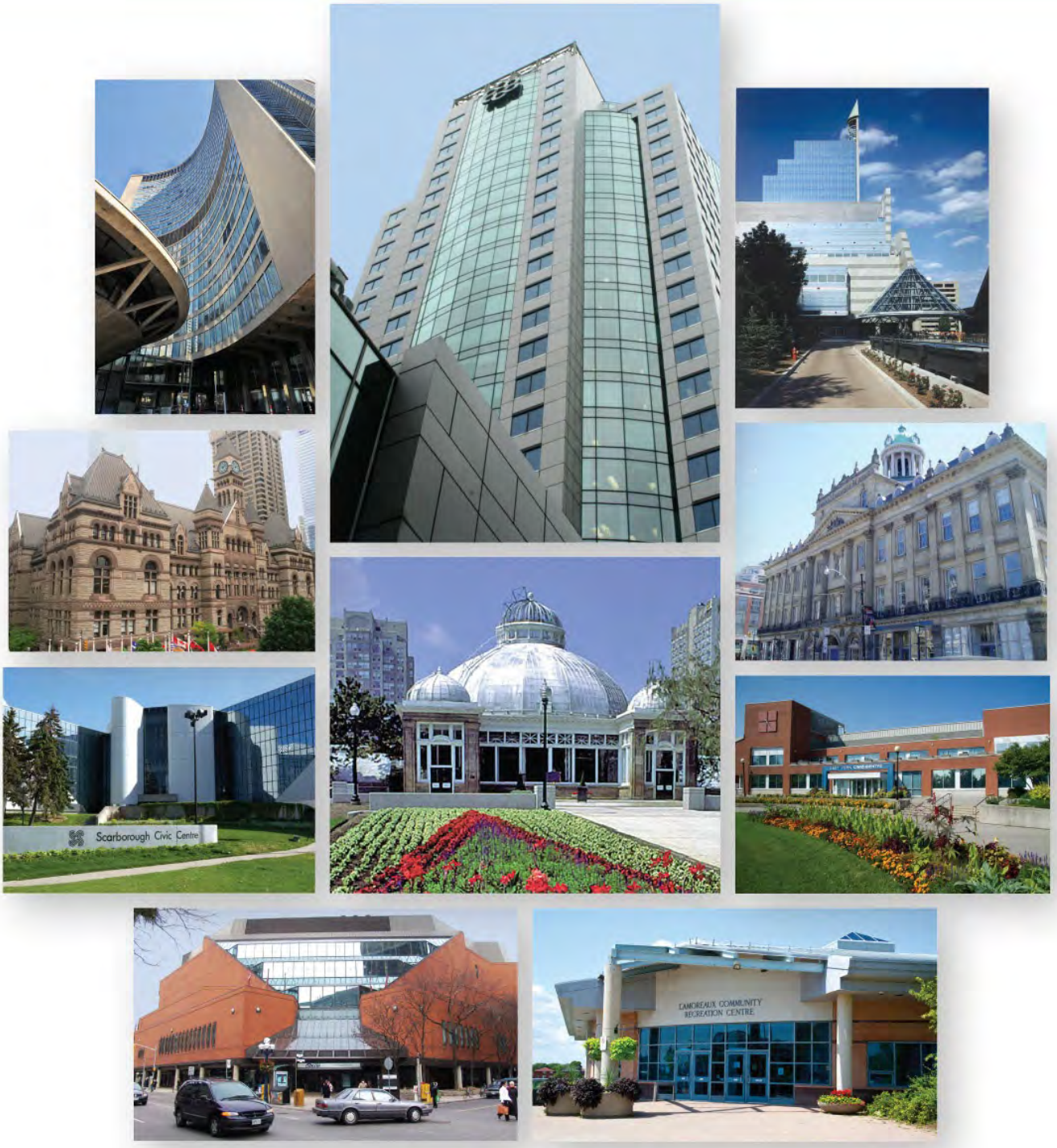
City of Toronto
Energy Conservation & Demand Management Plan
(2014 - 2019)



Report Date: July 2014

TORONTO

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Executive Summary

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.

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.

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1 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

2 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.

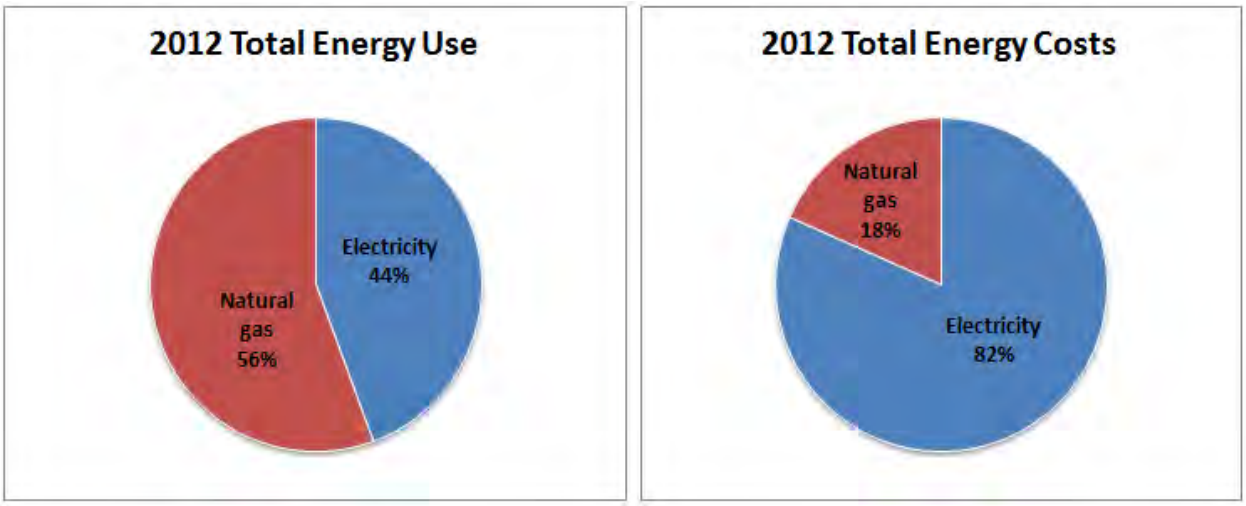

Figure 1: Total Energy Use and Costs

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

Table 1: 2012 Annual Energy Use by Facility Type

3 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.

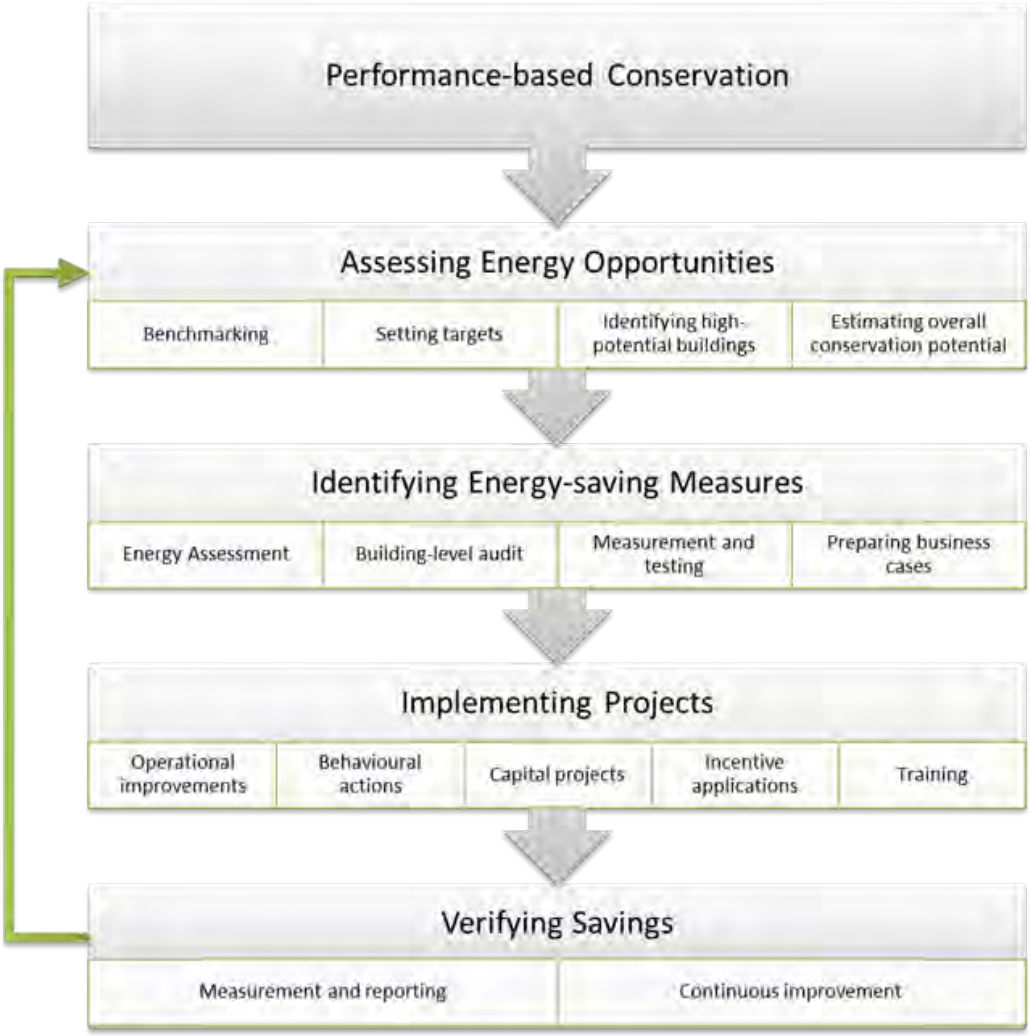

Figure 2: Performance-based Conservation Methodology for the ECDM Plan

4 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.

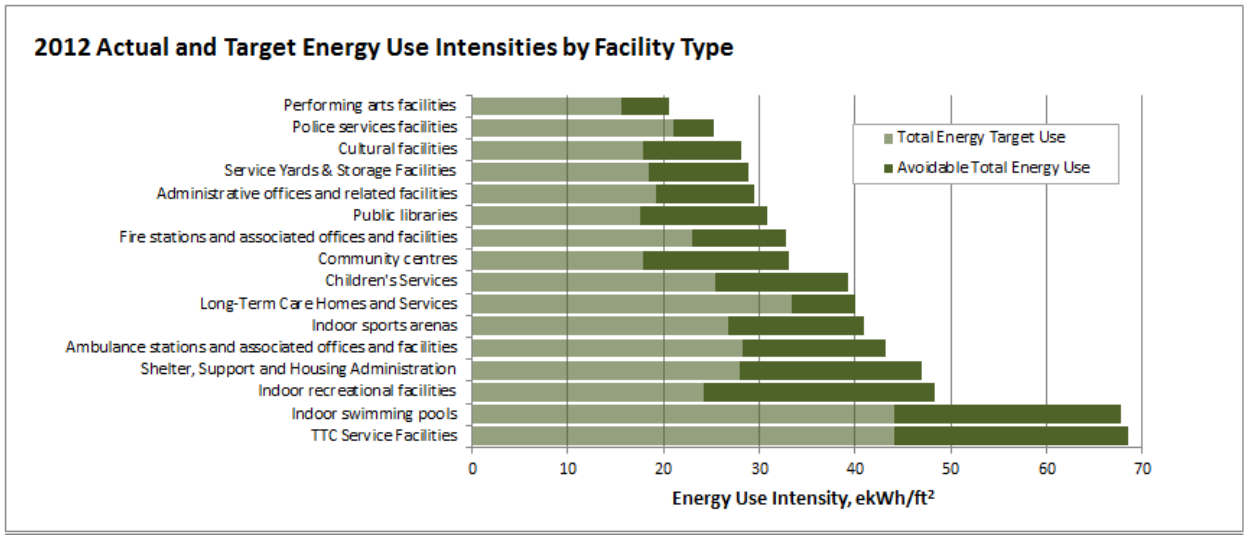

Figure 3: Actual and Target Energy Use Intensities

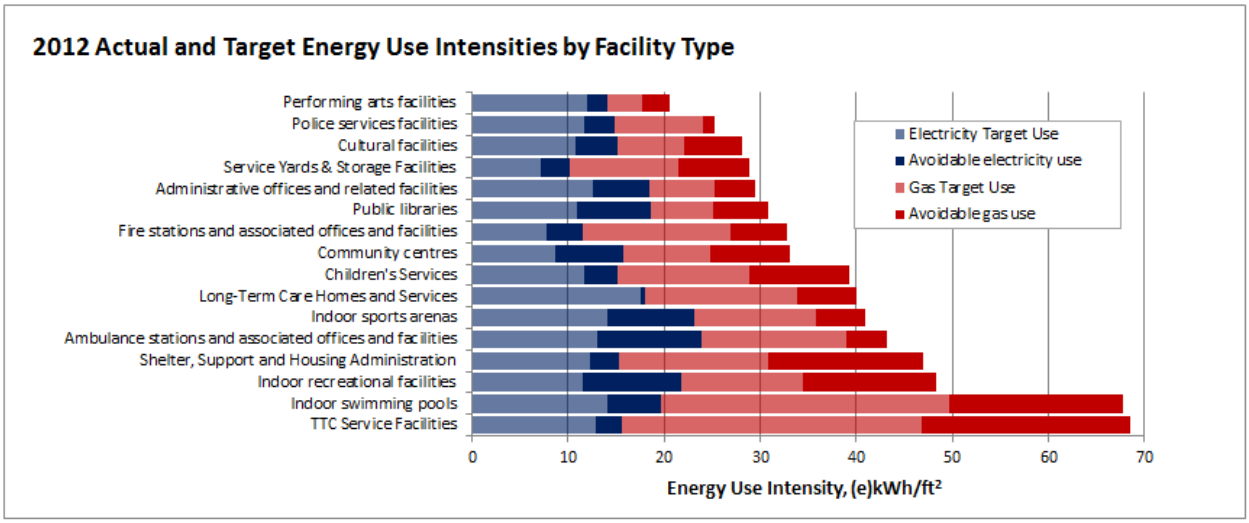

Figure 4: Actual and Target Energy Use Intensities with Electricity and Gas Targets

5 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.

6 Renewable Energy

The City has implemented 35 renewable energy generation installations across multiple facilities covered by this report. Additional renewable energy installations have not been included due to the scope of the operation types defined for reporting by the Ontario Ministry of Energy. In addition to solar and geothermal systems, deep lake water cooling has been implemented at 4 facilities. The City is reviewing feasibility and planning to install renewable energy generation installations at 64 additional locations. Existing and proposed future installations are summarized in the following chart.

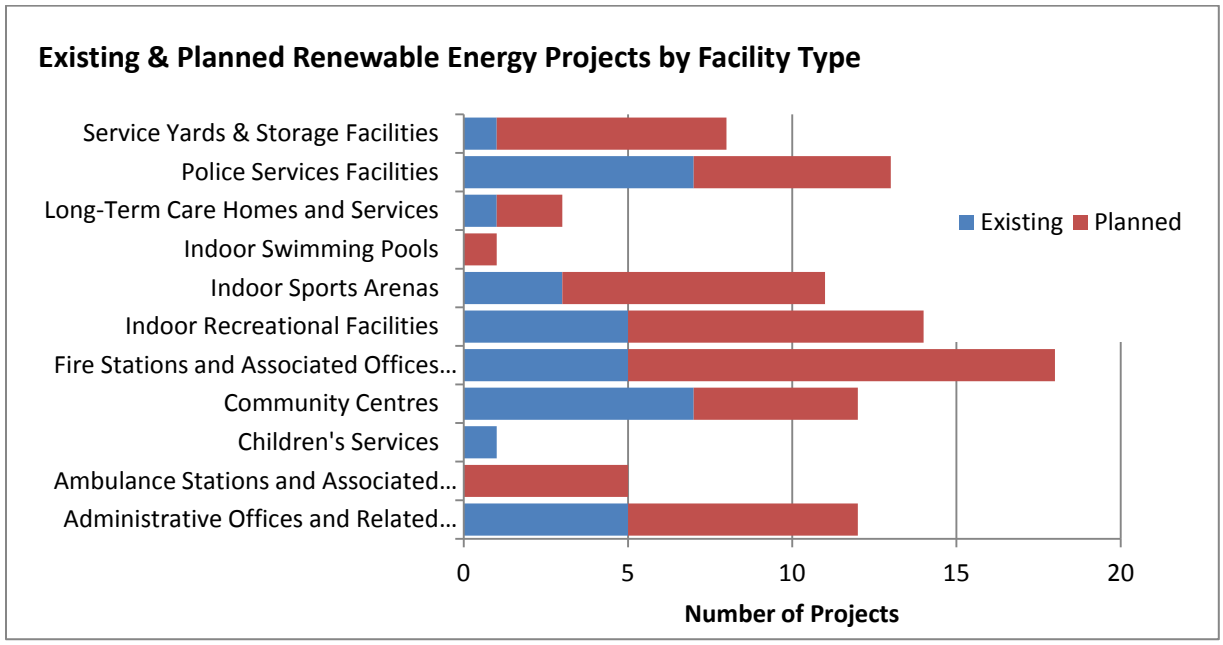

Figure 6: Summary of Existing and Planned Renewable Energy Generation Installations

7 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

Table 2: 10-Year Financial Picture

8 Program Implementation

8.1 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.

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.

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.

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.

9 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.

Administrative Offices and Related Facilities

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1. Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 51 administrative offices and related facilities in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B.

The total area for all of the buildings is 4,846,672 ft^2. Administrative offices and related facilities range in size from just over 2,500 ft^2 to over 787,000 ft^2.

The facilities equipped with a renewable energy system are listed below:

Building Name	Building Address	Renewable Installation	System Size	Unit
City Hall	100 Queen St W	Deep Lake Water Cooling	700	kW
Coronation Park	711 Lakeshore Blvd W	Geothermal	13.4	kW
East York Civic Centre	850 Coxwell Ave	Solar Photovoltaic	40	kW
Metro Hall	55 John St	Deep Lake Water Cooling	1200	kW
Old City Hall	60 Queen St W	Deep Lake Water Cooling		

Table 3: Current Renewable Energy Systems on Administrative Offices and Related Facilities

The facilities range from 0% to 100% air-conditioned. One facility (Etobicoke Civic Centre Court 2) is fully served by electric heat. There are a number of other facilities using between 5 and 40% electric heat. Two facilities (21 Panorama and York Civic Center) are served by water source heat pumps. There are food services at a number of facilities, ranging from 1 to 5% of building served. There are data/call centres serving a small portion of the following facilities: 60 Tiffield Rd, Consolidated Communication Ctr, Metro Hall, Old City Hall, Scarborough Civic Centre and Dyas Rd 18. The Dyas Road Archive Building is 100% data/call centre. There are outdoor ice rinks at City Hall, North York Civic Centre and Scarborough Civic Centre.

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 51 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	89,647,971	$12,550,716
Natural Gas (m^3)	5,120,203	$1,331,253
Total		**$13,881,969**

Table 4: 2012 Energy Use and Costs for City of Toronto Administrative Offices and Related Facilities

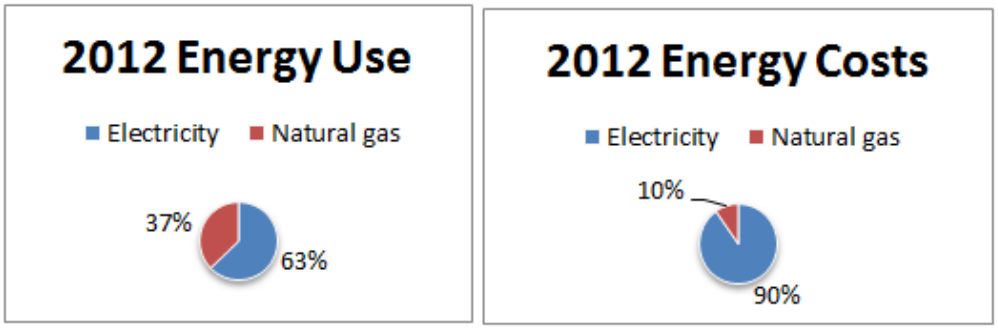

Figure 5: 2012 Energy Use and Cost Breakdown for City of Toronto Administrative Facilities

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 51 buildings. Total energy use ranges from approximately 6.8 to 128.4 ekWh/ft^2. There are also wide ranges for electricity and gas use per ft^2. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

