplified to streamline and lower the cost of measure development, procurement and implementation. Consideration is given to grouping facilities with similar measures in order to achieve economies of scale.

### 9.1.3 Low-Potential Facilities

For buildings with less than five thousand dollars in annual savings, the process is further simplified to a standardized checklist of measures. The checklist will be used by City staff for the corresponding building type and measures identified through this process will be implemented by competitively procured installers. Operational changes, maintenance practices and behavioural change engagement will be implemented by staff.

# 10 Conclusion

The City of Toronto has a strong history in raising energy efficiency and lowering the carbon footprint of its own buildings. Over the past 10 years, the Energy & Waste Management Office has cumulatively avoided costs of approximately $43 million attributed to the implementation of energy retrofit projects.

The Energy Conservation and Demand Management reports have been shared with divisional representatives to allow an open and transparent approach and to ensure inclusivity in the planning and application of energy conservation projects. Associated investment in additional capital and operational improvements will further reduce corporate energy consumption and greenhouse gas emissions. Building level analysis will define specific projects and justify the required investments based on associated savings.

The plan has identified facilities with high, medium and low energy saving potential. By taking a strategic implementation approach, the City can achieve a high economic return on investment while upgrading the buildings' infrastructure and improving energy performance. The results will reinforce City of Toronto's position as a leader in energy efficiency and climate change mitigation among North American cities, while upgrading the energy performance of the City's facilities.