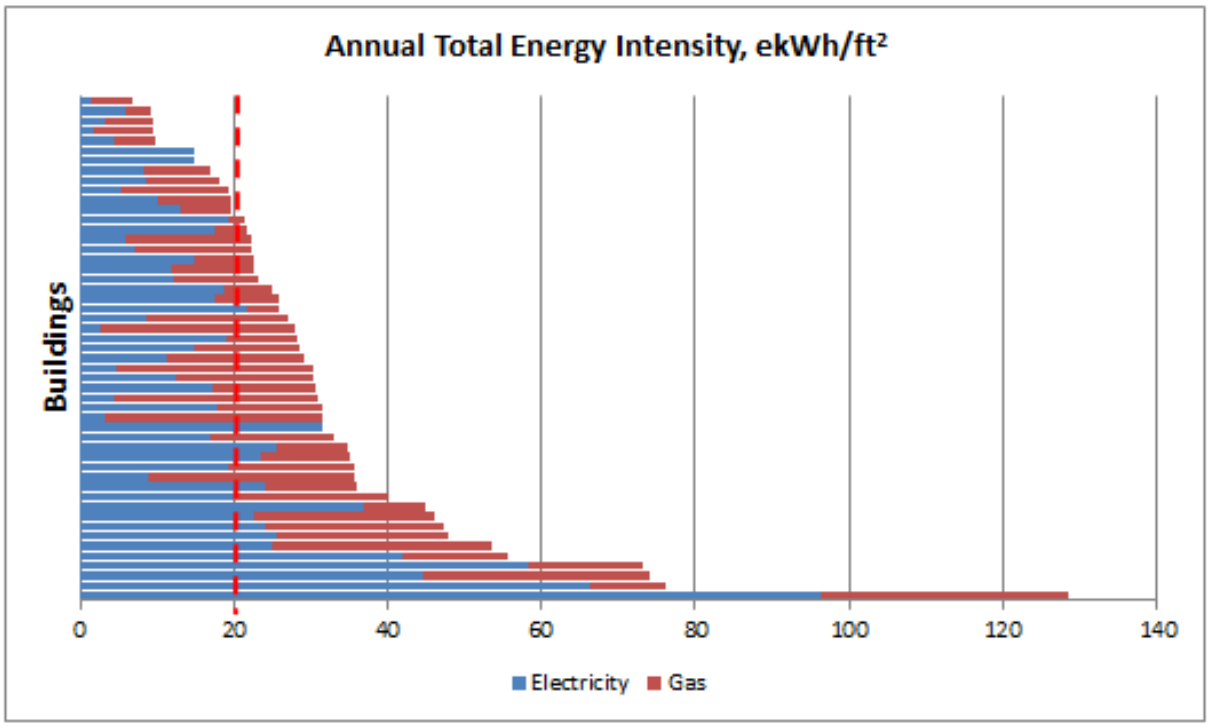

Figure 6: 2012 Total Energy Intensity Benchmark

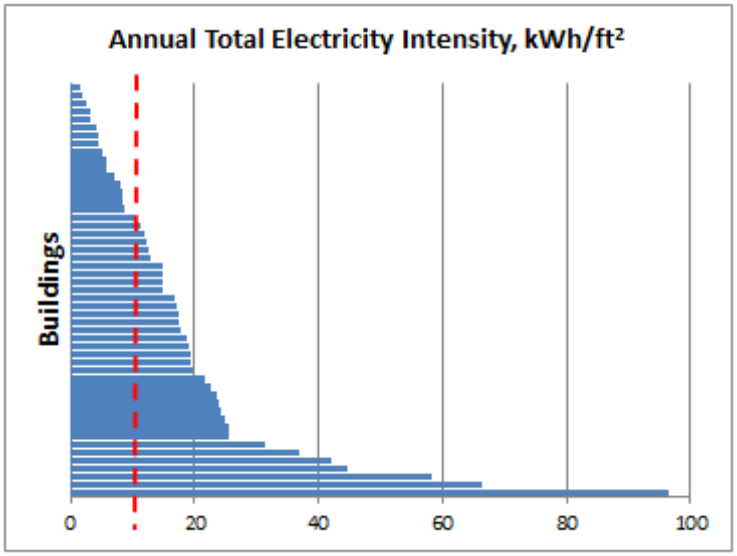

Figure 7: 2012 Total Electricity Intensity Benchmark

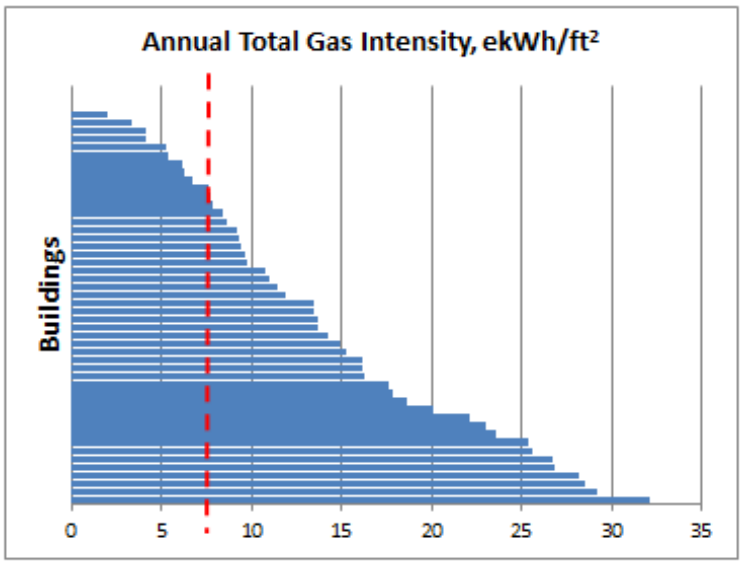

Figure 8: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for administrative offices and related facilities are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each administrative office and related facility to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	10.9	kWh/ft²/year
	Cooling	0.7	kWh/ft²/year
	Heating	0.3	kWh/ft²/year
	Total	12.0	kWh/ft²/year
Gas	Base	1.0	ekWh/ft²/year
	Heating	7.2	ekWh/ft²/year
	Total	8.2	ekWh/ft²/year
Total energy	Total	20.1	ekWh/ft²/year

Table 5: Top Quartile Targets

The data set for target-setting is made up of 52 administrative offices and related facilities with complete and reliable data, 44 of which are City of Toronto buildings and 8 are from other municipalities. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)), % of the area which is air conditioned, % of the area served by a data

centre, % of the area served by food services and presence of an outdoor ice rink. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each administrative office and related facility. The total savings potential for each administrative office and related facility is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 51 administrative offices and related facilities are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There are 16 administrative office and related facilities with annual savings potential greater than $100,000. 21 administrative offices and related facilities have annual savings potential between $5,000 and $100,000, and 14 administrative offices and related facilities have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 51 buildings is $4,549,651 ($4,038,390 for electricity and $511,261 for gas) with an average total energy savings of 34%.

For the 16 high-potential savings facilities, the total annual savings potential is $3,779,833 ($3,470,009 for electricity and $309,824 for gas) with an average total energy savings of 39%.

For the 21 mid-potential savings facilities, the total annual savings potential is $739,852 ($559,425 for electricity and $180,427 for gas) with an average total energy savings of 25%.

For the 14 low-potential savings facilities, the total annual savings potential is $29,965 ($8,955 for electricity and $21,010 for gas) with an average total energy savings of 23%.

	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 51 facilities	**28%**	**52%**	**20%**	**32%**	**$4,038,390**	**82%**	**30%**	**38%**	**$511,261**	**34%**	**$4,549,651**	**$2,307,651**	**$196,639**	**4,846,672**	**6,867,864**
High potential savings facilities (16)	35%	49%	21%	39%	$3,470,009	82%	27%	41%	$309,824	39%	$3,779,833	$1,982,862	$119,163	2,660,621	4,965,509
Mid-potential savings facilities (21)	14%	58%	17%	16%	$ 559,425	81%	32%	36%	$180,427	25%	$ 739,852	$ 319,672	$ 69,395	1,938,902	1,743,479
Low potential savings facilities (14)	01%	53%	07%	04%	$ 8,955	54%	33%	35%	$ 21,010	23%	$ 29,965	$ 5,117	$ 8,081	247,149	158,876

Table 6: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 4 below shows the total potential savings for all 51 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	16.6	11.9	28%	$ 2,896,272
Electric Cooling (kWh/ft²)	1.0	0.5	52%	$ 291,339
Electric Heating (kWh/ft²)	0.5	0.4	20%	$ 47,807
Total Electricity (kWh/ft²) for facilities w/o component intensities	24.4	11.2	54%	$ 802,972
Gas Baseload (ekWh/ft²)	2.2	0.4	82%	$ 194,302
Gas Heating (ekWh/ft²)	9.1	6.4	30%	$ 295,642
Total Gas (ekWh/ft²) for facilities w/o component intensities	9.1	7.1	21%	$ 21,317
Total Energy (ekWh/ft²)	**29.4**	**19.3**	**34%**	**$ 4,549,651**

High savings | Moderate savings | Low savings

Table 7: Savings Potential for Administrative Offices and Facilities

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electric Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Previous Energy Efficiency Initiatives

In 2004, the City of Toronto undertook a study to identify building improvement measures that would improve energy and water efficiency and reduce the operating cost and environmental impact of Civic Centres located throughout the City of Toronto.

Table 5 below summarizes the estimated overall project costs, savings and estimated energy reduction for 13 Civic Centres and related facilities as a result of the 2004 project.

				Project Cost & Savings (estimated)					Estimated Annual Energy Reduction			
Project Name & Start Year	Completion Year	Num. of Bldgs	Total Floor Area (m2)	Retrofit Cost	Total $Savings	Total ekWh Savings	Total CO2 Savings (tonnes)	Payback	Save kWh	Save kW	Save Nat.Gas m3	Save Steam mlbs
Civic Centers 2004	2006	13	253,804	$4,465,481	$567,973	7,260,336	1,797	7.9	6,112,271	4,268	110,972	1,453

Table 8: 2004 Civic Centres and Related Facilities Project Estimated Project Costs and Savings

2.2 Proposed Energy Efficiency Measures

Table 6 below shows the full range of possible energy efficiency measures for the entire portfolio of administrative offices and related facilities. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 51 facilities indicate that the larger part of the savings will come from measures associated with electric cooling and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

⇓

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B17	Optimize dishwasher operation (only run when full)	4	4	8	Year 1		Building Occupants
P3	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M16	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P1	Optimize DHW temperature control	2	4	6	Year 2	annual review	
P2	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	4	5	Year 3	10 to 15	
M14	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M15	Replace DHW boilers with more efficient models	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off machines, office and kitchen equipment when not needed	4	2	6	Year 1	Annual Review	Building Occupants
B2	Unplug machines, office and kitchen equipment if not actively used	4	2	6	Year 1	Annual Review	Building Occupants
B3	Turn off computer monitors when not in use	4	2	6	Year 1	Annual Review	Building Occupants
B4	Enable ENERGY STAR power settings on your computer	4	2	6	Year 1	Annual Review	Building Occupants
B5	Unplug chargers when not in use	4	2	6	Year 1	Annual Review	Building Occupants
B6	Turn off lights when areas not in use	4	2	6	Year 1	Annual Review	Building Occupants
B7	Make use of natural light instead of turning on lights where possible	4	2	6	Year 1	Annual Review	Building Occupants
M1	Optimize operating schedules for fans and pumps	3	2	5	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	2	5	Year 2	Seasonal Review	
EL4	Install power factor correction	3	2	5	Year 3	15+	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	2	3	Year 5	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	2	3	Year 5	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	2	3	Year 5	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	2	3	Year 5	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	2	3	Year 5	10 to 15	
L6	Replace festive lighting with LED	1	2	3	Year 5	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	2	3	Year 5	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	2	3	Year 5	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	2	3	Year 5	4 to 6	
EL3	Install controls on vending machines	1	2	3	Year 5	10 to 15	
EL5	Submeter data and call centres	1	2	3	Year 5	Seasonal Review	
M3	Install variable frequency drives (VFDs) on suitable fans and pumps	1	2	3	Year 5	10 to 20	
M4	Convert electric hot water heaters to natural gas	1	2	3	Year 5	10 to 15	
	Other:_____						
	_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B8	Adjust blinds (to retain heat in winter)	4	2	6	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	2	6	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	2	6	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	2	5	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	2	4	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	2	3	Year 5	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	2	3	Year 5	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	2	3	Year 5	seasonal review	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementatio	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B11	Winterize room air-conditioners	4	4	8	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	4	8	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	4	8	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1		Building Occupants
M12	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M13	Test and tune the air conditioning units	3	4	7	Year 2	3	
M10	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M11	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B18	Check and clear baseboard heaters of obstructions	4	3	7	Year 1		Building Occupants
B19	Adjust blinds (to retain heat in winter)	4	3	7	Year 1		Building Occupants
B20	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	3	7	Year 1		Building Occupants
M17	Optimize operating periods of ventilation systems supplying heated spaces	2	3	5	Year 2	seasonal review	
M18	Test and adjust ventilation systems to optimize outside air volumes	3	3	6	Year 2	seasonal review	
M20	Test and tune boiler efficiency	3	3	6	Year 2	seasonal review	
M22	Check heating system for flow balancing and air venting	3	3	6	Year 2	seasonal review	
EN1	Check and seal exterior walls and openings	3	3	6	Year 2	10 to 15	
EN5	Seal window and door frames	3	3	6	Year 2	5	
M23	Optimize fan-coil unit and entrance heater controls	3	3	6	Year 2	seasonal review	
M24	Consider heating system zoning	2	3	5	Year 2	n/a	
M19	Test, repair, replace and right-size heating control valves and outside air dampers	2	3	5	Year 3	10 to 15	
M21	Upgrade heating system control to optimize space temperatures and operating periods	1	3	4	Year 4	10 to 15	
EN2	Insulate the attic adequately	1	3	4	Year 4	10 to 15	
EN3	Reclad the building's exterior	1	3	4	Year 4	20 to 24	
EN4	Replace single-pane windows with double-pane windows	1	3	4	Year 4	20 to 24	
EN6	If replacing the roof, ensure R-value at least 22	1	3	4	Year 4	n/a	
M25	Install high efficiency burners	1	3	4	Year 4	15 to 20	
M26	Replace boilers with more efficient models	1	3	4	Year 4	15 to 20	
M27	Replace old rooftop units with energy efficient units	1	3	4	Year 4	15 to 20	
M28	Install heat recovery or solar heating units	1	3	4	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

Table 9: Energy Saving Measures for Administrative Offices and Related Facilities

The specific measures and implementation timeline for each individual administrative office and related facility will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
Elections Building	89 Northline Rd	Solar PV	100	kW
Etobicoke Civic Centre	2 Civic Centre Crt	Solar PV	40	kW
Etobicoke Civic Centre	2 Civic Centre Crt	Geothermal	600	kW
Survey and Mapping Services	18 Dyas Rd	Solar PV	60	kW
East York Civic Centre	850 Coxwell Ave	Geothermal	700	kW
Eastville Training Centre	1 Eastville Ave	Geothermal	140	kW
Etobicoke Civic Centre	399 The West Mall	Geothermal	265	kW

Table 10 : Proposed Renewable Energy Systems for Administrative Offices and Related Facilities

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities, is $4.20/ft^2 (see Appendix A). The budget allows for lighting audits, lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low potential buildings is set at 40 percent of the basic amount to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium and low potential administrative offices and related facilities are summarized in Table 7 below.

Annual Savings Potential	Number of facilities	Average Area (ft^2)	Estimated Implementation Cost $/ft^2	Estimated Implementation Cost $	Estimated Savings potential $	% of total savings	Payback
> $100,000	16	166,289	5.04	$ 13,409,531	$ 3,779,833	83.1%	3.55
$5,000 - $100,000	21	92,329	4.20	$ 8,143,386	$ 739,852	16.3%	11.01
< $5,000	14	17,654	1.68	$ 415,211	$ 29,965	0.7%	13.86
	51			**$ 21,968,128**	**$ 4,549,651**		**4.83**

Table 11: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the specific measures for each building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.

- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 9 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	16	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	21	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	14	$ 150	< $5,000	Division Champion and staff
		51			

Table 12: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There are 16 administrative offices and related facilities with over $100,000 in annual energy saving potential. Over 83% of the total energy savings for all administrative offices and related facilities can be found at these 16 facilities.

These 16 administrative offices and related facilities can save an average of 39% of their total energy use. The total annual energy savings are estimated to be over $3,779,800 and individual building annual savings range from approximately $110,000 to over $531,000. The annual GHG savings are estimated to be approximately 4,965,500 kg.

These 16 administrative offices and related facilities can save an average of 39% of their total electricity use (35% Electric Baseload, 49% Electric Cooling and 21% Electric Heating). The total annual electricity savings are estimated to be approximately $3,470,009 and individual building annual savings range from just over $92,350 to over $519,000.

These 16 administrative offices and related facilities can save an average of 41% of their total gas use (82% Gas Baseload and 27% Gas Heating). The total annual gas savings are estimated to be approximately $309,800 and individual building annual savings range from $0 to over $135,200.

These 16 administrative offices and related facilities will undergo Building Performance Audits (see the Implementation Plan for further details). For a complete description of the Building Performance Audit, refer to Appendix A.

See Appendix B for the associated energy savings potential by energy use component.

The highest percentage reductions for these facilities can be found in Gas Baseload and Electric Cooling. After the implementation of the proposed measures, these facilities are eligible to receive over $2,100,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 21 administrative offices and related facilities with between $5,000 and $100,000 in annual energy saving potential. Approximately 16% of the total energy savings for all 51 administrative offices and related facilities can be found in these 21 facilities.

These 21 administrative offices and related facilities can save an average of 25% of their total energy use. The total annual energy savings are estimated to be almost $740,000 and individual building annual savings range from approximately $5,900 to almost $90,700. The annual GHG savings are approximately 1,743,500 kg.

These 21 administrative offices and related facilities can save an average of 16% of their total electricity use (14% Electric Baseload, 58% Electric Cooling and 17% Electric Heating). The total annual electricity savings are estimated to be approximately $559,400 and individual building annual savings range from $0 to over $76,500.

These 21 administrative offices and related facilities can save an average of 36% of their total gas use (81% Gas Baseload and 32% Gas Heating). The total annual gas savings are estimated to be approximately $180,430 and individual building annual savings range from $0 to over $43,700.

These 21 facilities will undergo an Energy Assessment with highest potential administrative offices and related facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 21 administrative offices and related facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 21 administrative offices and related facilities can be found in Electric Cooling and Gas Baseload. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these administrative offices and related facilities are eligible to receive over $389,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 14 administrative offices and related facilities with less than $5,000 in savings potential. Less than 1% of the total energy savings for all 51 administrative offices and related facilities can be found in these 14 facilities.

These 14 administrative offices and related facilities can save an average of 23% of their total energy use. The total annual energy savings are estimated to be approximately $29,960 and individual building annual savings range from $0 to almost $5,000. The annual GHG savings are approximately 158,880 kg.

These 14 administrative offices and related facilities can save an average of 4% of their total electricity use (1% Electric Baseload, 53% Electric Cooling and 7% Electric Heating). The total annual electricity savings are estimated to be approximately $8,955 and individual building annual savings range from $0 to over $4,000.

These 14 administrative offices and related facilities can save an average of 35% of their total gas use (54% Gas Baseload and 33% Gas Heating). The total annual gas savings are estimated to be approximately $21,000 and individual building annual savings range from $0 to over $4,400.

These 14 facilities will undergo a checklist approach with highest potential administrative offices and related facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 14 administrative offices and related facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 14 administrative offices and related facilities can be found in Electric Cooling and Gas Baseload.

The energy savings checklist will be used by the Division Champion for the administrative offices and related facilities in conjunction with the building operator and/or service contractor for each administrative office and related facility. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 9 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 51 facilities. The total costs to implement the energy management and retrofit plan for administrative offices and related facilities are estimated to be $22,105,978. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	120,000
Energy Assessment	$	15,750
Checklist	$	2,100
Implementation	$	21,968,128
Total	**$**	**22,105,978**

Table 13: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 10 and Figure 5 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from the Building Performance Audit will occur in Year 1, with all 16 Building Performance Audits completed by the end of Year 4. The implementation of these measures will begin in Year 2 and will be completed by the end of Year 5. Identification of measures from Energy Assessments will begin in Year 1, with all 21 Energy Assessments completed by the end of Year 6. The implementation of these measures will begin in Year 2, and will be completed by the end of Year 7. Identification of measures from the Checklists will begin in Year 2, with all 17 Checklists completed by the end of Year 6. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification, and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $12,916,515. The cumulative net cash flow becomes positive in Year 8.

The implementation plan includes the following assumptions:

- Approximately 76% of the project budget will be spent in the first 5 years, and the other 24% in the following 5 years.
- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 76% of facilities will be retrofitted in the first 5 years and 24% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.

- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).

- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
High Potential - Building Performance Audit	4	4	4	4	0	0	0	0	0	0	16
Mid Potential - Energy Assessment	4	4	4	4	4	1	0	0	0	0	21
Low Potential - Checklist	0	3	3	3	3	2	0	0	0	0	14
Assessment Costs	$ 33,000	$ 33,468	$ 33,478	$ 33,487	$ 3,497	$ 1,088	$ -	$ -	$ -	$ -	$ 138,018
Implementation Costs	$ -	$ 5,101,606	$ 5,298,057	$ 5,404,018	$ 5,512,099	$ 1,847,013	$ 513,573	$ -	$ -	$ -	$ 23,676,366
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 3,300	$ 513,507	$ 533,153	$ 543,751	$ 551,560	$ 184,810	$ 51,357	$ -	$ -	$ -	$ 2,381,438
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 255,080	$ 519,983	$ 790,184	$ 1,065,789	$ 1,158,140	$ 1,183,818	$ 1,183,818	$ 1,183,818	$ 1,183,818	
Annual Costs	$ 36,300	$ 5,903,661	$ 6,384,671	$ 6,771,440	$ 7,132,944	$ 3,191,051	$ 1,748,749	$ 1,183,818	$ 1,183,818	$ 1,183,818	$ 34,720,271
Estimated Achieved Annual Savings		$ 612,263	$ 2,155,591	$ 3,897,953	$ 5,025,710	$ 5,869,444	$ 6,382,916	$ 6,719,716	$ 7,058,001	$ 7,410,901	$ 45,132,496
Estimated Incentives	$ -	$ 1,232,629	$ 606,410	$ 346,303	$ 300,664	$ 15,643	$ 2,641	$ -	$ -	$ -	$ 2,504,290
Annual Savings and Incentives	$ -	$ 1,844,892	$ 2,762,001	$ 4,244,257	$ 5,326,373	$ 5,885,087	$ 6,385,557	$ 6,719,716	$ 7,058,001	$ 7,410,901	$ 47,636,787
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 1,452	-$ 163,803	-$ 308,710	-$ 409,797	-$ 482,060	-$ 374,298	-$ 188,826	$ -	$ -	-$ 1,928,945
Net Cash Flow incl borrowing costs	-$ 36,300	-$ 4,060,221	-$ 3,786,473	-$ 2,835,893	-$ 2,216,368	$ 2,211,977	$ 4,262,510	$ 5,347,072	$ 5,874,183	$ 6,227,083	$ 10,987,570
Cumulative Net Cash Flow	-$ 36,300	-$ 4,095,069	-$ 7,717,739	-$ 10,244,923	-$ 12,051,494	-$ 9,357,458	-$ 4,720,649	$ 815,249	$ 6,689,432	$ 12,916,515	

Table 14: Cash Flow for 10-Year Implementation Plan

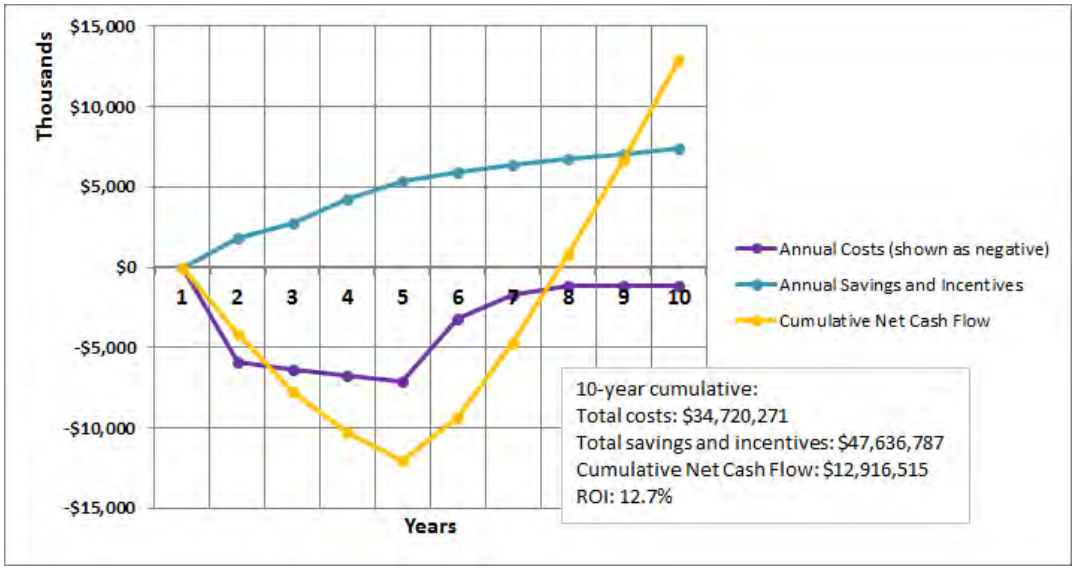

Figure 9: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above). Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for administrative office and related facilities is determined as the average kWh/day for March, April, October and November multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from May to September, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Deep Lake Water Cooling: Multiply Electric Cooling Target by 0.29

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload (ekWh/ft^2)

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2)

Garage: Add 20 ekWh/ft^2 to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Indoor Recreational Facilities:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant (ekWh/ft^2 of ice/week) * Months ice-in * 52 weeks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool (ekWh/ft^2 of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2

- (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Heating for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Fire stations and associated offices and facilities
- Shelter, Support and Housing Administration
- Ambulance stations and associated offices and facilities
- Storage facilities where equipment or vehicles are maintained, repaired or stored
- Public libraries
- Long-Term Care Homes and Services
- Police Services facilities
- Children's Services
- Administrative offices and related facilities, including municipal council chambers

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	1.80	100%	6.5	2.3	
Mechanical	1.50	30%	6	0.6	0.7
Electrical	0.25	100%	8	0.3	
Envelope	0.50	0%	10		0.2
Process	0.15	0%	5		0.1
Total	**4.20**		**6.8**	**3.19**	**1.02**

Table 15: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls. They also include lighting audits.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process (domestic hot water) measures include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers

- Performance based target setting customized for your building
- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available, the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Administrative Offices and Related Facilities

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 51 administrative office and related facility buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
21 Panorama	21 Panorama Crt	96,369
277 Victoria	277 Victoria St	111,385
505 Richmond	505 Richmond St W	94,561
52 Hillcrest Ave	52 Hillcrest Ave	4,585
60 Tiffield Rd	60 Tiffield Rd	64,831
75-81 Elizabeth	77 Elizabeth St	14,768
88 Sunrise Ave	88 Sunrise Ave	34,843
89 Northline Road	89 Northline Road	55,004
Archives and Records Centre	255 Spadina Rd	39,590
Atlantic Ave Storage Bldg	98 Atlantic Ave	43,002
Central Services Office	329 Chaplin Cres	18,299
Central Water Services	545 Commissioners St	32,679
City Hall	100 Queen St W	780,060
Civic Centre Court 2	2 Civic Centre Crt	46,145
College Dovercourt Office	455 Dovercourt Rd	19,138
Consolidated Communication Ctr	703 Don Mills Rd	132,999
Dee Avenue Lab	30 Dee Ave	14,994
Dyas Rd 18	18 Dyas Rd	73,926
Dyas Road Archive Bldg	14 Dyas Rd	28,589
East York Civic Centre	850 Coxwell Ave	67,543
Eastern District Office	1 Eastville Ave	19,849
Etobicoke Civic Centre	399 The West Mall	154,925
Etobicoke North Office	220 Attwell Dr	20,279
Etobicoke South Office	779 The Queensway	22,497
Gunn Building	1138 Bathurst Street	39,297
Health HQ	524 Oakwood Ave	14,144
Health Office	662 Jane St	2,540
Inglis and Subway Ops Buildings	1138 Bathurst Street	253,623
Markham Rd 1530	1530 Markham Rd	120,104
McBrien Building	1900 Yonge Street	92,751
Memorial Park Ave 175	175 Memorial Park Ave	6,394
Metro Hall	55 John St	787,186
North District Office	275 Merton St	66,748

North York Central Office	1117 Finch Ave W	18,934
North York Civic Centre	5100 Yonge Street	303,510
Old City Hall	60 Queen St W	350,494
Pape Avenue Multiuse Building	126 Pape Ave	9,365
Patten Building	835 Davenport Road	33,164
Property Dept Workshop	786 Dundas St E	39,170
Property Maintenance Office	149 River St	13,487
Queen Street Office	1631 Queen St E	25,327
Scarborough Admin Office	1076 Ellesmere Rd	20,398
Scarborough Civic Centre	150 Borough Dr	372,861
Scarborough North Office	5639 Finch Ave E	49,385
Scarborough West Office	1225 Kennedy Rd	19,999
St Lawrence Hall	157 King St East	55,413
Support Services Building	1138 Bathurst Street	8,158
Toronto Admin Office	281 Front St E	54,638
Toronto Island Service Office	0 Hanlans Pt, B22 Office	20,968
Western District Office	61 Edgehill Rd	4,844
York Civic Center	2700 Eglinton Ave W	72,915

Table 16: Administrative Office and Related Facility Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 51 administrative office and related facility buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
52 Hillcrest Ave	1.45	5.39	6.84
Health Office	5.81	3.40	9.21
Toronto Island Service Office	3.11	6.25	9.37
Atlantic Ave Storage Bldg	1.84	7.69	9.53
North District Office	4.51	5.21	9.72
Patten Building	14.79	0.00	14.79
Support Services Building	14.79	0.00	14.79
Central Services Office	7.89	9.77	17.66
Old City Hall	9.48	8.70	18.19
Eastern District Office	5.03	14.18	19.21
21 Panorama	9.87	9.40	19.27
Dyas Rd 18	17.55	4.19	21.74

277 Victoria	19.82	2.01	21.82
Scarborough Admin Office	5.90	16.08	21.97
89 Northline Road	7.07	15.08	22.15
Inglis and Subway Ops Buildings	14.79	7.78	22.57
Health HQ	11.82	10.88	22.70
75-81 Elizabeth	12.21	11.07	23.28
Scarborough Civic Centre	18.72	6.12	24.84
Scarborough North Office	20.80	4.14	24.94
Property Maintenance Office	8.12	18.64	26.77
College Dovercourt Office	2.43	25.42	27.85
Etobicoke South Office	19.04	9.29	28.33
Queen Street Office	15.03	13.49	28.52
Metro Hall	22.07	6.70	28.77
Memorial Park Ave 175	11.43	17.63	29.05
Civic Centre Court 2	29.85	0.00	29.85
505 Richmond	4.63	25.38	30.01
Toronto Admin Office	12.32	17.75	30.07
Western District Office	3.92	26.52	30.44
Markham Rd 1530	17.14	13.44	30.58
88 Sunrise Ave	17.77	13.49	31.26
Property Dept Workshop	3.26	28.47	31.73
City Hall	23.94	8.39	32.33
Etobicoke Civic Centre	16.83	16.24	33.07
Etobicoke North Office	25.56	9.12	34.69
East York Civic Centre	23.62	11.51	35.14
Dyas Road Archive Bldg	19.45	16.14	35.59
Pape Avenue Multiuse Building	8.82	26.94	35.77
St Lawrence Hall	23.97	11.83	35.80
North York Central Office	19.89	20.23	40.12
Central Water Services	36.13	7.84	43.97
York Civic Center	22.63	21.52	44.15
Scarborough West Office	25.66	20.99	46.65
North York Civic Centre	24.12	22.87	46.99
Archives and Records Centre	24.07	28.60	52.67
McBrien Building	42.04	13.72	55.76
Gunn Building	58.14	14.97	73.12
60 Tiffield Rd	44.49	29.20	73.69
Consolidated Communication Ctr	65.16	9.69	74.85
Dee Avenue Lab	96.35	32.50	128.85

Table 17: Administrative Office and Related Facility 2012 Energy Intensity

5.3 Target-setting Method and Metrics

7 administrative offices and related facilities were determined to be ineligible for determination of energy components or target-setting. See Appendix A. The excluded facilities are listed below.

Facility	Days in 2012	Energy type
Gunn Building	TTC buildings for which only annual usage numbers were made available	
Inglis and Subway Ops Buildings	TTC buildings for which only annual usage numbers were made available	
McBrien Building	TTC buildings for which only annual usage numbers were made available	
Patten Building	TTC buildings for which only annual usage numbers were made available	
Support Services Building	TTC buildings for which only annual usage numbers were made available	
Memorial Park Ave 175	330	Electricity
Health Office	396	Electricity

Table 18: Excluded Facilities

After excluding these 7 facilities, 44 City of Toronto facilities and 8 facilities from other municipalities were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component.

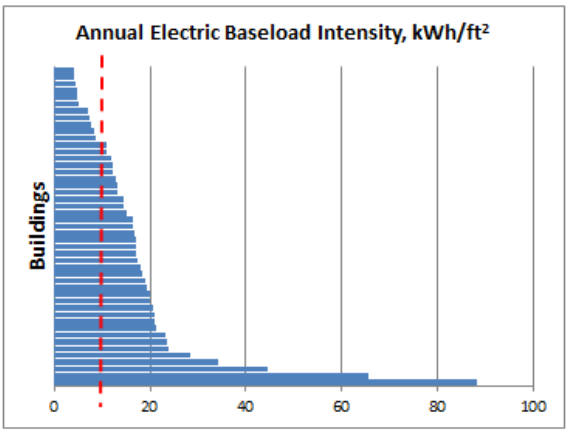

Figure 10: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for administrative offices and related facilities ranges from 4.2 to 88.2 ekWh/ft^2 and the top-quartile is 10.92 ekWh/ft^2.

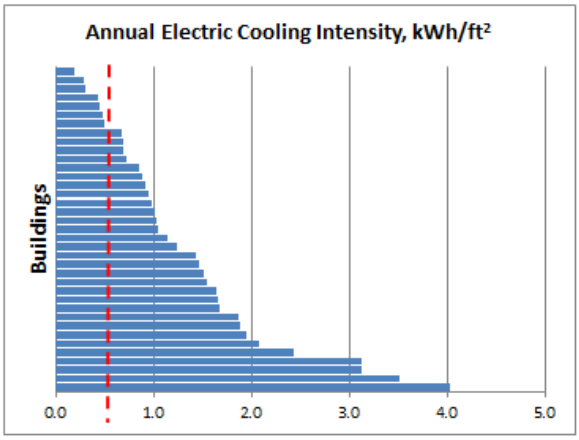

Figure 11: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for administrative offices and related facilities ranges from 0.2 to 4.0 ekWh/ft^2 and the top-quartile is 0.69 ekWh/ft^2.

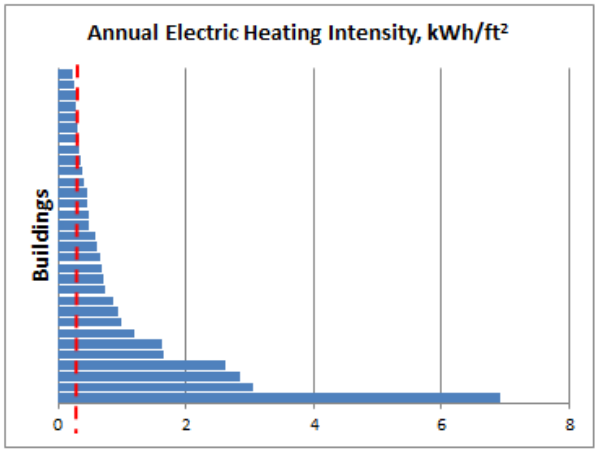

Figure 12: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for administrative offices and related facilities ranges from 0.2 to 6.9 ekWh/ft^2 and the top-quartile is 0.34 ekWh/ft^2.

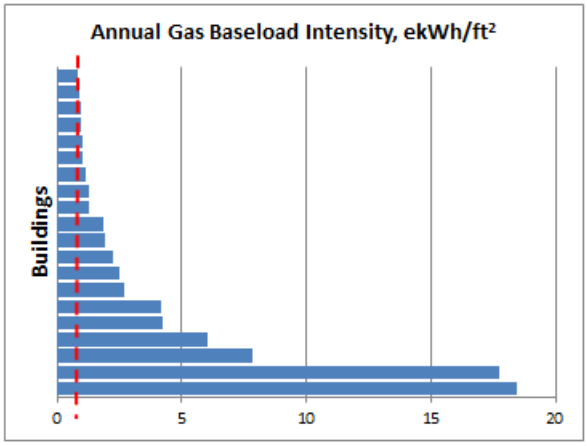

Figure 13: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for administrative offices and related facilities ranges from 0.9 to 18.4 ekWh/ft^2 and the top-quartile is 1.01 ekWh/ft^2.

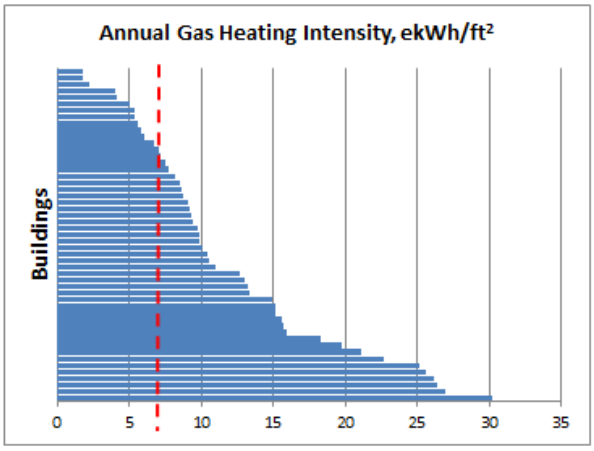

Figure 14: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for administrative offices and related facilities ranges from 1.8 to 30.2 ekWh/ft^2 and the top-quartile is 7.15 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of administrative offices and related facilities, the factors are % of the facility area served by electric heat, % of DHW heated by electricity, use of ground-source or water-source heat pumps, % of the area served by electric air

conditioning, % of the area served by a data centre, % of area served by food services and presence of an outdoor ice rink.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from Total Electricity use (or Total Gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 16 High Savings Potential Administrative Offices and Related Facilities

Buildings are sorted by total annual savings potential, starting with the highest savings potential buildings.

There are 16 administrative offices and related facilities with over $100,000 in annual savings potential.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
High potential savings facilities (16)	35%	49%	21%	39%	$3,470,009	82%	27%	41%	$309,824	39%	$3,779,833	$1,982,862	$119,163	2,660,621	4,965,509
City Hall	29%			29%	$ 519,242	24%	4%		$ 11,875	21%	$ 531,117	$ 296,710	$ 4,567	780,060	493,795
North York Civic Centre	37%	45%	17%	38%	$ 385,207	100%		78%	$135,263	57%	$ 520,470	$ 220,118	$ 52,024	303,510	1,280,196
Consolidated Communication Ctr	36%	100%		37%	$ 450,826	100%	16%	26%	$ 8,501	36%	$ 459,327	$ 257,615	$ 3,270	132,999	415,658
McBrien Building				73%	$ 399,603			41%	$ 12,956	65%	$ 412,559	$ 228,344	$ 4,983	92,751	407,606
60 Tiffield Rd	58%			58%	$ 235,420	73%	84%	83%	$ 39,544	68%	$ 274,965	$ 134,526	$ 15,209	64,831	470,755
Gunn Building				81%	$ 257,914			46%	$ 6,725	73%	$ 264,639	$ 147,379	$ 2,587	39,297	251,250
Scarborough Civic Centre	23%		51%	23%	$ 228,332			0%	$ -	18%	$ 228,332	$ 130,476	$ -	372,861	179,404
277 Victoria	40%	100%		43%	$ 132,766			0%	$ -	39%	$ 132,766	$ 75,867	$ -	111,385	104,316
York Civic Center	41%	57%		43%	$ 99,202	87%	55%	72%	$ 28,309	57%	$ 127,510	$ 56,687	$ 10,888	72,915	282,528
Inglis and Subway Ops Buildings				24%	$ 125,074			0%	$ -	16%	$ 125,074	$ 71,471	$ -	253,623	98,272
Etobicoke Civic Centre	24%	36%		25%	$ 92,356	23%	52%	50%	$ 31,461	37%	$ 123,817	$ 52,775	$ 12,100	154,925	299,930
East York Civic Centre	45%	100%	43%	52%	$ 116,772		32%	29%	$ 5,685	45%	$ 122,457	$ 66,727	$ 2,186	67,543	132,833
Dee Avenue Lab	53%		64%	53%	$ 106,886	100%	86%	86%	$ 10,480	61%	$ 117,366	$ 61,078	$ 4,031	14,994	159,717
Markham Rd 1530	28%	100%		34%	$ 99,285		44%	41%	$ 16,755	37%	$ 116,040	$ 56,734	$ 6,444	120,104	199,094
Civic Centre Court 2	62%			59%	$ 113,307				$ -	59%	$ 113,307	$ 64,747	$ -	46,145	89,027
Central Water Services	67%		25%	65%	$ 107,816		36%	35%	$ 2,271	60%	$ 110,087	$ 61,609	$ 874	32,679	101,125

Table 19: Savings Potential for 16 High Savings Potential Administrative Facilities

Savings Potential by Energy Use Component for the 21 Mid Savings Potential Administrative Offices and Related Facilities

Buildings are sorted by total annual savings potential, starting with the highest savings potential buildings.

There are 21 administrative offices and related facilities with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (21)	14%	58%	17%	16%	$ 559,425	81%	32%	36%	$180,427	25%	$ 739,852	$ 319,672	$ 69,395	1,938,902	1,743,479
Archives and Records Centre	48%	67%		53%	$ 70,407	95%	29%	71%	$ 20,264	63%	$ 90,671	$ 40,233	$ 7,794	39,590	201,764
St Lawrence Hall	38%	62%		41%	$ 76,537	83%		42%	$ 6,993	42%	$ 83,530	$ 43,735	$ 2,690	55,413	110,676
Scarborough North Office	45%			46%	$ 65,966		14%	14%	$ 714	41%	$ 66,680	$ 37,695	$ 274	49,385	56,987
Dyas Rd 18	28%	100%		31%	$ 57,010			0%	$ -	25%	$ 57,010	$ 32,577	$ -	73,926	44,793
Metro Hall	4%			4%	$ 56,721				$ -	3%	$ 56,721	$ 32,412	$ -	787,186	44,567
Scarborough West Office	50%	54%		49%	$ 35,330	100%	75%	80%	$ 8,422	63%	$ 43,752	$ 20,188	$ 3,239	19,999	88,623
505 Richmond				0%	$ -		72%	73%	$ 43,737	61%	$ 43,737	$ -	$ 16,822	94,561	316,084
Old City Hall		73%	23%	8%	$ 30,600		17%		$ 12,646	12%	$ 43,245	$ 17,486	$ 4,864	350,494	115,431
Etobicoke North Office	53%	67%	71%	55%	$ 39,562		18%	17%	$ 806	45%	$ 40,368	$ 22,607	$ 310	20,279	36,912
88 Sunrise Ave	36%			34%	$ 29,897		46%	45%	$ 5,372	39%	$ 35,269	$ 17,084	$ 2,066	34,843	62,315
North York Central Office	37%	64%		38%	$ 20,138		73%	71%	$ 6,868	55%	$ 27,006	$ 11,507	$ 2,642	18,934	65,460
Toronto Admin Office		100%		14%	$ 12,745	62%	53%	55%	$ 13,331	38%	$ 26,076	$ 7,283	$ 5,127	54,638	106,356
Etobicoke South Office	35%	100%	40%	41%	$ 24,415		22%	22%	$ 1,149	35%	$ 25,564	$ 13,951	$ 442	22,497	27,486
89 Northline Road		100%		23%	$ 12,716		53%	53%	$ 10,994	43%	$ 23,709	$ 7,266	$ 4,228	55,004	89,443
Property Dept Workshop				0%	$ -	100%	73%	74%	$ 20,718	66%	$ 20,718	$ -	$ 7,968	39,170	149,726
Patten Building				24%	$ 16,356				$ -	24%	$ 16,356	$ 9,346	$ -	33,164	12,851
Dyas Road Archive Bldg		100%		5%	$ 4,197		55%	54%	$ 6,314	28%	$ 10,511	$ 2,398	$ 2,428	28,589	48,928
College Dovercourt Office				0%	$ -		72%	71%	$ 8,653	65%	$ 8,653	$ -	$ 3,328	19,138	62,534
21 Panorama		14%		2%	$ 2,869		23%	23%	$ 5,137	12%	$ 8,006	$ 1,640	$ 1,976	96,369	39,378
Scarborough Admin Office		100%	7%	12%	$ 2,030		54%	52%	$ 4,318	42%	$ 6,348	$ 1,160	$ 1,661	20,398	32,801
Queen Street Office		29%		4%	$ 1,931	100%	35%	47%	$ 3,992	24%	$ 5,923	$ 1,104	$ 1,535	25,327	30,365

Table 20: Savings Potential for 21 Medium Savings Potential Administrative Facilities

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 14 Low Savings Potential Administrative Offices and Related Facilities

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 14 administrative offices and related facilities with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (14)	01%	53%	07%	04%	$ 8,955	54%	33%	35%	$ 21,010	23%	$ 29,965	$ 5,117	$ 8,081	247,149	158,876
Pape Avenue Multiuse Building		100%		5%	$ 578	76%	69%	69%	$ 4,404	54%	$ 4,983	$ 331	$ 1,694	9,365	32,283
Property Maintenance Office			29%	3%	$ 471		63%	62%	$ 3,887	44%	$ 4,358	$ 269	$ 1,495	13,487	28,464
Eastern District Office				0%	$ -	100%	55%	58%	$ 4,073	43%	$ 4,073	$ -	$ 1,567	19,849	29,436
Support Services Building				24%	$ 4,026				$ -	24%	$ 4,026	$ 2,301	$ -	8,158	3,163
75-81 Elizabeth	8%	100%	2%	8%	$ 1,972		32%	30%	$ 1,238	18%	$ 3,210	$ 1,127	$ 476	14,768	10,495
Western District Office				0%	$ -		77%	76%	$ 2,443	66%	$ 2,443	$ -	$ 940	4,844	17,656
Memorial Park Ave 175				0%	$ -			58%	$ 1,635	35%	$ 1,635	$ -	$ 629	6,394	11,819
Central Services Office				0%	$ -		36%	35%	$ 1,552	19%	$ 1,552	$ -	$ 597	18,299	11,219
Toronto Island Service Office		100%		14%	$ 1,259			0%	$ -	5%	$ 1,259	$ 719	$ -	20,968	989
Health HQ	0%		14%	1%	$ 146		28%	25%	$ 978	12%	$ 1,124	$ 83	$ 376	14,144	7,184
Atlantic Ave Storage Bldg		100%		5%	$ 503		5%	5%	$ 415	5%	$ 918	$ 288	$ 160	43,002	3,395
North District Office				0%	$ -	100%		4%	$ 378	2%	$ 378	$ -	$ 145	66,748	2,729
52 Hillcrest Ave				0%	$ -	100%		1%	$ 6	1%	$ 6	$ -	$ 2	4,585	45
Health Office				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	2,540	0

Table 21: Savings Potential for 14 Low Savings Potential Administrative Facilities

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use – Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Children's Services

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1 Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 9 children's services buildings in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B. All 9 buildings are childcare centres.

The total area for all buildings is 64,186 ft2. The children's services buildings range in size from less than 5,000 ft2 to over 11,000 ft2.

There is one geothermal installation at Yonge Hearts Child Care Centre located at 5176 Yonge Street.

The majority of the children's services buildings are 100% air-conditioned, with the exception of Woodbine Childcare Centre (which is not air-conditioned). Three facilities are served by less than 10% of electric heat (City Kids Childcare Centre, Albion Road Childcare and Malvern Childcare Centre). Even though they are not reported to be using electric heat, the electricity profiles show that the majority of the other children's services buildings have significant additional use of electricity in winter months. While some of this usage may be due to longer hours of lighting or electric motors, use of electric heaters is indicated and should be further explored. Identifying and limiting electricity use associated with space heating will be one of the first measures recommended in the plan (see section on proposed energy efficiency measures). Most of the children's services buildings (with the exception of Woodbine Childcare Centre and Jesse Ketchum Childcare Centre) are partially served by water source heat pumps.

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 9 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	972,955	$136,214
Natural Gas (m^3)	149,634	$38,905
Total		**$175,118**

Table 22: 2012 Energy Use and Costs for 9 City of Toronto Children's Services Buildings

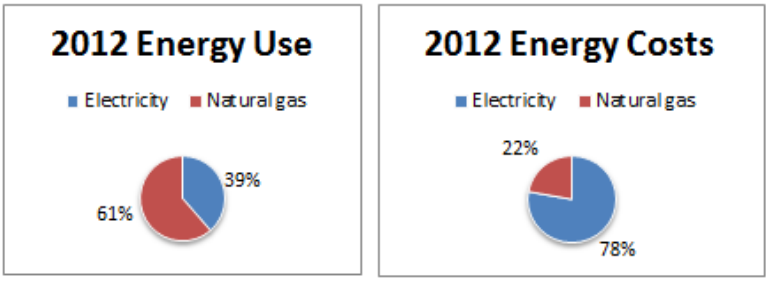

Figure 15: 2012 Energy Use and Cost Breakdown for City of Toronto Children's Services Buildings

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 9 buildings. Total energy use ranges from approximately 17 to over 100 ekWh/ft^2. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

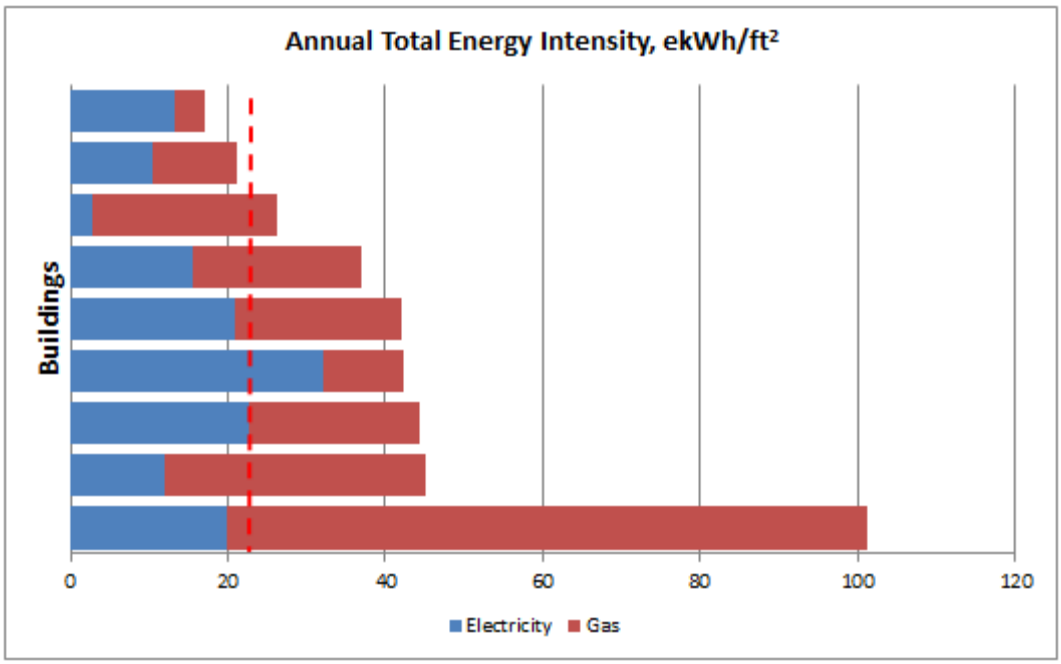

Figure 16: 2012 Total Energy Intensity Benchmark

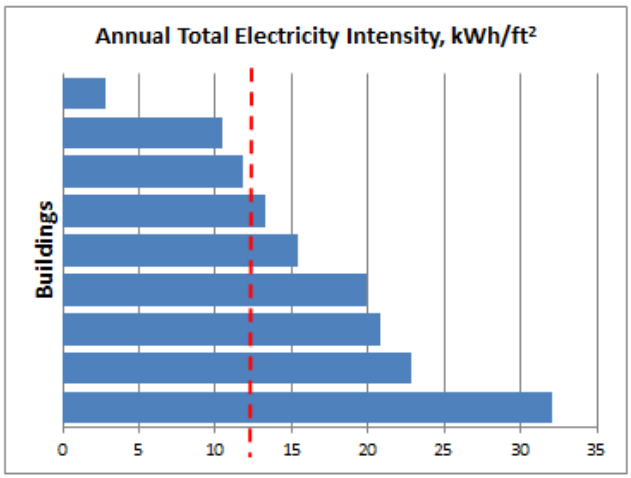

Figure 17: 2012 Total Electricity Intensity Benchmark

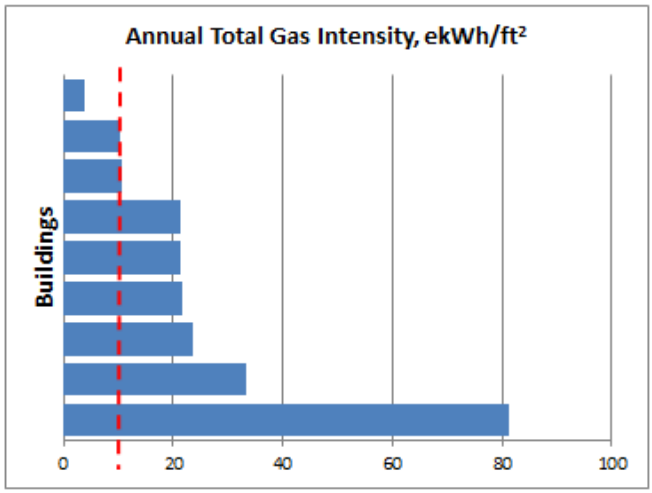

Figure 18: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for children's services buildings are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each children's services building to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	11.3	kWh/ft²/year
	Cooling	0.5	kWh/ft²/year
	Heating	0.4	kWh/ft²/year
	Total	12.3	kWh/ft²/year
Gas	Base	3.1	ekWh/ft²/year
	Heating	7.6	ekWh/ft²/year
	Total	10.7	ekWh/ft²/year
Total energy	Total	23.0	ekWh/ft²/year

Table 23: Top Quartile Targets

9 children's services buildings made up the data set for target-setting, all of which are City of Toronto buildings with complete and reliable data. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)), and % of the area which is air conditioned. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each children's services building. The total savings potential for each children's services building is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 9 children's services buildings are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There are no children's services buildings with annual savings potential greater than $100,000. 4 children's services buildings have annual savings potential between $5,000 and $100,000 and 5 children's services buildings have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 9 buildings is $48,045 ($31,311 for electricity and $16,733 for gas) with an average total energy savings of 35%.

For the 4 mid-potential savings facilities, the total annual savings potential is $39,803 ($29,522 for electricity and $10,281 for gas) with an average total energy savings of 46%.

For the 5 low-potential savings facilities, the total annual savings potential is $8,242 ($1,790 for electricity and $6,453 for gas) with an average total energy savings of 23%.

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 9 facilities	**16%**	**45%**	**70%**	**23%**	**$ 31,311**	**72%**	**24%**	**43%**	**$ 16,733**	**35%**	**$ 48,045**	**$ 17,892**	**$ 6,436**	**64,186**	**145,533**
Mid-potential savings facilities (4)	27%	55%	80%	35%	$ 29,522	83%	14%	55%	$ 10,281	46%	$ 39,803	$ 16,870	$ 3,954	24,714	97,495
Low potential savings facilities (5)	02%	20%	26%	03%	$ 1,790	45%	29%	32%	$ 6,453	23%	$ 8,242	$ 1,023	$ 2,482	39,472	48,038

Table 24: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest percentage savings are to be found and guides the priorities for implementation. Table 4 below shows the total potential savings for all 9 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	12.9	10.8	16%	$ 18,830
Electric Cooling (kWh/ft²)	0.7	0.4	45%	$ 2,820
Electric Heating (kWh/ft²)	2.0	0.6	70%	$ 9,661
Total Electricity (kWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Gas Baseload (ekWh/ft²)	9.5	2.6	72%	$ 11,107
Gas Heating (ekWh/ft²)	14.6	11.1	24%	$ 5,627
Total Gas (ekWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Total Energy (ekWh/ft²)	**39.3**	**25.4**	**35%**	**$ 48,045**

High savings | Moderate | Low savings

Table 25: Savings Potential Based on Energy Use Component for 9 Children's Services Buildings

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (Electric Heating (i.e. higher electricity use in winter months as described above under Building Characteristics) and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electric Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Proposed Energy Efficiency Measures

Table 5 below shows the full range of possible energy efficiency measures for the entire portfolio of children's services buildings. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 9 facilities indicate that the largest percentage reductions will come from measures associated with electric cooling, electric heating and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off machines, office and kitchen equipment when not needed	4	1	5	Year 1	Annual Review	Building Occupants
B2	Unplug machines, office and kitchen equipment if not actively used	4	1	5	Year 1	Annual Review	Building Occupants
B3	Turn off computer monitors when not in use	4	1	5	Year 1	Annual Review	Building Occupants
B4	Enable ENERGY STAR power settings on your computer	4	1	5	Year 1	Annual Review	Building Occupants
B5	Unplug chargers when not in use	4	1	5	Year 1	Annual Review	Building Occupants
B6	Turn off lights when areas not in use	4	1	5	Year 1	Annual Review	Building Occupants
B7	Make use of natural light instead of turning on lights where possible	4	1	5	Year 1	Annual Review	Building Occupants
M1	Optimize operating schedules for fans and pumps	3	1	4	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	1	4	Year 2	Seasonal Review	
EL4	Install power factor correction	3	1	4	Year 4	15+	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	1	2	Year 5	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	1	2	Year 5	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	1	2	Year 5	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	1	2	Year 5	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	1	2	Year 5	10 to 15	
L6	Replace festive lighting with LED	1	1	2	Year 5	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	1	2	Year 5	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	1	2	Year 5	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	1	2	Year 5	4 to 6	
EL3	Install controls on vending machines	1	1	2	Year 5	10 to 15	
M3	Install variable frequency drives (VFDs) on suitable fans and pumps	1	1	2	Year 5	10 to 20	
M4	Convert electric hot water heaters to natural gas	1	1	2	Year 5	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B8	Adjust blinds (to retain heat in winter)	4	4	8	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	4	8	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	4	7	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	4	6	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	4	5	Year 3	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	4	5	Year 3	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	4	5	Year 3	seasonal review	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B11	Winterize room air-conditioners	4	4	8	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	4	8	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	4	8	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1		Building Occupants
M10	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M12	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M13	Test and tune the air conditioning units	3	4	7	Year 2	3	
M11	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B17	Optimize dishwasher operation (only run when full)	4	4	8	Year 1		Building Occupants
P3	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M16	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P1	Optimize DHW temperature control	2	4	6	Year 2	annual review	
P2	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	4	5	Year 3	10 to 15	
M14	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M15	Replace DHW boilers with more efficient models	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B18	Check and clear baseboard heaters of obstructions	4	2	6	Year 1		Building Occupants
B19	Adjust blinds (to retain heat in winter)	4	2	6	Year 1		Building Occupants
B20	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	2	6	Year 1		Building Occupants
M17	Optimize operating periods of ventilation systems supplying heated spaces	2	2	4	Year 2	seasonal review	
M18	Test and adjust ventilation systems to optimize outside air volumes	3	2	5	Year 2	seasonal review	
M20	Test and tune boiler efficiency	3	2	5	Year 2	seasonal review	
M22	Check heating system for flow balancing and air venting	3	2	5	Year 2	seasonal review	
EN1	Check and seal exterior walls and openings	3	2	5	Year 2	10 to 15	
EN5	Seal window and door frames	3	2	5	Year 2	5	
M23	Optimize fan-coil unit and entrance heater controls	3	2	5	Year 2	seasonal review	
M24	Consider heating system zoning	2	2	4	Year 2	n/a	
M19	Test, repair, replace and right-size heating control valves and outside air dampers	2	2	4	Year 4	10 to 15	
M21	Upgrade heating system control to optimize space temperatures and operating periods	1	2	3	Year 5	10 to 15	
EN2	Insulate the attic adequately	1	2	3	Year 5	10 to 15	
EN3	Reclad the building's exterior	1	2	3	Year 5	20 to 24	
EN4	Replace single-pane windows with double-pane windows	1	2	3	Year 5	20 to 24	
EN6	If replacing the roof, ensure R-value at least 22	1	2	3	Year 5	n/a	
M25	Install high efficiency burners	1	2	3	Year 5	15 to 20	
M26	Replace boilers with more efficient models	1	2	3	Year 5	15 to 20	
M27	Replace old rooftop units with energy efficient units	1	2	3	Year 5	15 to 20	
M28	Install heat recovery or solar heating units	1	2	3	Year 5	10 to 15	
	Other:_____						
	_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 26: Energy Saving Measures for Children's Services Buildings

The specific measures and implementation timeline for individual children's services buildings will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities is $4.20/ft^2 (see Appendix A). The budget allows for lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high-potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low potential buildings is set at 40 percent of the basic amount to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium, and low potential children's services buildings are summarized in Table 6 below.

Annual Savings Potential	Number of facilities	Average Area (ft^2)	Estimated Implementation Cost $/ft^2	Estimated Implementation Cost $	Estimated Savings potential $	% of total savings	Payback
> $100,000	0	-	5.04	$ -	$ -	0.0%	
$5,000 - $100,000	4	6,179	4.20	$ 103,799	$ 39,803	82.8%	2.61
< $5,000	5	7,894	1.68	$ 66,312	$ 8,242	17.2%	8.05
	9			**$ 170,112**	**$ 48,045**		**3.54**

Table 27: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the Specific Measures for Each Building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.

- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 7 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	4	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	5	$ 150	< $5,000	Division Champion and staff
		9			

Table 28: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Energy Assessment

There are 4 children's services buildings with between $5,000 and $100,000 in annual energy saving potential. Approximately 83% of the total energy savings for all 9 children's services buildings can be found in these 4 facilities.

These 4 children's services buildings can save an average of 46% of their total energy use. The total annual energy savings are estimated to be over $39,800 and individual building annual savings range from approximately $5,560 to over $15,300. The annual GHG savings are approximately 97,500 kg.

These 4 children's services buildings can save an average of 35% of their total electricity use (27% Electric Baseload, 55% Electric Cooling and 80% Electric Heating). The total annual electricity savings are estimated to be approximately $29,500 and individual building annual savings range from about $3,300 to almost $15,000.

These 4 children's services buildings can save an average of 55% of their total gas use (83% Gas Baseload and 14% Gas Heating). The total annual gas savings are estimated to be approximately $10,300 and individual building annual savings range from approximately $400 to approximately $8,650.

These 4 facilities will undergo an Energy Assessment with highest potential children's services buildings focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 4 children's services buildings and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 4 children's services buildings can be found in Electric Heating and Gas Baseload. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these children's services buildings are eligible to receive over $20,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Savings Checklist

There are 5 children's services buildings with less than $5,000 in savings potential. Approximately 17% of the total energy savings for all 9 children's services buildings can be found in these 5 facilities.

These 5 children's services buildings can save an average of 23% of their total energy use. The total annual energy savings are estimated to be approximately $8,200 and individual building annual savings range from $0 to approximately $4,200. The annual GHG savings are approximately 48,000 kg.

These 5 children's services buildings can save an average of 3% of their total electricity use (2% Electric Baseload, 20% Electric Cooling and 26% Electric Heating). The total annual electricity savings are estimated to be approximately $1,800 and individual building annual savings range from $0 to around $1,000.

These 5 children's services buildings can save an average of 32% of their total gas use (45% Gas Baseload and 29% Gas Heating). The total annual gas savings are estimated to be approximately $6,400 and individual building annual savings range from $0 to over $4,200.

These 5 facilities will undergo a checklist approach with highest potential children's services buildings focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 5 children's services buildings and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 5 children's services buildings can be found in Gas Baseload and Gas Heating.

The energy savings checklist will be used by the Division Champion for the children's services buildings in conjunction with the building operator and/or service contractor for each children's services building. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 8 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 9 facilities. The total costs to

implement the energy management and retrofit plan for children's services buildings is estimated to be $173,862. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	3,000
Checklist	$	750
Implementation	$	170,112
Total	**$**	**173,862**

Table 29: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 9 and Figure 51 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from Energy Assessments will begin in Year 1, with all 4 Energy Assessments completed by the end of Year 4. The implementation of these measures will begin in Year 2, and be completed by the end of Year 5. Identification of measures from the Checklists will begin in Year 2, with all 5 Checklists completed by the end of Year 6. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $214,091. The cumulative net cash flow becomes positive in Year 7.

The implementation plan includes the following assumptions:

- Approximately 71% of the project budget will be spent in the first 5 years, and the other 29% in the following 5 years.
- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 71% of medium and low potential savings facilities will be retrofitted in the first 5 years and 29% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.

- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).

- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
Mid Potential - Energy Assessment	1	1	1	1	0	0	0	0	0	0	4
Low Potential - Checklist	0	1	1	1	1	1	0	0	0	0	5
Assessment Costs	$ 750	$ 906	$ 909	$ 912	$ 166	$ 169	$ -	$ -	$ -	$ -	$ 3,812
Implementation Costs	$ -	$ 26,998	$ 41,612	$ 42,445	$ 43,294	$ 14,936	$ 15,234	$ -	$ -	$ -	$ 184,519
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 75	$ 2,790	$ 4,252	$ 4,336	$ 4,346	$ 1,510	$ 1,523	$ -	$ -	$ -	$ 18,833
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 1,350	$ 3,431	$ 5,553	$ 7,717	$ 8,464	$ 9,226	$ 9,226	$ 9,226	$ 9,226	
Annual Costs	$ 825	$ 32,045	$ 50,204	$ 53,245	$ 55,523	$ 25,079	$ 25,984	$ 9,226	$ 9,226	$ 9,226	$ 270,583
Estimated Achieved Annual Savings		$ 4,237	$ 17,409	$ 36,071	$ 50,660	$ 60,981	$ 67,210	$ 70,984	$ 74,533	$ 78,260	$ 460,346
Estimated Incentives	$ -	$ 8,708	$ 6,869	$ 4,444	$ 3,677	$ 630	$ -	$ -	$ -	$ -	$ 24,328
Annual Savings and Incentives	$ -	$ 12,945	$ 24,278	$ 40,515	$ 54,337	$ 61,611	$ 67,210	$ 70,984	$ 74,533	$ 78,260	$ 484,674
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 33	-$ 797	-$ 1,834	-$ 2,343	-$ 2,391	-$ 929	$ -	$ -	$ -	-$ 8,327
Net Cash Flow incl borrowing costs	-$ 825	-$ 19,133	-$ 26,724	-$ 14,565	-$ 3,528	$ 34,141	$ 40,297	$ 61,758	$ 65,307	$ 69,034	$ 205,764
Cumulative Net Cash Flow	-$ 825	-$ 19,925	-$ 45,851	-$ 58,582	-$ 59,767	-$ 23,236	$ 17,991	$ 79,749	$ 145,057	$ 214,091	

Table 30: Cash Flow for 10-Year Implementation Plan

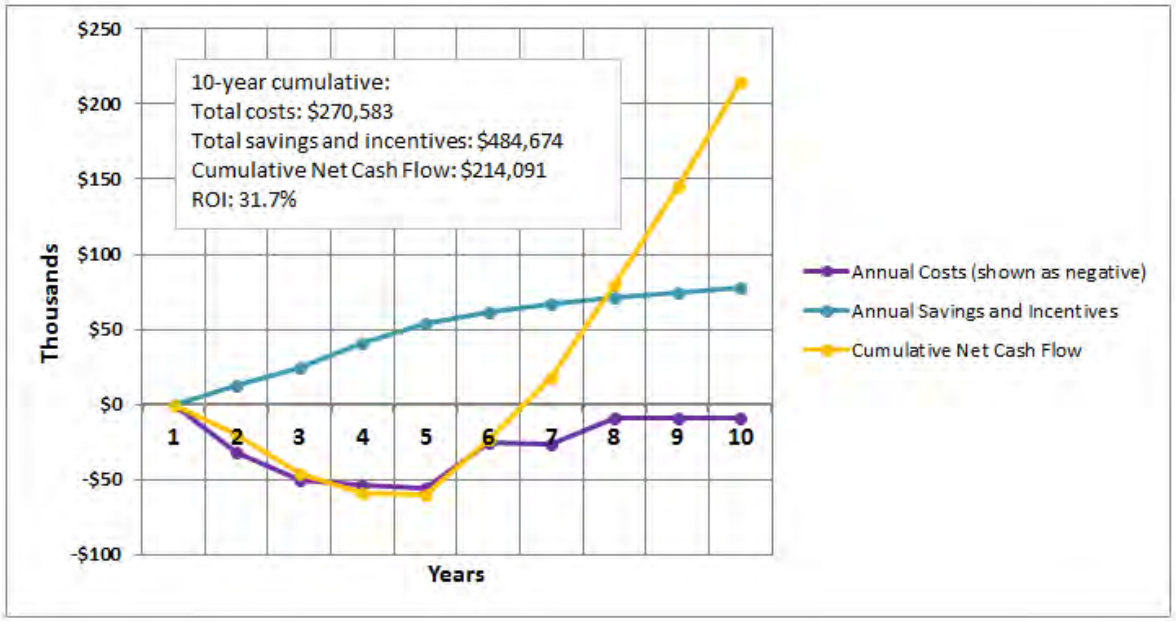

Figure 19: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above) and facilities of the same type from other municipalities. Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for children's services buildings is determined as the average kWh/day for April, May, September and October multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from June to August, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February, March, November and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-

standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload (ekWh/ft^2)

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2)

Garage: Add 20 ekWh/ft^2 to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Indoor Recreational Facilities:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant (ekWh/ft^2 of ice/week) * Months ice-in * 52 weeks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool (ekWh/ft^2 of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Heating for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Fire stations and associated offices and facilities
- Shelter, Support and Housing Administration
- Ambulance stations and associated offices and facilities
- Storage facilities where equipment or vehicles are maintained, repaired or stored
- Public libraries
- Long-Term Care Homes and Services
- Police stations and associated offices and facilities
- Children's Services
- Administrative offices and related facilities, including municipal council chambers

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	1.80	100%	6.5	2.3	
Mechanical	1.50	30%	6	0.6	0.7
Electrical	0.25	100%	8	0.3	
Envelope	0.50	0%	10		0.2
Process	0.15	0%	5		0.1
Total	**4.20**		**6.8**	**3.19**	**1.02**

Table 31: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process (domestic hot water) measures include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved, and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers
- Performance based target setting customized for your building

- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available, the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Children's Services Buildings

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 9 children's services buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Ancaster Childcare	45 Ancaster Rd.	7,018
Albion Road Childcare	1545 Albion Rd.	5,543
City Kids Childcare Centre	34 Bathurst St.	8,461
Danforth Childcare Centre	1125 Danforth Ave.	6,351
Jesse Ketchum Childcare Centre	7 Berryman St.	11,550
Malvern Childcare Centre	1321 Neilson Rd.	6,501
Thomas Berry Childcare Centre	3495 Lakeshore Blvd. W.	9,117
Willowridge Childcare Centre	30 Earldown Dr.	4,844
Woodbine Childcare Centre	1100 Woodbine Ave.	4,801

Table 32: Children's Services Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 9 children's services buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft^2)	2012 Total Gas Intensity ($ekWh/ft^2$)	2012 Total Energy Intensity ($ekWh/ft^2$)
Woodbine Childcare Centre	13.24	3.80	17.04
City Kids Childcare Centre	10.41	10.81	21.22
Jesse Ketchum Childcare Centre	2.91	23.67	26.57
Albion Road Childcare	15.44	21.31	36.75
Ancaster Childcare	20.76	21.31	42.07
Malvern Childcare Centre	31.98	10.21	42.19
Danforth Childcare Centre	23.08	21.69	44.76
Thomas Berry Childcare Centre	11.66	33.47	45.14
Willowridge Childcare Centre	19.50	81.33	100.83

Table 33: Children's Services 2012 Energy Intensity

5.3 Target-setting Method and Metrics

No children's services buildings were determined to be ineligible for determination of energy components or target-setting. See Appendix A.

9 City of Toronto facilities were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component.

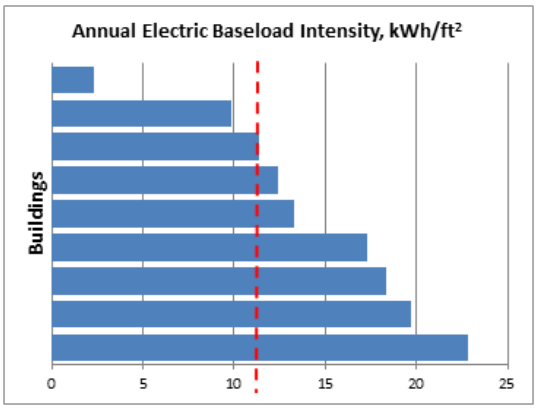

Figure 20: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for children's services buildings ranges from 2.3 to 22.8 ekWh/ft^2 and the top-quartile is 11.3 ekWh/ft^2.

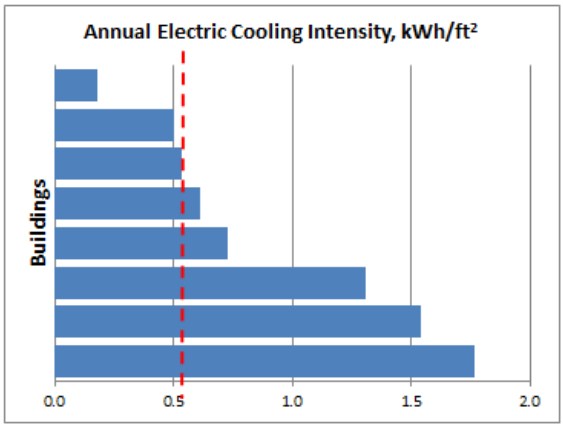

Figure 21: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for children's services buildings ranges from 0.2 to 1.8 ekWh/ft^2 and the top-quartile is 0.53 ekWh/ft^2.

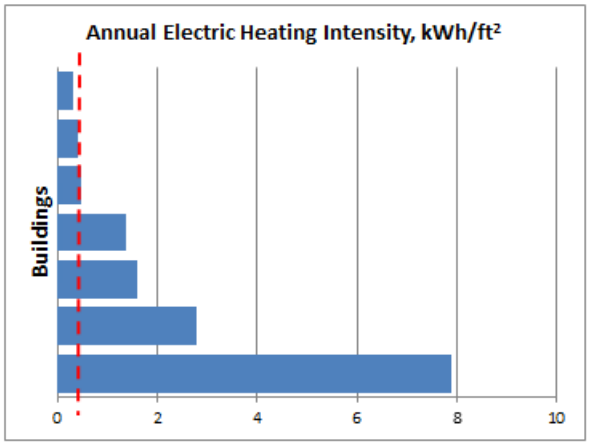

Figure 22: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for children's services buildings ranges from 0.3 to 7.9 ekWh/ft^2 and the top-quartile is 0.4 ekWh/ft^2.

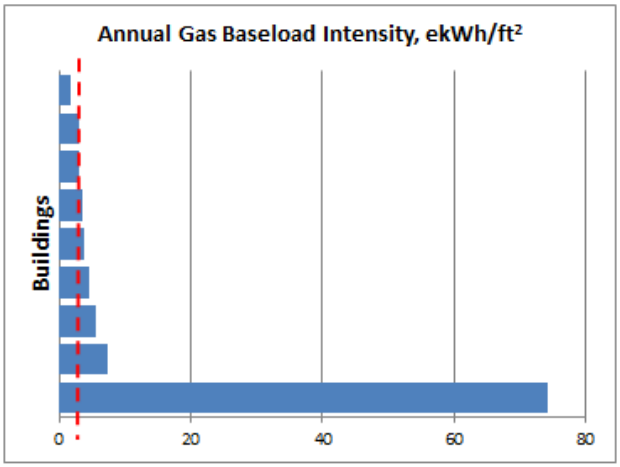

Figure 23: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for children's services buildings ranges from 1.8 to 74.2 ekWh/ft^2 and the top-quartile is 3.1 ekWh/ft^2.

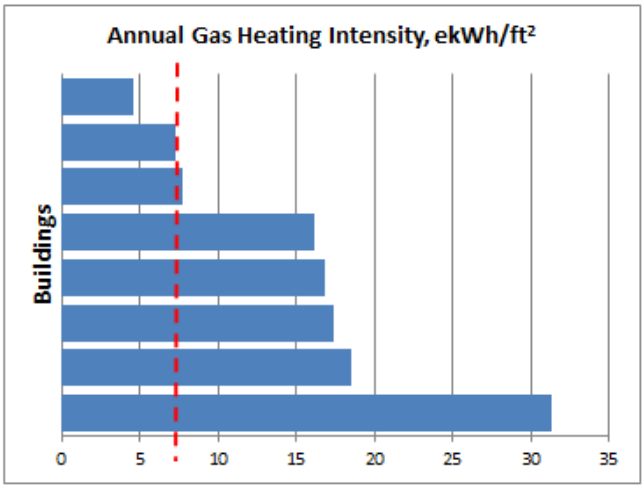

Figure 24: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for children's services buildings ranges from 0.3 to 31.4 ekWh/ft^2 and the top-quartile is 7.65 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of children's services buildings, the factors are % of the facility area served by electric heat, %of DHW heated by electricity, use of ground-source or water-source heat pumps, and % of the area served by electric air conditioning.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from Total Electricity use (or Total Gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 4 Mid-Savings Potential Children's Services Buildings

Buildings are sorted by total annual savings potential, starting with the highest saving potential buildings.

There are 4 children's services buildings with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (4)	27%	55%	80%	35%	$ 29,522	83%	14%	55%	$ 10,281	46%	$ 39,803	$ 16,870	$ 3,954	24,714	97,495
Malvern Childcare Centre	37%	55%	91%	51%	$ 14,963	45%		25%	$ 409	45%	$ 15,372	$ 8,551	$ 157	6,501	14,711
Willowridge Childcare Centre	22%	61%		25%	$ 3,352	96%		87%	$ 8,652	75%	$ 12,004	$ 1,916	$ 3,328	4,844	65,158
Danforth Childcare Centre	27%	66%	38%	30%	$ 6,250		21%	18%	$ 614	24%	$ 6,864	$ 3,571	$ 236	6,351	9,349
Ancaster Childcare	17%	18%	70%	24%	$ 4,956	21%	15%	16%	$ 606	20%	$ 5,563	$ 2,832	$ 233	7,018	8,277

Table 34: Savings Potential for 4 Medium Savings Potential Children's Services Buildings

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 5 Low-Savings Potential Children's Services Buildings

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 5 children's services buildings with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (5)	02%	20%	26%	03%	$ 1,790	45%	29%	32%	$ 6,453	23%	$ 8,242	$ 1,023	$ 2,482	39,472	48,038
Thomas Berry Childcare Centre				0%	$ -	100%	53%	55%	$ 4,228	41%	$ 4,228	$ -	$ 1,626	9,117	30,556
Jesse Ketchum Childcare Centre				0%	$ -	58%	9%	24%	$ 1,654	21%	$ 1,654	$ -	$ 636	11,550	11,956
Albion Road Childcare		3%	57%	6%	$ 720	33%	13%	18%	$ 521	13%	$ 1,241	$ 411	$ 201	5,543	4,334
Woodbine Childcare Centre	9%	100%		12%	$ 1,070	12%		11%	$ 49	12%	$ 1,119	$ 611	$ 19	4,801	1,193
City Kids Childcare Centre				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	8,461	0

Table 35: Savings Potential for 5 Low-Savings Potential Children's Services Buildings

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use – Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Community Centres

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1 Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 69 community centres in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B.

The total area for all of the buildings is 2,000,971 ft^2. Community centres range in size from approximately 1,400 ft^2 to over 250,000 ft^2.

The facilities equipped with a renewable energy system are as follows:

Building Name	Building Address	Renewable Installation	System Size	Unit
Albion Community Centre	1485 Albion Rd	Solar Pool Heating	67	KW
Armour Heights Community Centre	2140 Avenue Rd	Solar Air	120	KW
Birchmount RC (Solar Utility)	93 Birchmount Rd	Solar Hot Water	245	KW
Grandravine CC	23 Grandravine Dr	Solar Photovoltaic	100	kW
McGregor Arena	2231 Lawrence Ave E	Solar Photovoltaic	75	kW
Scadding Court Community Centre	707 Dundas St W	Solar Air	115	kW

Table 36 : Current Renewable Energy Systems on Community Centres

The facilities range from 0% to 100% air-conditioned. No facilities are fully served by electric heat and there are a number of other facilities using between 5 and 30% electric heat. Only one facility (Forest Hill CC) is served by a water source heat pump. There are food services at a number of facilities, ranging from 1 to 10% of building served.

The community centres fall into four types:

- Facilities with indoor ice rinks only
- Facilities with indoor pools only
- Facilities with both indoor rinks and indoor pools
- Facilities without indoor rinks or indoor pools

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of

electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 69 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	31,387,377	$4,394,233
Natural Gas (m^3)	3,349,628	$870,903
Total		**$5,265,136**

Table 37: 2012 Energy Use and Costs for 69 City of Toronto Community Centres

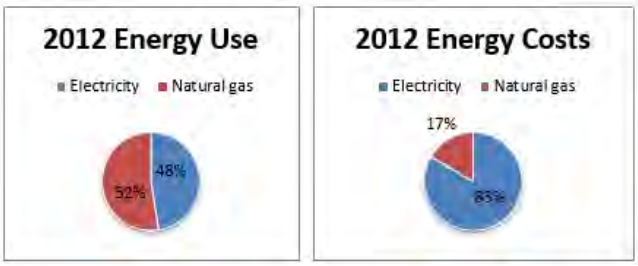

Figure 25: 2012 Energy Use and Cost Breakdown for 69 City of Toronto Community Centres

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 69 buildings. Total energy use ranges from approximately 4.3 to 94.8 ekWh/ft^2. There are also wide ranges for electricity and gas use per ft^2. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

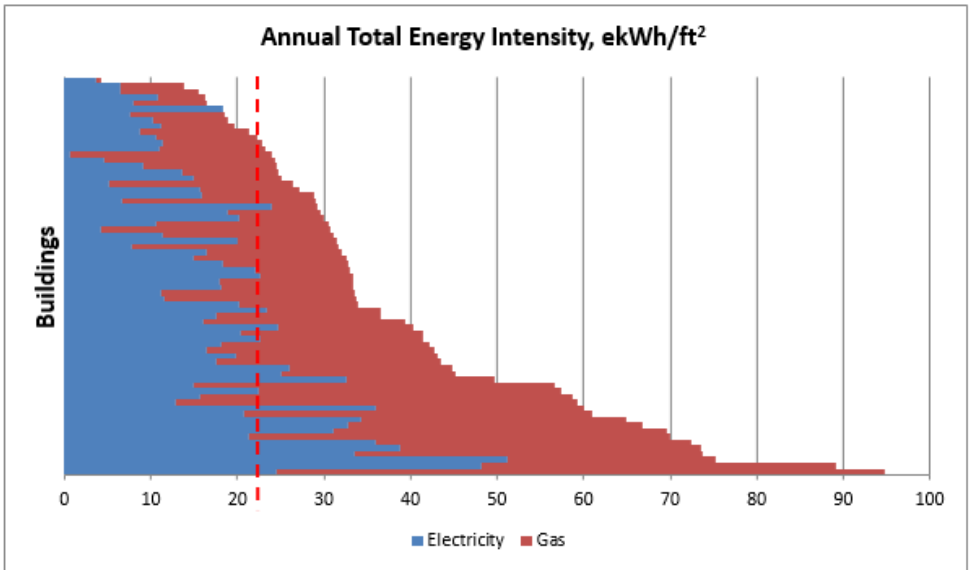

Figure 26: 2012 Total Energy Intensity Benchmark

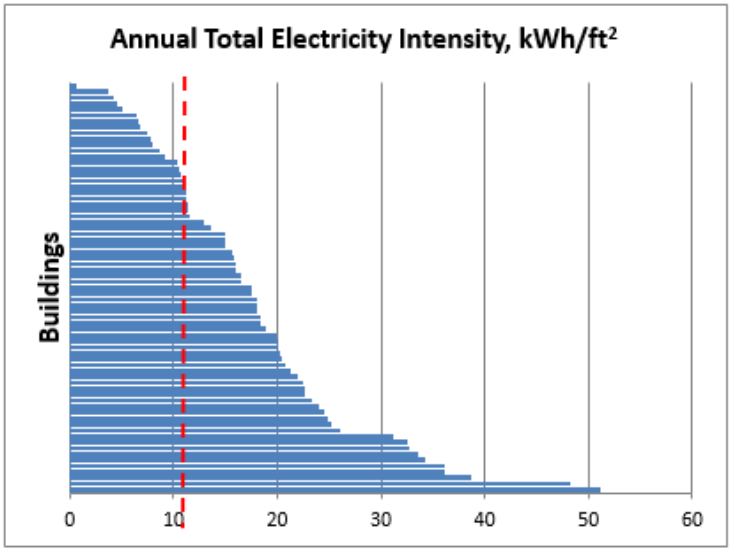

Figure 27: 2012 Total Electricity Intensity Benchmark

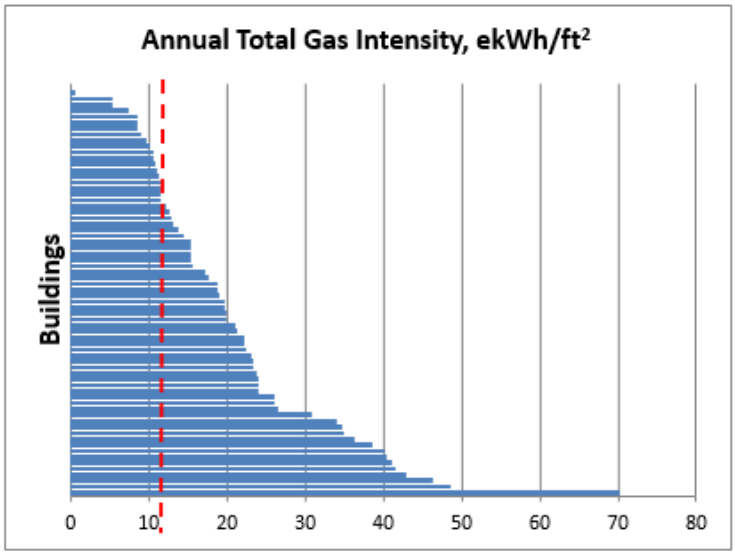

Figure 28: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for community centres are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each community centre to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	9.2	kWh/ft²/year
	Cooling	0.8	kWh/ft²/year
	Heating	1.8	kWh/ft²/year
	Total	11.8	kWh/ft²/year
Gas	Base	1.8	ekWh/ft²/year
	Heating	9.7	ekWh/ft²/year
	Total	11.5	ekWh/ft²/year
Total energy	Total	23.3	ekWh/ft²/year

Table 38: Top Quartile Targets

The data set for target-setting is made up of 87 community centres and indoor recreational facilities with complete and reliable data, all of which are City of Toronto facilities. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)), % of the area which is air conditioned and % of the area served by food services. The targets for facilities with indoor rinks are adjusted for size of the ice surface and time period that the ice is in. The targets for facilities with indoor pools are adjusted for the size of the pool. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each community centre. The total savings potential for each community centre is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 69 community centres are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There are 9 community centres with annual savings potential greater than $100,000. 41 community centres have annual savings potential between $5,000 and $100,000, and 19 community centres have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 69 buildings is $2,369,391 ($1,955,930 for electricity and $413,462 for gas) with an average total energy savings of 46%.

For the 9 high-potential savings facilities, the total annual savings potential is $1,181,804 ($1,025,079 for electricity and $156,725 for gas) with an average total energy savings of 61%.

For the 41 mid-potential savings facilities, the total annual savings potential is $1,151,047 ($914,751 for electricity and $236,296 for gas) with an average total energy savings of 45%.

For the 19 low-potential savings facilities, the total annual savings potential is $36,541($16,100 for electricity and $20,441 for gas) with an average total energy savings of 11%.

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 69 facilities	**44%**	**74%**	**40%**	**45%**	**$1,955,930**	**70%**	**40%**	**47%**	**$413,462**	**46%**	**$2,369,391**	**$1,117,674**	**$159,024**	**2,000,971**	**4,524,858**
High potential savings facilities (9)	64%	100%	13%	65%	$1,025,079	77%	49%	58%	$156,725	61%	$1,181,804	$ 585,759	$ 60,279	420,191	1,938,059
Mid-potential savings facilities (41)	37%	77%	47%	40%	$ 914,751	69%	42%	49%	$236,296	45%	$1,151,047	$ 522,715	$ 90,883	1,166,121	2,426,424
Low potential savings facilities (19)	02%	17%	06%	03%	$ 16,100	36%	12%	18%	$ 20,441	11%	$ 36,541	$ 9,200	$ 7,862	414,659	160,374

Table 39: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 4 below shows the total potential savings for all 69 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	14.4	8.1	44%	$ 1,723,201
Electric Cooling (kWh/ft²)	1.1	0.3	74%	$ 168,249
Electric Heating (kWh/ft²)	1.1	0.7	40%	$ 64,480
Total Electricity (kWh/ft²) for facilities w/o component intensities	9.1	9.1	0%	$ -
Gas Baseload (ekWh/ft²)	4.5	1.3	70%	$ 148,868
Gas Heating (ekWh/ft²)	13.1	7.8	40%	$ 260,114
Total Gas (ekWh/ft²) for facilities w/o component intensities	13.0	8.6	34%	$ 4,479
Total Energy (ekWh/ft²)	**33.0**	**17.8**	**46%**	**$ 2,369,391**

High savings | Moderate savings | Low savings

Table 40: Savings Potential Based on Energy Use Component for 69 Community Centres

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electric Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Previous Energy Efficiency Initiatives

In 2006, the City of Toronto undertook a study to identify improvement measures that would improve energy efficiency and reduce the operating cost and environmental impact of community centers located throughout the City of Toronto.

Table 5 below summarizes the estimated overall project costs, savings and estimated energy reduction for 51 community centers as a result of the 2006 project.

			Project Cost & Annual Savings (estimated)					Estimated Energy Reduction			
Project Name & Year	Num. of Bldgs	Total Floor Area (m2)	Retrofit Cost	Total $Savings	Total ekWh Savings	Total CO2 Savings (tonnes)	Payback	Electrcity Savings kWh	Electrcity Savings kW	Natural Gas Savings m3	Water Savings m3
Community Center 2006	51	128,494	$6,021,021	$750,000	13,334,358	2,664	8.0	1,536,340	223	1,140,820	0

Table 41: 2006 Community Centre Project Estimated Project Costs and Savings

2.2 Proposed Energy Efficiency Measures

Table 6 below shows the full range of possible energy efficiency measures for the entire portfolio of community centres. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 69 facilities indicate that the largest percentage reductions will come from measures associated with electric cooling and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off/unplug machines, office and kitchen equipment, chargers when not needed	4	4	8	Year 1	Annual Review	Building Occupants
B2	Enable ENERGY STAR power settings, turn off computers when not in use	4	4	8	Year 1	Annual Review	Building Occupants
B3	Turn off lights when areas not in use	4	4	8	Year 1	Annual Review	Building Occupants
B4	Make use of natural light instead of turning on lights where possible	4	4	8	Year 1	Annual Review	Building Occupants
P1	Upgrade control of under-pad heating	4	4	8	Year 1	Seasonal Review	
P3	Upgrade/adjust ice temperature control	4	4	8	Year 1	Seasonal Review	
P6	Repair low-emissivity ceiling	4	4	8	Year 1	Seasonal Review	
P10	Install compressor head pressure control	4	4	8	Year 1	Seasonal Review	
P2	Lower water use for ice resurfacing	4	4	8	Year 2	Seasonal Review	
P4	Implement ice temperature reset based on types of use	4	4	8	Year 2	Seasonal Review	
P5	Reduce ice thickness	4	4	8	Year 2	Seasonal Review	
P7	Reduce brine pump operation	4	4	8	Year 2	Seasonal Review	
M1	Optimize operating schedules for fans and pumps	3	4	7	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	4	7	Year 2	Seasonal Review	
P8	Reduce rink lighting operation	4	4	8	Year 2	Seasonal Review	
EL4	Install power factor correction	3	4	7	Year 2	15+	
P11	Insulate brine headers	3	4	7	Year 2	5 to 10	
P9	Install/make better use of multi-level rink lighting control	2	4	6	Year 3	Seasonal Review	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	4	5	Year 4	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut	1	4	5	Year 4	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	4	5	Year 4	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	4	5	Year 4	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	4	5	Year 4	10 to 15	
L6	Replace festive lighting with LED	1	4	5	Year 4	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	4	5	Year 4	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	4	5	Year 4	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	4	5	Year 4	4 to 6	
EL3	Install controls on vending machines	1	4	5	Year 4	10 to 15	
EN1	Install low-emissivity ceiling	1	4	5	Year 4	10 to 12	
M3	Replace/right-size pumps	1	4	5	Year 4	10 to 20	
M4	Install variable speed drive on brine pump	1	4	5	Year 4	10 to 15	
M5	Install multi-pass refrigerant pipe configuration	1	4	5	Year 4	20 to 30	
M6	Install de-ionized water system	1	4	5	Year 4	5 to 10	
M7	Replace ice resurfacer with high efficiency unit	1	4	5	Year 4	10 to 15	
M8	Replace ice plant with high efficiency unit	1	4	5	Year 4	15 to 20	
M9	Install variable frequency drives (VFDs) on suitable fans and pumps	1	4	5	Year 4	10 to 20	
M10	Convert electric hot water heaters to natural gas	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B5	Adjust blinds (to retain heat in winter)	4	4	8	Year 1	annual review	Building Occupants
B6	Avoid use of electric heaters	4	4	8	Year 1	annual review	Building Occupants
B7	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1	annual review	Building Occupants
M11	Control fan coil and entrance heaters to optimize run-times	3	4	7	Year 2	seasonal review	
M12	Evaluate conversion from electric heating to natural gas	2	4	6	Year 2	n/a	
M13	Convert electric to gas dehumidifiers	1	4	5	Year 2	15 to 20	
P12	Control car plug-in outlets	3	4	7	Year 2	seasonal review	
M14	Install snow sensors to control the snow-melting system	1	4	5	Year 4	seasonal review	
M15	Upgrade base building heating system to avoid use of electric heaters	1	4	5	Year 4	seasonal review	
M16	Upgrade electric heating controls to optimize space temperatures and operating periods	1	4	5	Year 4	seasonal review	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementatio	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B8	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1	annual review	Building Occupants
B9	Only cool rooms that are being used	4	4	8	Year 1	annual review	Building Occupants
B10	Install and use energy efficient ceiling fans	4	4	8	Year 1	annual review	Building Occupants
B11	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1	annual review	Building Occupants
B12	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1	annual review	Building Occupants
P13	Upgrade/adjust dehumidifier controls	3	4	7	Year 2	seasonal review	
M18	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M19	Test and tune the air conditioning units	3	4	7	Year 2	3	
M17	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M20	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B13	Optimize dishwasher operation (only run when full)	4	4	8	Year 1	annual review	Building Occupants
P16	Identify and repair hot water leaks	4	4	8	Year 1	annual review	
P15	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M21	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P19	Optimize pool water temperature control, reset based on use	4	4	8	Year 2	seasonal review	
P14	Optimize DHW temperature control	2	4	6	Year 2	annual review	
M22	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
P17	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P18	Install low flow showerheads and faucet aerators	1	4	5	Year 4	10 to 15	
M23	Install ice plant heat recovery	1	4	5	Year 4	10 to 15	
M24	Install solar hot water heating	1	4	5	Year 4	10 to 15	
M25	Install heat recovery dehumidification system	1	4	5	Year 4	10 to 15	
M26	Replace DHW boilers with more efficient models	1	4	5	Year 4	10 to 15	
	Other:_____						
	_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B14	Check and clear baseboard heaters of obstructions	4	4	8	Year 1	annual review	Building Occupants
B15	Adjust blinds (to retain heat in winter)	4	4	8	Year 1	annual review	Building Occupants
B16	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1	annual review	Building Occupants
P21	Isolate idle boilers	4	4	8	Year 1	seasonal review	
P22	Reduce circulating pump operation in mild weather	4	4	8	Year 1	seasonal review	
M27	Optimize operating periods of ventilation systems	2	4	6	Year 2	seasonal review	
M28	Test and adjust ventilation systems to optimize outside air volumes	3	4	7	Year 2	seasonal review	
M29	Test and tune boiler efficiency	3	4	7	Year 2	seasonal review	
M30	Check heating system for flow balancing and air venting	3	4	7	Year 2	seasonal review	
EN2	Check and seal exterior walls and openings	3	4	7	Year 2	10 to 15	
EN3	Seal window and door frames	3	4	7	Year 2	5	
EN4	Insulate and seal dividing walls between arena and heated areas	3	4	7	Year 2	5	
M29	Optimize fan-coil unit and entrance heater controls	3	4	7	Year 2	seasonal review	
P20	Control loading dock heating	4	4	8	Year 2	annual review	
M32	Test, repair, replace and right-size heating control valves and outside air dampers	2	4	6	Year 3	10 to 15	
M31	Replace spectator heating system with radiant heat	1	4	5	Year 4	10 to 15	
M33	Upgrade heating system control to optimize space temperatures and operating periods	1	4	5	Year 4	10 to 15	
EN5	Replace single-pane windows with double-pane windows	1	4	5	Year 4	20 to 25	
EN6	If replacing the roof, ensure R-value at least 22	1	4	5	Year 4	n/a	
M34	Install high efficiency burners	1	4	5	Year 4	15 to 20	
M35	Replace boilers with more efficient models	1	4	5	Year 4	15 to 20	
M36	Replace old rooftop units with energy efficient units	1	4	5	Year 4	15 to 20	
M37	Install heat recovery or solar heating units	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

Table 42: Energy Saving Measures for Community Centres

The specific measures and implementation timeline for each individual community centre will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
Birchmount Community Centre	101 Ridgetop Rd	Solar PV	10	kW
Commander Park Community Centre	140 Commander Blvd	Solar PV	248	kW
Cummer Community Centre	6000 Leslie St	Solar PV	100	kW
Forest Hill Library Community Centre	700 Eglinton Ave W	Solar PV	75	kW
Heron Park Community Centre	292 Manse Rd	Solar PV	187	kW
Scadding Court Community Centre	707 Dundas St W	Geothermal	42	kW

Table 43 : Future Proposed Renewable Energy Systems on Community Centres

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities, is $9.38/ft2 (see Appendix A). The budget allows for lighting audits, lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low potential buildings is set $0.75 to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium and low potential community centres are summarized in Table 7 below.

Annual Savings Potential	Number of facilities	Average Area (ft^2)	Estimated Implementation Cost $/$ft^2$	Estimated Implementation Cost $	Estimated Savings potential $	% of total savings	Payback
> $100,000	9	46,688	11.25	$ 4,727,152	$ 1,181,804	49.9%	4.00
$5,000 - $100,000	41	28,442	9.38	$ 10,932,388	$ 1,151,047	48.6%	9.50
< $5,000	19	21,824	0.75	$ 310,994	$ 36,541	1.5%	8.51
	69			**$ 15,970,534**	**$ 2,369,391**		**6.74**

Table 44: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the Specific Measures for Each Building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.

- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 8 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	9	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	41	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	19	$ 150	< $5,000	Division Champion and staff
		69			

Table 45: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There are 9 community centres with over $100,000 in annual energy saving potential. Approximately 50% of the total energy savings for all 69 community centres can be found at these 9 facilities.

These 9 community centres can save an average of 61% of their total energy use. The total annual energy savings are estimated to be over $1,181,800 and individual building annual savings range from approximately $104,100 to over $172,900. The annual GHG savings are estimated to be approximately 1,938,000 kg.

These 9 community centres can save an average of 65% of their total electricity use (64% Electric Baseload, 100% Electric Cooling and 13% Electric Heating). The total annual electricity savings are estimated to be approximately $1,025,079 and individual building annual savings range from almost $78,000 to over $145,000.

These 9 community centres can save an average of 58% of their total gas use (77% Gas Baseload and 49% Gas Heating). The total annual gas savings are estimated to be approximately $156,700 and individual building annual savings range from $0 to over $43,000.

These 9 community centres will undergo Building Performance Audits (see the Implementation Plan for further details). For a complete description of the Building Performance Audit, refer to Appendix A.

See Appendix B for the associated energy savings potential by energy use component.

The highest percentage reductions for these facilities can be found in Gas Baseload and Electric Cooling. After the implementation of the proposed measures, these facilities are eligible to receive over $646,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 41 community centres with between $5,000 and $100,000 in annual energy saving potential. Approximately 49% of the total energy savings for all 69 community centres can be found in these 41 facilities.

These 41 community centres can save an average of 45% of their total energy use. The total annual energy savings are estimated to be over $1,151,000 and individual building annual savings range from approximately $6,500 to almost $80,000. The annual GHG savings are approximately 2,426,400 kg.

These 41 community centres can save an average of 40% of their total electricity use (37% Electric Baseload, 77% Electric Cooling and 47% Electric Heating). The total annual electricity savings are estimated to be approximately $914,750 and individual building annual savings range from $0 to over $79,000.

These 41 community centres can save an average of 49% of their total gas use (69% Gas Baseload and 42% Gas Heating). The total annual gas savings are estimated to be approximately $236,300 and individual building annual savings range from $0 to over $25,000.

These 41 facilities will undergo an Energy Assessment with highest potential community centres focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 41 community centres and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 41 community centres can be found in Electric Cooling and Gas Baseload. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these community centres are eligible to receive over $613,500 in in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 19 community centres with less than $5,000 in savings potential. Approximately 1.5% of the total energy savings for all 69 community centres can be found in these 19 facilities.

These 19 community centres can save an average of 11% of their total energy use. The total annual energy savings are estimated to be approximately $36,540 and individual building annual savings range from $0 to over $4,980. The annual GHG savings are approximately 160,370 kg.

These 19 community centres can save an average of 3% of their total electricity use (2% Electric Baseload, 17% Electric Cooling and 6% Electric Heating). The total annual electricity savings are estimated to be approximately $16,100 and individual building annual savings range from $0 to almost $4,000.

These 19 community centres can save an average of 18% of their total gas use (36% Gas Baseload and 12% Gas Heating). The total annual gas savings are estimated to be approximately $20,440 and individual building annual savings range from $0 to over $4,900.

These 19 facilities will undergo a checklist approach with highest potential community centres focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 19 community centres and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 19 community centres can be found in Electric Cooling and Gas Baseload.

The energy savings checklist will be used by the Division Champion for the community centres in conjunction with the building operator and/or service contractor for each community centre. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 9 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 69 facilities. The total costs to implement the energy management and retrofit plan for community centres are estimated to be $16,071,634. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	67,500
Energy Assessment	$	30,750
Checklist	$	2,850
Implementation	$	15,970,534
Total	**$**	**16,071,634**

Table 46: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 10 and Figure 5 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from the Building Performance Audits will occur in Year 1, with all 9 Building Performance Audits completed by the end of Year 3. The implementation of these measures will begin in Year 2 and will be completed by the end of Year 4. Identification of measures from Energy

Assessments will begin in Year 1, with all 41 Energy Assessments completed by the end of Year 5. The implementation of these measures will begin in Year 2, and will be completed by the end of Year 6. Identification of measures from the Checklists will begin in Year 2, with all 20 Checklists completed by the end of Year 5. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $-583,239. The cumulative net cash flow becomes positive in Year 11.

The implementation plan includes the following assumptions:

- Approximately 76% of the project budget will be spent in the first 5 years, and the other 24% in the following 5 years.
- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 76% of facilities will be retrofitted in the first 5 years and 24% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.
- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).
- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
High Potential - Building Performance Audit	3	3	3	0	0	0	0	0	0	0	9
Mid Potential - Energy Assessment	9	9	9	9	5	0	0	0	0	0	41
Low Potential - Checklist	0	5	5	5	4	0	0	0	0	0	19
Assessment Costs	$ 29,250	$ 30,030	$ 30,046	$ 7,562	$ 4,412	$ -	$ -	$ -	$ -	$ -	$ 101,300
Implementation Costs	$ -	$ 4,136,120	$ 4,305,693	$ 4,391,807	$ 2,739,923	$ 1,575,153	$ -	$ -	$ -	$ -	$ 17,148,696
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 2,925	$ 416,615	$ 433,574	$ 439,937	$ 274,434	$ 157,515	$ -	$ -	$ -	$ -	$ 1,725,000
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 206,806	$ 422,091	$ 641,681	$ 778,677	$ 857,435	$ 857,435	$ 857,435	$ 857,435	$ 857,434.79	
Annual Costs	$ 32,175	$ 4,789,572	$ 5,191,403	$ 5,480,986	$ 3,797,447	$ 2,590,103	$ 857,435	$ 857,435	$ 857,435	$ 857,435	$ 25,311,425
Estimated Achieved Annual Savings		$ 269,234.47	$ 1,015,501.55	$ 1,999,469.15	$ 2,697,601.16	$ 3,098,523.53	$ 3,321,147.83	$ 3,500,670.27	$ 3,675,703.78	$ 3,859,488.97	$ 23,437,341
Estimated Incentives	$ -	$ 531,790	$ 378,847	$ 288,737	$ 57,541	$ 19,783	$ -	$ -	$ -	$ -	$ 1,276,698
Annual Savings and Incentives	$ -	$ 801,025	$ 1,394,348	$ 2,288,206	$ 2,755,142	$ 3,118,307	$ 3,321,148	$ 3,500,670	$ 3,675,704	$ 3,859,489	$ 24,714,039
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 1,287	-$ 160,829	-$ 312,711	-$ 440,422	-$ 482,114	-$ 460,986	-$ 362,438	-$ 256,708	-$ 143,978	-$ 2,621,474
Net Cash Flow incl borrowing costs	-$ 32,175	-$ 3,989,834	-$ 3,957,884	-$ 3,505,491	-$ 1,482,727	$ 46,090	$ 2,002,727	$ 2,280,798	$ 2,561,561	$ 2,858,077	-$ 3,218,860
Cumulative Net Cash Flow	-$ 32,175	-$ 4,020,722	-$ 7,817,777	-$ 11,010,558	-$ 12,052,862	-$ 11,524,658	-$ 9,060,945	-$ 6,417,709	-$ 3,599,440	-$ 597,386	

Table 47: Cash Flow for 10-Year Implementation Plan

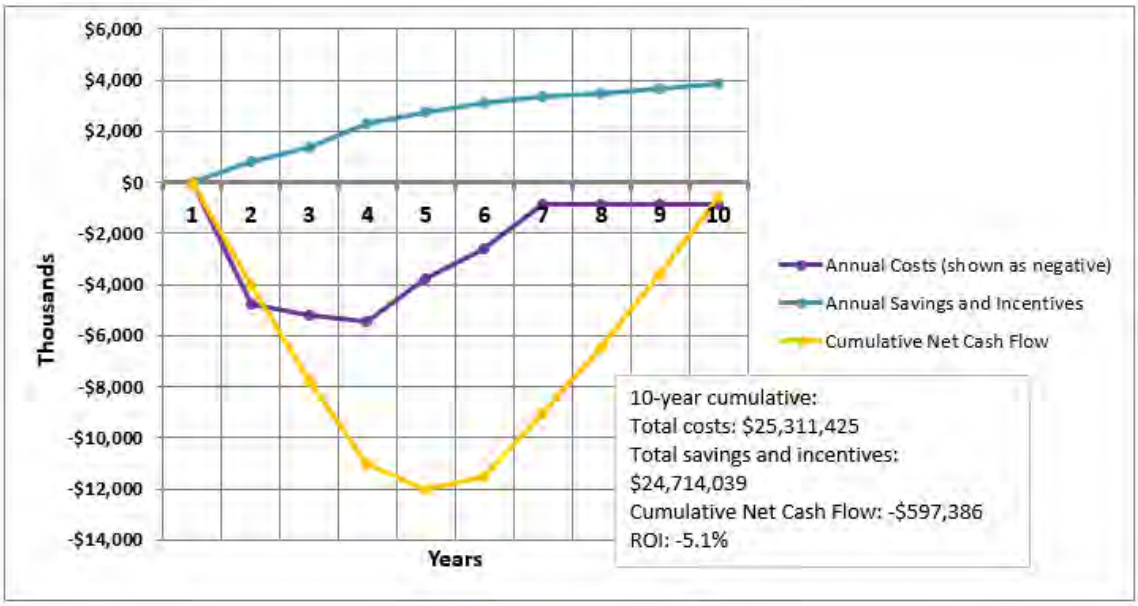

Figure 29: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above). Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for community centres is determined as the average kWh/day for March, April, October and November multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from May to September, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload (ekWh/ft^2)

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2)

Garage: Add 20 ekWh/ft^2 to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Community Centres:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant (ekWh/ft^2 of ice/week) * Months ice-in * 52 weeks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool (ekWh/ft^2 of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Heating for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Indoor swimming pools
- Indoor sports arenas
- Community centres
- Recreational facilities

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	2.25	100%	6.5	2.9	
Mechanical	1.88	30%	6	0.8	0.9
Electrical	0.25	100%	8	0.3	
Envelope	0.50	100%	10		0.0
Process	4.5	30%	5		2.5
Total	**9.38**		**5.9**	**3.93**	**3.40**

Table 48: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls. They also include lighting audits.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process measures (for facilities with rinks or pools) include cost effective retrofits to the pool circulation pump, dehumidification, heat recovery, retrofits to ice plant and related equipment and controls (if applicable). Costs for process measures (for facilities without rinks or pools) include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers
- Performance based target setting customized for your building
- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and

low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available, the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Community Centres

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 69 community centre buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
519 Church St Community Centre	519 Church St	15,554
Albion Community Centre & Pool (indoor)	1485 Albion Rd	20,688
Amesbury Community Center	1507 Lawrence Ave W	37,975
Armour Height C.C	2140 Avenue Rd	19,773
Banbury C.C.	120 Banbury Rd	9,537
Berner Trail C.C	120 Berner Trail	10,204
Birchmount C.C	93 Birchmount Rd	46,167
Birkdale C.C	1299 Ellesmere Rd	11,733
Burrows Hall Community Complex	1081 Progress Ave	252,952
Cecil Community Centre	58 Cecil St	5,769
Cedar Brook C.C	91 Eastpark Blvd	14,951
Cedar Ridge C.C	225 Confederation Dr	13,110
Chapley C.C / Wilmington Park	205 Wilmington Ave	6,997
Commander Park C.C	140 Commander Blvd	56,317
Community Centre 55	97 Main St	8,999
Curran Hall C.C	277 Orton Park Rd	2,508
Davenport C.C	1347 Davenport Rd	2,282
David Appleton Community Centre	33A Pritchard Ave	2,906
Driftwood C.C	4401 Jane St	25,015
Earl Bales C.C & Senior	4169 Bathurst St	31,953
East Scar Boys/Girls Club	100 Galloway Rd	13,972
East York Community Centre	1081A Pape Ave	31,000
Eastview Neighbourhood Community Centre	86 Blake St	25,510
Edithvale C.C	7 Edithvale Dr	24,725
Ellesmere C.C	20 Canadian Rd	24,402
Elmbank Community Centre	10 Rampart Rd	14,725
Fairbanks Community Centre	2213 Dufferin St	19,364
Falstaff C.C	50 Falstaff Ave	13,853
Flemingdon C.C	150 Grenoble Dr	10,000
Forest Hill C.C	666 Eglinton Ave W	32,841
Franklin Horner	432 Horner Ave	39,500
Glenlong C.C & A.I.R	35 Glen Long Ave	10,236
Harbourfront Community Centre	627 Queens Quay West	123,214

Harwood Hall Community Centre	85 Cayuga Ave	4,306
Heron Park C.C	4285 Lawrence Ave E	52,377
Humber Sheppard Community Centre	3100 Weston Rd	57,867
Jenner Jean-Marie C.C.	48 Thorncliffe Park Dr	13,207
L'Amoreaux Tennis Club	200 Silver Springs Blvd	31,474
Lamp Senior Centre	185 Fifth St	26,318
Lawrence Heights C.C.	9 Replin Rd	22,152
Ledbury Community Center	160 Ledbury St	5,780
Leslie Grove Park	1158 Queen St E	1,389
Main Square Community Centre	245 Main St	35,123
Masaryk-Cowan C.R.C	220-224 Cowan Av	32,270
McGregor Park C.C	2231 Lawrence Ave E	45,262
Metro Track And Field	4700 Keele St.	96,338
Mid-Scarborough C.C	2467 Eglinton Ave E	89,125
Mount Dennis Community Centre	4 Hollis St	3,003
Northwood C.C	15 Clubhouse Crt	36,167
North York Memorial Hall	5120 Yonge	10,473
Oakdale Community Center	350 Grandravine Dr	10,000
Oakridge C.C	63 Pharmacy Ave	18,600
O'Connor C.C	1386 Victoria Park Ave	16,253
Ourland Community Centre	18 Ourland Ave	9,451
Port Union C.C	5450 Lawrence Ave E	19,978
Ralph Thornton Community Centre	765 Queen St E	17,061
Scadding Court Community Centre	707 Dundas St W	46,694
Scarborough Village C.C	3600 Kingston Rd	58,125
Sir Adam Beck	525 Horner Ave	7,341
St James Town C.C.	495 Sherbourne St	23,002
St Lawrence C.C	224 The Esplanade	46,113
Stanley C.C	25 Stanley Rd	12,895
Sunnybrook Park	1070 Leslie St	43,702
Sunshine Center for Seniors	0 Wards Isl Bdg60	2,250
Tall Pines C.C	64 Rylander Blvd	5,188
Tam Heather C.C	730 Military Trail	28,546
Thistletown C.C	925 Albion Rd	44,810
West Rouge C.C	270 Rouge Hills Dr	24,402
West Scarborough N.C	313 Pharmacy Ave	25,199

Table 49: Community Centre Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 69 community centre buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Burrows Hall Community Complex	3.56	0.67	4.23
Sir Adam Beck	6.35	7.42	13.77
Metro Track And Field	6.53	9.00	15.53
Cedar Brook C.C	10.88	5.32	16.20
Sunshine Center for Seniors	16.35	0.00	16.35
Community Centre 55	7.91	8.57	16.47
Amesbury Community Center	7.27	11.07	18.33
Harbourfront Community Centre	10.25	8.50	18.76
Tall Pines C.C	11.15	8.55	19.70
Northwood C.C	8.70	12.73	21.44
Banbury C.C.	10.60	11.66	22.25
Armour Height C.C	11.11	11.52	22.63
Ellesmere C.C	10.54	12.18	22.71
Davenport C.C	0.59	23.32	23.91
Cedar Ridge C.C	13.60	10.33	23.93
Humber Sheppard Community Ctr	4.56	19.59	24.15
West Rouge C.C	9.17	15.47	24.65
Mount Dennis Community Ctr	14.53	10.20	24.73
Commander Park C.C	16.24	9.73	25.98
Harwood Hall Community Ctr	5.08	21.27	26.36
Eastview Neighbourhood Comm Ctr	15.37	11.44	26.80
Birkdale C.C	21.70	5.21	26.90
Franklin Horner	5.94	22.31	28.25
Oakridge C.C	15.49	12.87	28.36
Scarborough Village C.C	17.78	10.82	28.59
North York Memorial Hall	18.94	10.70	29.64
Leslie Grove Park	3.49	26.48	29.97
Jenner Jean-Marie C.C.	10.00	20.15	30.15
Lawrence Heights C.C.	10.64	20.07	30.70
Earl Bales C.C & Senior	20.09	10.66	30.75
Curran Hall C.C	15.76	15.45	31.21
Falstaff C.C	11.43	19.82	31.25

Masaryk-Cowan C.R.C	20.07	11.44	31.51
Thistletown C.C	7.86	23.87	31.73
Sunnybrook Park	16.52	15.37	31.89
Driftwood C.C	14.92	17.80	32.72
Mid-Scarborough C.C	18.35	14.47	32.81
Fairbanks Community Centre	16.34	16.61	32.96
Lamp Senior Centre	17.95	15.47	33.43
Flemingdon C.C	11.13	22.49	33.62
Ralph Thornton Community Ctr	11.52	22.33	33.85
Forest Hill C.C	20.16	13.77	33.92
O'Connor C.C	17.51	18.79	36.30
Port Union C.C	23.31	13.13	36.44
Heron Park C.C	22.16	15.32	37.48
Stanley C.C	16.00	23.35	39.35
Oakdale Community Center	22.48	18.92	41.40
Ourland Community Ctr	20.47	21.07	41.53
Elmbank Community Centre	17.70	23.98	41.68
Scadding Court Community Ctr	16.53	26.29	42.81
Berner Trail C.C	19.86	23.28	43.14
Main Square Comm Ctr	17.47	26.00	43.48
McGregor Park C.C	26.54	17.14	43.68
Edithvale C.C	25.58	18.66	44.24
David Appleton Community Centre	25.23	20.03	45.27
East Scar Boys/Girls Club	22.00	34.64	56.63
Cecil Community Ctr	14.95	41.90	56.85
East York Community Centre	15.79	42.89	58.68
West Scarborough N.C	12.90	46.07	58.97
Ledbury Community Center	35.93	23.98	59.91
519 Church St Comm Ctr	34.22	30.56	64.78
Tam Heather C.C	30.59	36.57	67.16
St Lawrence C.C	19.98	48.47	68.45
Birchmount C.C	30.55	38.61	69.16
Chapley C.C / Wilmington Park	48.09	23.99	72.08
L'Amoreaux Tennis Club	33.69	39.87	73.55
Glenlong C.C & A.I.R	39.24	34.89	74.13
St James Town C.C.	47.87	41.45	89.32
Albion Comm Ctr & Pool (indoor)	24.74	69.77	94.51

Table 50: Community Centre 2012 Energy Intensity

5.3 Target-setting Method and Metrics

5 community centres were determined to be ineligible for determination of energy components or target-setting. See Appendix A. The excluded facilities are listed below.

Facility	Days in 2012	Energy type
Cedar Brook C.C	457	Electricity
Davenport C.C	396	Electricity
Flemingdon C.C	389	Electricity
Harwood Hall Community Ctr	394	Electricity
Community Centre 55	311	Electricity

Table 51: Excluded Facilities

After excluding these 5 facilities, 79 community centres and indoor recreational facilities were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component. The red line on each chart indicates the top quartile for each component which is the target for that component.

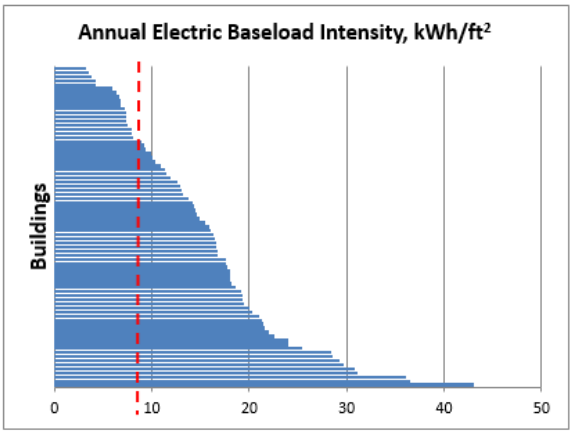

Figure 30: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent. Electric Baseload for community centres ranges from 3.3 to 43.0 ekWh/ft^2 and the top-quartile is 9.21 ekWh/ft^2.

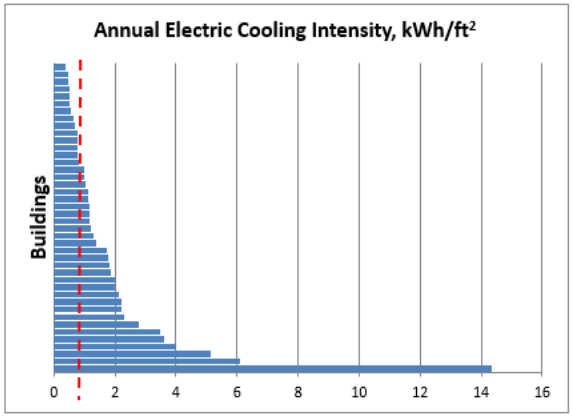

Figure 31: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for community centres ranges from 0.5 to 14.3 ekWh/ft^2 and the top-quartile is 0.77 ekWh/ft^2.

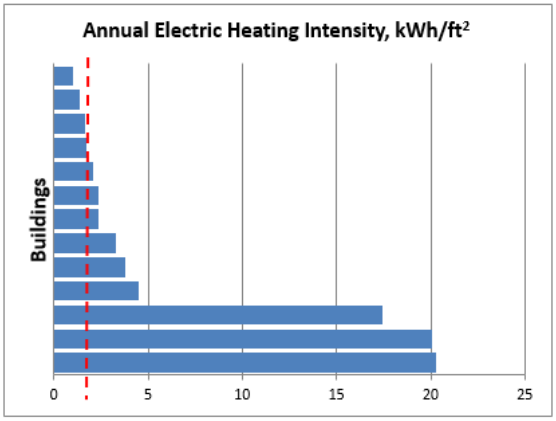

Figure 32: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for community centres ranges from 1.0 to 20.3 ekWh/ft^2 and the top-quartile is 1.76 ekWh/ft^2.

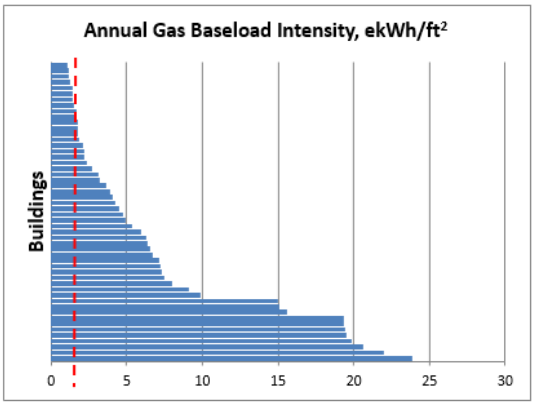

Figure 33: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for community centres ranges from 1.1 to 23.9 ekWh/ft^2 and the top-quartile is 1.83 ekWh/ft^2.

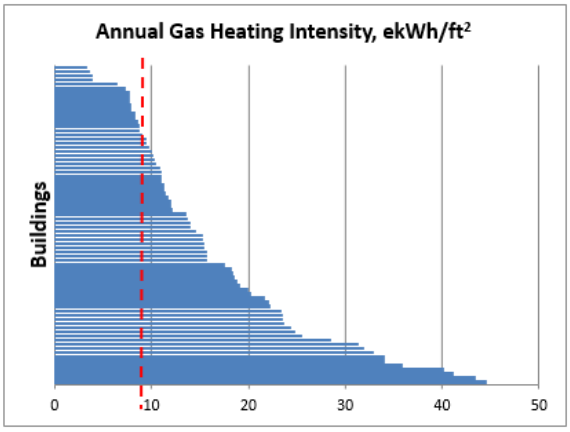

Figure 34: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for community centres ranges from 3.4 to 44.6 ekWh/ft^2 and the top-quartile is 9.71 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of community centres, the factors are % of the facility area served by electric heat, % of DHW heated by electricity, use of ground-source or water-source heat pumps, % of the area served by electric air conditioning, % of area served by food services, presence and size of ice surface (including months of ice-in) and presence and size of indoor swimming pool.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from Total Electricity use (or Total Gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 9 High Savings Potential Community Centres

Buildings are sorted by total annual savings potential, starting with the highest savings potential buildings.

There are 9 community centres with over $100,000 in annual savings potential.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
High potential savings facilities (9)	64%	100%	13%	65%	$1,025,079	77%	49%	58%	$156,725	61%	$1,181,804	$ 585,759	$ 60,279	420,191	1,938,059
Birchmount C.C	69%	100%		72%	$ 141,687	88%	59%	70%	$ 31,299	71%	$ 172,986	$ 80,964	$ 12,038	46,167	337,518
McGregor Park C.C	71%			86%	$ 145,193	86%		67%	$ 13,057	79%	$ 158,250	$ 82,968	$ 5,022	45,262	208,439
St James Town C.C.	79%	100%		81%	$ 125,429	80%	70%	71%	$ 17,066	77%	$ 142,495	$ 71,674	$ 6,564	23,002	221,887
Tam Heather C.C	74%			88%	$ 107,347	16%	72%	68%	$ 17,752	77%	$ 125,099	$ 61,341	$ 6,828	28,546	212,638
L'Amoreaux Tennis Club	60%	100%	21%	67%	$ 99,399		75%	72%	$ 22,785	70%	$ 122,185	$ 56,799	$ 8,764	31,474	242,768
St Lawrence C.C	57%			60%	$ 77,998	92%	61%	77%	$ 43,018	72%	$ 121,016	$ 44,570	$ 16,545	46,113	372,173
Heron Park C.C	63%			70%	$ 113,084	64%	7%	25%	$ 5,133	52%	$ 118,217	$ 64,619	$ 1,974	52,377	125,950
Mid-Scarborough C.C	48%	100%		48%	$ 110,831	23%	20%	20%	$ 6,615	36%	$ 117,445	$ 63,332	$ 2,544	89,125	134,885
Scarborough Village C.C	58%			72%	$ 104,111			0%	$ -	45%	$ 104,111	$ 59,492	$ -	58,125	81,801

Table 52: Savings Potential for 9 High Savings Potential Community Centres

Savings Potential by Energy Use Component for the 41 Mid Savings Potential Community Centres

Buildings are sorted by total annual savings potential, starting with the highest savings potential buildings.

There are 41 community centres with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (41)	37%	77%	47%	40%	$ 914,751	69%	42%	49%	$236,296	45%	$1,151,047	$ 522,715	$ 90,883	1,166,121	2,426,424
Commander Park C.C	52%			62%	$ 79,165			0%	$ -	39%	$ 79,165	$ 45,237	$ -	56,317	62,201
Edithvale C.C	62%	100%		66%	$ 58,032		45%	43%	$ 4,929	56%	$ 62,962	$ 33,161	$ 1,896	24,725	81,220
519 Church St Comm Ctr	70%	100%		73%	$ 54,519	74%	59%	63%	$ 7,509	68%	$ 62,028	$ 31,154	$ 2,888	15,554	97,104
Scadding Court Community Ctr	35%			35%	$ 37,489	75%	51%	58%	$ 17,730	49%	$ 55,220	$ 21,423	$ 6,819	46,694	157,592
Main Square Comm Ctr	43%	100%		46%	$ 39,344	79%	44%	56%	$ 12,765	52%	$ 52,109	$ 22,482	$ 4,910	35,123	123,165
East York Community Centre	35%	100%		39%	$ 26,472	90%	61%	73%	$ 24,436	64%	$ 50,908	$ 15,127	$ 9,398	31,000	197,393
Sunnybrook Park	43%			43%	$ 43,304		33%	32%	$ 5,347	37%	$ 48,651	$ 24,745	$ 2,057	43,702	72,669
Masaryk-Cowan C.R.C	52%	100%		51%	$ 46,436		11%	11%	$ 1,012	37%	$ 47,448	$ 26,535	$ 389	32,270	43,797
Glenlong C.C & A.I.R	55%		88%	68%	$ 38,482	91%	40%	68%	$ 6,113	68%	$ 44,594	$ 21,989	$ 2,351	10,236	74,411
Earl Bales C.C & Senior	45%		36%	49%	$ 44,075		6%	5%	$ 458	34%	$ 44,533	$ 25,186	$ 176	31,953	37,937
Forest Hill C.C	47%			42%	$ 38,930		43%	43%	$ 4,899	42%	$ 43,829	$ 22,246	$ 1,884	32,841	65,990
Chapley C.C / Wilmington Park	70%		80%	79%	$ 37,249	91%		78%	$ 3,304	79%	$ 40,553	$ 21,285	$ 1,271	6,997	53,146
Port Union C.C	52%	100%		61%	$ 39,529	1%	14%	12%	$ 794	43%	$ 40,323	$ 22,588	$ 305	19,978	36,795
Albion Comm Ctr & Pool (indoor)	13%	69%		18%	$ 12,659	64%	71%	69%	$ 25,195	56%	$ 37,854	$ 7,234	$ 9,690	20,688	192,025
East Scar Boys/Girls Club	57%	100%		60%	$ 25,831	71%	66%	67%	$ 8,200	65%	$ 34,032	$ 14,761	$ 3,154	13,972	79,559
West Scarborough N.C	19%	100%		25%	$ 11,363	92%	60%	76%	$ 22,029	64%	$ 33,392	$ 6,493	$ 8,473	25,199	168,132
Lamp Senior Centre	45%	100%		44%	$ 29,145		28%	25%	$ 2,554	35%	$ 31,699	$ 16,654	$ 982	26,318	41,357
Ledbury Community Center	41%		91%	70%	$ 20,304	91%		79%	$ 2,755	74%	$ 23,058	$ 11,602	$ 1,059	5,780	35,861
Elmbank Community Centre	49%			50%	$ 18,227	53%	52%	52%	$ 4,644	51%	$ 22,871	$ 10,415	$ 1,786	14,725	47,886
Birkdale C.C	59%			62%	$ 22,042			0%	$ -	50%	$ 22,042	$ 12,596	$ -	11,733	17,319
Oakridge C.C	33%	100%		44%	$ 17,576	55%		17%	$ 1,026	32%	$ 18,603	$ 10,044	$ 395	18,600	21,227
O'Connor C.C	42%			38%	$ 15,245	75%	17%	40%	$ 3,033	39%	$ 18,278	$ 8,712	$ 1,166	16,253	33,896
Eastview Neighbourhood Comm Ctr	32%			32%	$ 17,293	32%		8%	$ 562	21%	$ 17,854	$ 9,882	$ 216	25,510	17,646
Oakdale Community Center	44%		53%	46%	$ 14,495	88%		69%	$ 3,303	57%	$ 17,798	$ 8,283	$ 1,270	10,000	35,259
Berner Trail C.C	45%	100%		50%	$ 14,113	76%	38%	50%	$ 2,993	50%	$ 17,106	$ 8,065	$ 1,151	10,204	32,720
Stanley C.C	35%	100%		38%	$ 10,987	91%		75%	$ 5,681	60%	$ 16,668	$ 6,278	$ 2,185	12,895	49,691
Driftwood C.C	26%			23%	$ 12,046	73%	21%	40%	$ 4,488	32%	$ 16,533	$ 6,883	$ 1,726	25,015	41,897
Fairbanks Community Centre	31%			27%	$ 12,085		44%	44%	$ 3,539	36%	$ 15,624	$ 6,906	$ 1,361	19,364	35,068
Thistletown C.C				0%	$ -	62%	52%	54%	$ 14,447	40%	$ 14,447	$ -	$ 5,557	44,810	104,407
Humber Sheppard Community Ctr		100%		5%	$ 1,712		47%	44%	$ 12,484	36%	$ 14,196	$ 978	$ 4,802	57,867	91,567
Ourland Community Ctr	45%	28%		41%	$ 11,145		53%	50%	$ 2,509	46%	$ 13,655	$ 6,369	$ 965	9,451	26,892
North York Memorial Hall	44%	100%		48%	$ 13,340			0%	$ -	31%	$ 13,340	$ 7,623	$ -	10,473	10,482
Burrows Hall Community Complex		100%		11%	$ 13,253			0%	$ -	9%	$ 13,253	$ 7,573	$ -	252,952	10,413
Franklin Horner				0%	$ -		56%	56%	$ 12,406	44%	$ 12,406	$ -	$ 4,771	39,500	89,655
Ralph Thornton Community Ctr	9%	100%		15%	$ 4,014		55%	54%	$ 5,123	40%	$ 9,137	$ 2,294	$ 1,970	17,061	40,177
Cecil Community Ctr	36%	100%		34%	$ 4,158		76%	73%	$ 4,421	63%	$ 8,579	$ 2,376	$ 1,700	5,769	35,216
Ellesmere C.C		100%		20%	$ 7,326		12%	11%	$ 847	16%	$ 8,172	$ 4,186	$ 326	24,402	11,875
Cedar Ridge C.C	29%	100%		30%	$ 7,571			0%	$ -	17%	$ 7,571	$ 4,326	$ -	13,110	5,948
West Rouge C.C		100%		11%	$ 3,577		37%	37%	$ 3,510	27%	$ 7,087	$ 2,044	$ 1,350	24,402	28,174
David Appleton Community Centre	62%	100%		62%	$ 6,344	57%	38%	42%	$ 616	53%	$ 6,960	$ 3,625	$ 237	2,906	9,438
Armour Height C.C	19%			19%	$ 5,873	41%		11%	$ 637	15%	$ 6,510	$ 3,356	$ 245	19,773	9,218

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr				
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total				Electricity	Gas	ft²	kg/yr
Mid-potential savings facilities (41)	38%	79%	47%	40%	$ 917,311	67%	40%	46%	$216,902	43%	$1,134,213	$ 524,178	$ 83,424	1,147,726	2,288,279
Commander Park C.C	52%			62%	$ 79,165			0%	$ -	39%	$ 79,165	$ 45,237	$ -	56,317	62,201
Edithvale C.C	62%	100%		66%	$ 58,032		45%	43%	$ 4,929	56%	$ 62,962	$ 33,161	$ 1,896	24,725	81,220
519 Church St Comm Ctr	70%	100%		73%	$ 54,519	74%	59%	63%	$ 7,509	68%	$ 62,028	$ 31,154	$ 2,888	15,554	97,104
Scadding Court Community Ctr	35%			35%	$ 37,489	75%	51%	58%	$ 17,730	49%	$ 55,220	$ 21,423	$ 6,819	46,694	157,592
Main Square Comm Ctr	43%	100%		46%	$ 39,344	79%	44%	56%	$ 12,765	52%	$ 52,109	$ 22,482	$ 4,910	35,123	123,165
East York Community Centre	35%	100%		39%	$ 26,472	90%	61%	73%	$ 24,436	64%	$ 50,908	$ 15,127	$ 9,398	31,000	197,393
Sunnybrook Park	43%			43%	$ 43,304		33%	32%	$ 5,347	37%	$ 48,651	$ 24,745	$ 2,057	43,702	72,669
Masaryk-Cowan C.R.C	52%	100%		51%	$ 46,436		11%	11%	$ 1,012	37%	$ 47,448	$ 26,535	$ 389	32,270	43,797
Glenlong C.C & A.I.R	55%		88%	68%	$ 38,435	91%	40%	68%	$ 6,113	68%	$ 44,548	$ 21,963	$ 2,351	10,236	74,375
Earl Bales C.C & Senior	45%		35%	49%	$ 43,930		6%	5%	$ 458	34%	$ 44,387	$ 25,103	$ 176	31,953	37,823
Forest Hill C.C	47%			42%	$ 38,930		43%	43%	$ 4,899	42%	$ 43,829	$ 22,246	$ 1,884	32,841	65,990
Chapley C.C / Wilmington Park	70%		80%	79%	$ 37,217	91%		78%	$ 3,304	79%	$ 40,522	$ 21,267	$ 1,271	6,997	53,121
Port Union C.C	52%	100%		61%	$ 39,529	1%	14%	12%	$ 794	43%	$ 40,323	$ 22,588	$ 305	19,978	36,795
Albion Comm Ctr & Pool (indoor)	13%	69%		18%	$ 12,669	34%	41%	40%	$ 14,520	34%	$ 27,189	$ 7,239	$ 5,585	20,688	114,890
East Scar Boys/Girls Club	57%	100%		60%	$ 25,831	71%	66%	67%	$ 8,200	65%	$ 34,032	$ 14,761	$ 3,154	13,972	79,559
West Scarborough N.C	19%	100%		25%	$ 11,363	92%	60%	76%	$ 22,029	64%	$ 33,392	$ 6,493	$ 8,473	25,199	168,132
Lamp Senior Centre	45%	100%		44%	$ 29,145		28%	25%	$ 2,554	35%	$ 31,699	$ 16,654	$ 982	26,318	41,357
Ledbury Community Center	41%		91%	70%	$ 20,277	91%		79%	$ 2,755	73%	$ 23,032	$ 11,587	$ 1,059	5,780	35,840
Elmbank Community Centre	49%			50%	$ 18,227	53%	52%	52%	$ 4,644	51%	$ 22,871	$ 10,415	$ 1,786	14,725	47,886
Birkdale C.C	59%			62%	$ 22,042			0%	$ -	50%	$ 22,042	$ 12,596	$ -	11,733	17,319
Oakridge C.C	33%	100%		44%	$ 17,576	55%		17%	$ 1,026	32%	$ 18,603	$ 10,044	$ 395	18,600	21,227
O'Connor C.C	42%			38%	$ 15,245	75%	17%	40%	$ 3,033	39%	$ 18,278	$ 8,712	$ 1,166	16,253	33,896
Eastview Neighbourhood Comm Ctr	32%			32%	$ 17,293	32%		8%	$ 562	21%	$ 17,854	$ 9,882	$ 216	25,510	17,646
Oakdale Community Center	44%		52%	46%	$ 14,450	88%		69%	$ 3,303	57%	$ 17,752	$ 8,257	$ 1,270	10,000	35,223
Berner Trail C.C	45%	100%		50%	$ 14,113	76%	38%	50%	$ 2,993	50%	$ 17,106	$ 8,065	$ 1,151	10,204	32,720
Stanley C.C	35%	100%		38%	$ 10,987	91%		75%	$ 5,681	60%	$ 16,668	$ 6,278	$ 2,185	12,895	49,691
Driftwood C.C	26%			23%	$ 12,046	73%	21%	40%	$ 4,488	32%	$ 16,533	$ 6,883	$ 1,726	25,015	41,897
Fairbanks Community Centre	31%			27%	$ 12,085		44%	44%	$ 3,539	36%	$ 15,624	$ 6,906	$ 1,361	19,364	35,068
Humber Sheppard Community Ctr		100%		5%	$ 1,712		47%	44%	$ 12,484	36%	$ 14,196	$ 978	$ 4,802	57,867	91,567
Ourland Community Ctr	45%	29%		41%	$ 11,163		53%	50%	$ 2,509	46%	$ 13,673	$ 6,379	$ 965	9,451	26,906
North York Memorial Hall	44%	100%		48%	$ 13,340			0%	$ -	31%	$ 13,340	$ 7,623	$ -	10,473	10,482
Burrows Hall Community Complex		100%		11%	$ 13,253			0%	$ -	9%	$ 13,253	$ 7,573	$ -	252,952	10,413
Franklin Horner				0%	$ -		56%	56%	$ 12,406	44%	$ 12,406	$ -	$ 4,771	39,500	89,655
Ralph Thornton Community Ctr	9%	100%		15%	$ 4,014		55%	54%	$ 5,123	40%	$ 9,137	$ 2,294	$ 1,970	17,061	40,177
Cecil Community Ctr	36%	100%		34%	$ 4,158		76%	73%	$ 4,421	63%	$ 8,579	$ 2,376	$ 1,700	5,769	35,216
Jenner Jean-Marie C.C.	8%			8%	$ 2,827	18%	46%	43%	$ 5,728	31%	$ 8,555	$ 1,616	$ 2,203	26,415	43,616
Ellesmere C.C		100%		20%	$ 7,326		12%	11%	$ 847	16%	$ 8,172	$ 4,186	$ 326	24,402	11,875
Cedar Ridge C.C	29%	100%		30%	$ 7,571			0%	$ -	17%	$ 7,571	$ 4,326	$ -	13,110	5,948
West Rouge C.C		100%		11%	$ 3,577		37%	37%	$ 3,510	27%	$ 7,087	$ 2,044	$ 1,350	24,402	28,174
David Appleton Community Centre	62%	100%		62%	$ 6,344	57%	38%	42%	$ 616	53%	$ 6,960	$ 3,625	$ 237	2,906	9,438
Armour Height C.C	19%			19%	$ 5,873	41%		11%	$ 637	15%	$ 6,510	$ 3,356	$ 245	19,773	9,218

Table 53: Savings Potential for 41 Medium Savings Potential Community Centres

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 19 Low Savings Potential Community Centres

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 19 community centres with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (19)	02%	17%	06%	03%	$ 16,100	36%	12%	18%	$ 20,441	11%	$ 36,541	$ 9,200	$ 7,862	414,659	160,374
Lawrence Heights C.C.				0%	$ -	69%	34%	45%	$ 4,981	29%	$ 4,981	$ -	$ 1,916	22,152	36,001
Amesbury Community Center		100%		10%	$ 3,996		6%	6%	$ 587	7%	$ 4,583	$ 2,283	$ 226	37,975	7,384
Jenner Jean-Marie C.C.	8%			8%	$ 1,414	18%	46%	43%	$ 2,864	31%	$ 4,278	$ 808	$ 1,101	13,207	21,808
Falstaff C.C		8%		2%	$ 438		53%	49%	$ 3,383	32%	$ 3,822	$ 251	$ 1,301	13,853	24,796
Northwood C.C				0%	$ -	63%		24%	$ 2,779	14%	$ 2,779	$ -	$ 1,069	36,167	20,082
Flemingdon C.C				0%	$ -			49%	$ 2,751	33%	$ 2,751	$ -	$ 1,058	10,000	19,879
Curran Hall C.C	41%			40%	$ 2,208		37%	37%	$ 362	39%	$ 2,570	$ 1,262	$ 139	2,508	4,352
Sunshine Center for Seniors	37%		54%	45%	$ 2,324				$ -	45%	$ 2,324	$ 1,328	$ -	2,250	1,826
Mount Dennis Community Ctr	29%		15%	28%	$ 1,702		4%	4%	$ 30	18%	$ 1,732	$ 973	$ 12	3,003	1,554
Metro Track And Field		100%		2%	$ 1,665			0%	$ -	1%	$ 1,665	$ 951	$ -	96,338	1,308
Banbury C.C.	7%			7%	$ 993		15%	15%	$ 421	11%	$ 1,413	$ 567	$ 162	9,537	3,820
Tall Pines C.C	11%	100%		15%	$ 1,206			0%	$ -	8%	$ 1,206	$ 689	$ -	5,188	947
Harwood Hall Community Ctr				0%	$ -			46%	$ 1,053	37%	$ 1,053	$ -	$ 405	4,306	7,611
Davenport C.C				0%	$ -			51%	$ 675	49%	$ 675	$ -	$ 260	2,282	4,881
Leslie Grove Park				0%	$ -		62%	60%	$ 554	53%	$ 554	$ -	$ 213	1,389	4,003
Sir Adam Beck		100%		2%	$ 155			0%	$ -	1%	$ 155	$ 88	$ -	7,341	122
Cedar Brook C.C				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	14,951	0
Community Centre 55				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	8,999	0
Harbourfront Community Centre				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	123,214	0

Table 54: Savings Potential for 20 Low Savings Potential Community Centres

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use - Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Cultural Facilities

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1 Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 20 cultural facilities in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas of these facilities are provided in Appendix B.

The total area for all of the buildings is 596,553 ft^2. The cultural facilities range in size from less than 1,000 ft^2 to over 185,000 ft^2.

None of the facilities are equipped with a renewable energy system.

The facilities range from 0% to 100% air-conditioned. Two facilities (Historic Fort York and Gibson House Museum) are fully served by electric heat. Four other cultural facilities are using approximately 25% electric heat. No cultural facilities are served by ground or water source heat pumps.

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 20 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	9,015,694	$1,262,197
Natural Gas (m^3)	747,997	$194,479
Total		**$1,456,676**

Table 55: 2012 Energy Use and Costs for 20 City of Toronto Cultural Facilities

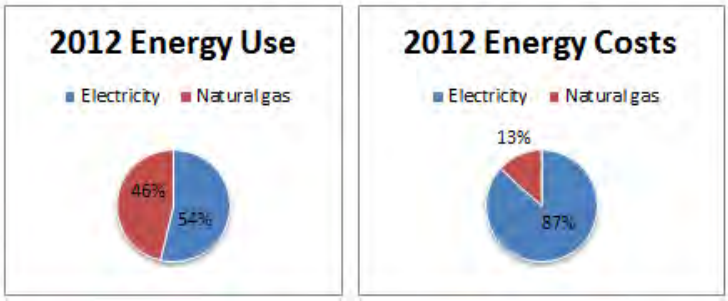

Figure 35: 2012 Energy Use and Cost Breakdown for 20 City of Toronto Cultural Facilities

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 20 buildings. Total energy use ranges from approximately 1.5 to over 96 ekWh/ft^2. There are also wide ranges for electricity and gas use per ft^2. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

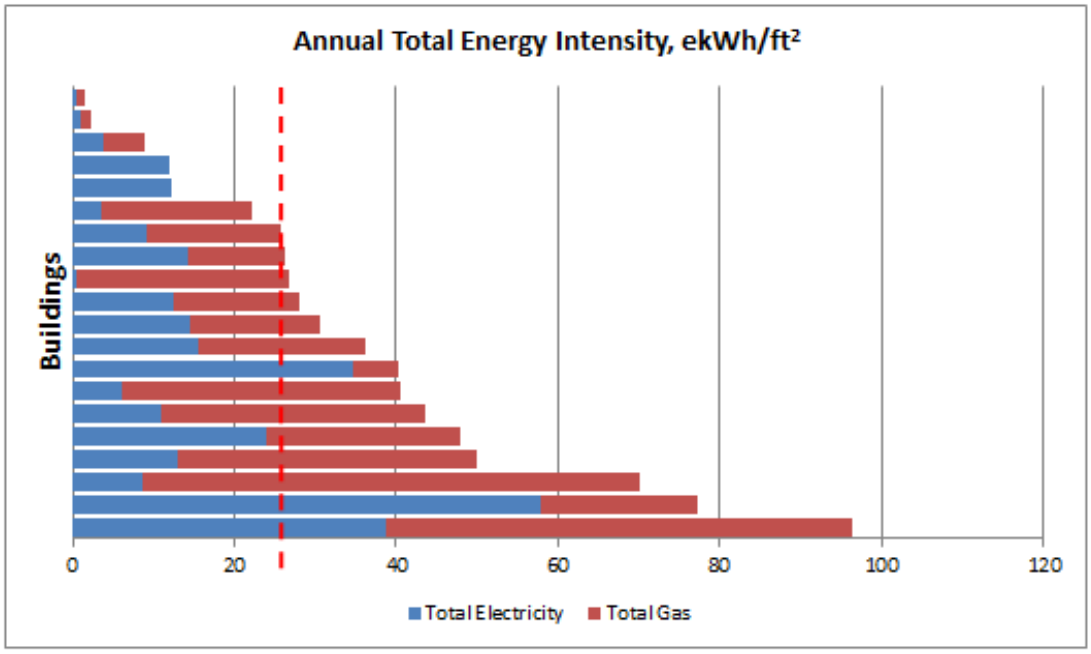

Figure 36: 2012 Total Energy Intensity Benchmark

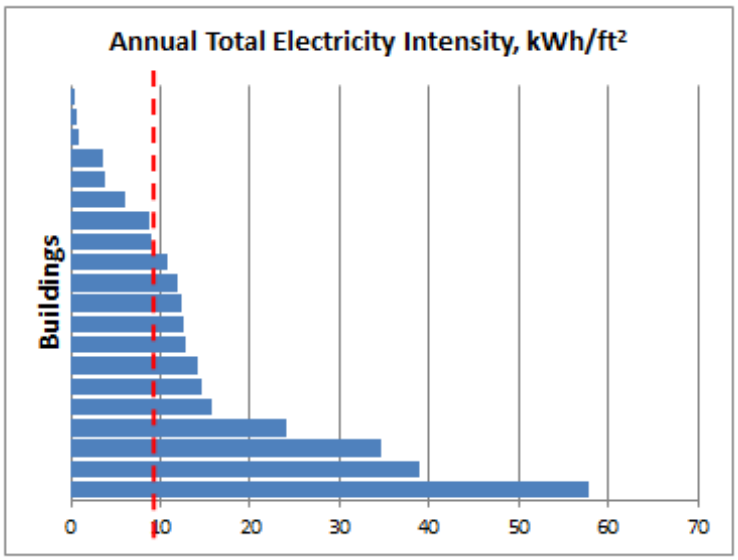

Figure 37: 2012 Total Electricity Intensity Benchmark

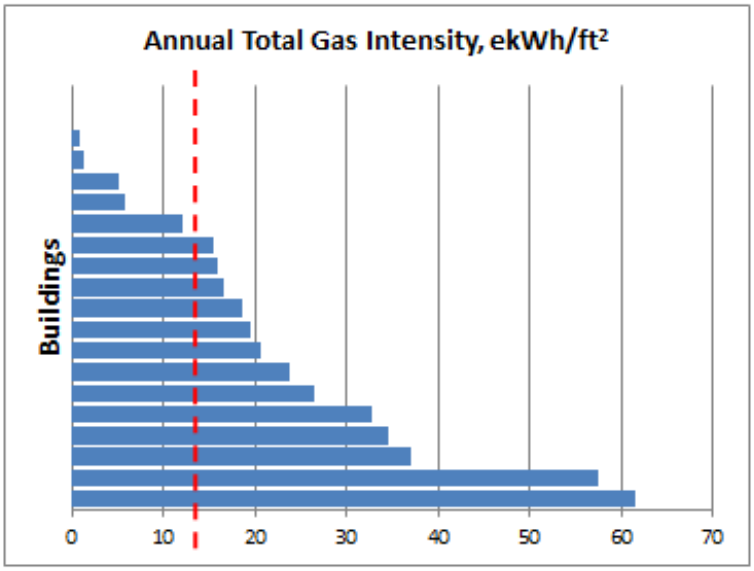

Figure 38: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for cultural facilities are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each cultural facility to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	8.1	kWh/ft²/year
	Cooling	0.7	kWh/ft²/year
	Heating	0.4	kWh/ft²/year
	Total	9.2	kWh/ft²/year
Gas	Base	2.2	ekWh/ft²/year
	Heating	12.0	ekWh/ft²/year
	Total	14.2	ekWh/ft²/year
Total energy	Total	23.4	ekWh/ft²/year

Table 56: Top Quartile Targets

The data set for target-setting is made up of 17 cultural facilities with complete and reliable data, all of which are City of Toronto buildings. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)) and % of the area which is air conditioned. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each cultural facility. The total savings potential for each cultural facility is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 20 cultural facilities are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There is 1 cultural facility with annual savings potential greater than $100,000. 9 cultural facilities have annual savings potential between $5,000 and $100,000 and 10 cultural facilities have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 20 buildings is $448,008 ($358,867 for electricity and $89,141 for gas) with an average total energy savings of 36%.

For the 1 high-potential savings facility, the total annual savings potential is $273,738 ($251,868 for electricity and $21,870 for gas) with an average total energy savings of 35%.

For the 9 mid-potential savings facilities, the total annual savings potential is $157,310 ($95,352 for electricity and $61,958 for gas) with an average total energy savings of 42%.

For the 10 low-potential savings facilities, the total annual savings potential is $16,960 ($11,647 for electricity and $5,313 for gas) with an average total energy savings of 19%.

	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 20 facilities	**30%**	**55%**	**31%**	**28%**	**$358,867**	**86%**	**40%**	**46%**	**$ 89,141**	**36%**	**$448,008**	**$205,067**	**$34,285**	**596,553**	**926,181**
High potential savings facilities (1)	30%	56%	00%	31%	$251,868	100%	00%	45%	$ 21,870	35%	$273,738	$143,925	$ 8,412	99,115	355,950
Mid-potential savings facilities (9)	35%	60%	46%	26%	$ 95,352	41%	58%	50%	$ 61,958	42%	$157,310	$ 54,487	$23,830	237,280	522,684
Low potential savings facilities (10)	13%	22%	01%	13%	$ 11,647	41%	14%	23%	$ 5,313	19%	$ 16,960	$ 6,656	$ 2,043	260,157	47,548

Table 57: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 4 below shows the total potential savings for all 20 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	15.1	10.6	30%	$ 318,199
Electric Cooling (kWh/ft²)	1.0	0.5	55%	$ 33,117
Electric Heating (kWh/ft²)	0.5	0.3	31%	$ 7,284
Total Electricity (kWh/ft²) for facilities w/o component intensities	8.7	8.7	0%	$ 267
Gas Baseload (ekWh/ft²)	2.5	0.4	86%	$ 24,728
Gas Heating (ekWh/ft²)	10.6	6.3	40%	$ 50,351
Total Gas (ekWh/ft²) for facilities w/o component intensities	17.5	11.3	35%	$ 14,062
Total Energy (ekWh/ft²)	**28.1**	**17.8**	**36%**	**$ 448,008**

High savings | Moderate | Low savings

Table 58: Savings Potential Based on Energy Use Component for 20 Cultural Facilities

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electric Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Proposed Energy Efficiency Measures

Table 5 below shows the full range of possible energy efficiency measures for the entire portfolio of cultural facilities. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 20 facilities indicate that the largest percentage reductions will come from measures associated with electric cooling and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off machines, office and kitchen equipment when not needed	4	3	7	Year 1	Annual Review	Building Occupants
B2	Unplug machines, office and kitchen equipment if not actively used	4	3	7	Year 1	Annual Review	Building Occupants
B3	Turn off computer monitors when not in use	4	3	7	Year 1	Annual Review	Building Occupants
B4	Enable ENERGY STAR power settings on your computer	4	3	7	Year 1	Annual Review	Building Occupants
B5	Unplug chargers when not in use	4	3	7	Year 1	Annual Review	Building Occupants
B6	Turn off lights when areas not in use	4	3	7	Year 1	Annual Review	Building Occupants
B7	Make use of natural light instead of turning on lights where possible	4	3	7	Year 1	Annual Review	Building Occupants
M1	Optimize operating schedules for fans and pumps	3	3	6	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	3	6	Year 2	Seasonal Review	
EL4	Install power factor correction	3	3	6	Year 3	15+	
L1	Conduct audit of exhibit and display lighting to identify possible improvements	3	3	6	Year 3	4 to 6	
L2	Replace incandescent and halogen light bulbs with high efficiency lighting	1	3	4	Year 4	10 to 15	
L3	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	3	4	Year 4	10 to 15	
L4	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	3	4	Year 4	10 to 15	
L5	Replace HID lighting with high efficiency fluorescent	1	3	4	Year 4	10 to 15	
L6	Replace outdoor lights and signage with high efficiency fixtures	1	3	4	Year 4	10 to 15	
L7	Replace festive lighting with LED	1	3	4	Year 4	10 to 15	
L8	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	3	4	Year 4	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	3	4	Year 4	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	3	4	Year 4	4 to 6	
EL3	Install controls on vending machines	1	3	4	Year 4	10 to 15	
M3	Install variable frequency drives (VFDs) on suitable fans and pumps	1	3	4	Year 4	10 to 20	
M4	Convert electric hot water heaters to natural gas	1	3	4	Year 4	10 to 15	
	Other:_____						
	_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B8	Adjust blinds (to retain heat in winter)	4	3	7	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	3	7	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	3	7	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	3	6	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	3	5	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	3	4	Year 4	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	3	4	Year 4	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	3	4	Year 4	seasonal review	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementatio	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B11	Winterize room air-conditioners	4	4	8	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	4	8	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	4	8	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1		Building Occupants
M10	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M12	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M13	Test and tune the air conditioning units	3	4	7	Year 2	3	
M11	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B17	Optimize dishwasher operation (only run when full)	4	4	8	Year 1		Building Occupants
P1	Optimize DHW temperature control	2	4	6	Year 2	annual review	
P3	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M16	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P2	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	4	5	Year 3	10 to 15	
M14	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M15	Replace DHW boilers with more efficient models	1	4	5	Year 3	10 to 15	
	Other:_____						
	_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B18	Check and clear baseboard heaters of obstructions	4	4	8	Year 1		Building Occupants
B19	Adjust blinds (to retain heat in winter)	4	4	8	Year 1		Building Occupants
B20	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1		Building Occupants
M17	Optimize operating periods of ventilation systems supplying heated spaces	2	4	6	Year 2	seasonal review	
M18	Test and adjust ventilation systems to optimize outside air volumes	3	4	7	Year 2	seasonal review	
M20	Test and tune boiler efficiency	3	4	7	Year 2	seasonal review	
M22	Check heating system for flow balancing and air venting	3	4	7	Year 2	seasonal review	
EN1	Check and seal exterior walls and openings	3	4	7	Year 2	10 to 15	
EN5	Seal window and door frames	3	4	7	Year 2	5	
M23	Optimize fan-coil unit and entrance heater controls	3	4	7	Year 2	seasonal review	
M24	Consider heating system zoning	2	4	6	Year 2	n/a	
M19	Test, repair, replace and right-size heating control valves and outside air dampers	2	4	6	Year 3	10 to 15	
M21	Upgrade heating system control to optimize space temperatures and operating periods	1	4	5	Year 3	10 to 15	
EN2	Insulate the attic adequately	1	4	5	Year 3	10 to 15	
EN3	Reclad the building's exterior	1	4	5	Year 3	20 to 24	
EN4	Replace single-pane windows with double-pane windows	1	4	5	Year 3	20 to 24	
EN6	If replacing the roof, ensure R-value at least 22	1	4	5	Year 3	n/a	
M25	Install high efficiency burners	1	4	5	Year 3	15 to 20	
M26	Replace boilers with more efficient models	1	4	5	Year 3	15 to 20	
M27	Replace old rooftop units with energy efficient units	1	4	5	Year 3	15 to 20	
M28	Install heat recovery or solar heating units	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 59: Energy Saving Measures for Cultural Facilities

The specific measures and implementation timeline for each individual cultural facility will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities is $4.65/ft^2 (see Appendix A). The budget allows for lighting audits, lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high-potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low-potential buildings is set at 40 percent of the basic amount to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium, and low potential cultural facilities are summarized in Table 6 below.

Annual Savings Potential	# of facilities	Average Area (ft2)	Estimated Implementation Cost $/sqft	Estimated Implementation Cost $	Estimated Savings potential $	Estimated Savings potential %	Payback
>$100,000	1	99,115	5.58	$ 553,061	$ 273,738	61.1%	2.02
$5,000-$100,000	9	26,364	4.65	$ 1,103,353	$ 157,310	35.1%	7.01
<$5,000	10	26,016	1.86	$ 483,893	$ 16,960	3.8%	28.53
	20			**$ 2,140,307**	**$ 448,008**		**4.78**

Table 60: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the Specific Measures for Each Building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.
- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 7 below.

		#	Cost	Savings Potential	Description	Resources
High Potential	Building Performance Audit (BPA)	1	$ 7,500	savings potential > $100,000	includes interval meter analysis and water consumption	engineer; energy analyst
Mid Potential	Energy Assessments	9	$ 750	savings potential $5,000 - $100,000	includes interval meter analysis	energy analyst
Low Potential	Checklists	10	$ 150	savings potential < $5,000		Division Champion and staff
		20				

Table 61: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There is 1 cultural facility (St Lawrence Market South) with over $100,000 in annual energy saving potential. Over 60% of the total energy savings for all cultural facilities can be found at this facility.

St Lawrence Market South can save an average of 35% of its total energy use. The total annual energy savings are estimated to be over $273,700 and the annual GHG savings are approximately 356,000 kg.

St Lawrence Market South can save an average of 31% of its total electricity use (30% Electric Baseload, 56% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $250,000.

St Lawrence Market South can save an average of 45% of its total gas use, and all of the savings are in Gas Baseload. The total annual gas savings are estimated to be approximately $22,000.

St Lawrence Market South will undergo a Building Performance Audit (see the Implementation Plan for further details). For a complete description of the Building Performance Audit, refer to Appendix A.

See Appendix B for the associated energy savings potential by energy use component.

The largest percentage reductions for this facility can be found in Gas Baseload and Electric Cooling. After the implementation of the proposed measures, this facility is eligible to receive over $150,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 9 cultural facilities with between $5,000 and $100,000 in annual energy saving potential. Approximately 37% of the total energy savings for all 20 cultural facilities can be found in these 9 facilities.

These 9 cultural facilities can save an average of 42% of their total energy use. The total annual energy savings are estimated to be over $157,000 and individual building annual savings range from approximately $5,100 to almost $34,000. The annual GHG savings are approximately 522,600 kg.

These 9 cultural facilities can save an average of 26% of their total electricity use (35% Electric Baseload, 60% Electric Cooling and 46% Electric Heating). The total annual electricity savings are estimated to be approximately $95,000 and individual building annual savings range from just under $10,000 to over $30,000.

These 9 cultural facilities can save an average of 50% of their total gas use (41% Gas Baseload and 58% Gas Heating). The total annual gas savings are estimated to be approximately $62,000 and individual building annual savings range from under $1,000 to over $30,000.

These 9 facilities will undergo an Energy Assessment with highest potential cultural facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 9 cultural facilities and their associated energy savings potential by energy use component.

The largest percentage reductions for this group of 9 cultural facilities can be found in Electric Cooling and Gas Heating. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these cultural facilities are eligible to receive over $78,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 10 cultural facilities with less than $5,000 in savings potential. Less than 4% of the total energy savings for all 20 cultural facilities can be found in these 10 facilities.

These 10 cultural facilities can save an average of 19% of their total energy use. The total annual energy savings are estimated to be approximately $17,000 and individual building annual savings range from approximately $300 to almost $5,000. The annual GHG savings are approximately 47,500 kg.

These 10 cultural facilities can save an average of 13% of their total electricity use (13% Electric Baseload, 22% Electric Cooling and 1% Electric Heating). The total annual electricity savings are estimated to be approximately $11,600 and individual building annual savings range from under $300 to over $4,800.

These 10 cultural facilities can save an average of 23% of their total gas use (41% Gas Baseload and 14% Gas Heating). The total annual gas savings are estimated to be approximately $5,300 and individual building annual savings range from under $100 to over $1,500.

These 10 facilities will undergo a checklist approach with highest potential cultural facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 10 cultural facilities and their associated energy savings potential by energy use component.

The largest percentage reductions for this group of 10 cultural facilities can be found in Gas Baseload and Electric Cooling.

The energy savings checklist will be used by the Division Champion for the cultural facilities in conjunction with the building operator and/or service contractor for each cultural facility. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 8 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 20 facilities. The total costs to implement the energy management and retrofit plan for cultural facilities is estimated to be $2,156,057. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	7,500
Energy Assessment	$	6,750
Checklist	$	1,500
Implementation	$	2,140,307
Total	**$**	**2,156,057**

Table 62: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 9 and Figure 5 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from the Building Performance Audit will occur in Year 1 and the implementation of these measures will occur in Year 2. Identification of measures from Energy Assessments will begin in Year 1, with all 9 Energy Assessments completed by the end of Year 5. The implementation of these measures will begin in Year 2, and will be completed by the end of Year 6. Identification of measures from the Checklists will begin in Year 2, with all 10 Checklists completed by the end of Year 6. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $1,577,884. The cumulative net cash flow becomes positive in Year 8.

The implementation plan includes the following assumptions:

- Approximately 77% of the project budget will be spent in the first 5 years, and the other 23% in the following 5 years.
- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 77% of facilities will be retrofitted in the first 5 years and 23% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.
- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).
- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
High Potential - Building Performance Audit	1	0	0	0	0	0	0	0	0	0	1
Mid Potential - Energy Assessment	2	2	2	2	1	0	0	0	0	0	9
Low Potential - Checklist	0	3	3	3	1	0	0	0	0	0	10
Assessment Costs	$ 9,000	$ 1,968	$ 1,978	$ 1,987	$ 916	$ -	$ -	$ -	$ -	$ -	$ 15,848
Implementation Costs	$ -	$ 830,500	$ 414,250	$ 422,535	$ 430,986	$ 192,556	$ -	$ -	$ -	$ -	$ 2,290,828
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 900	$ 83,247	$ 41,623	$ 42,452	$ 43,190	$ 19,256	$ -	$ -	$ -	$ -	$ 230,668
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 41,525	$ 62,238	$ 83,364	$ 104,914	$ 114,541	$ 114,541	$ 114,541	$ 114,541	$ 114,541.39	
Annual Costs	$ 9,900	$ 957,240	$ 520,088	$ 550,339	$ 580,005	$ 326,353	$ 114,541	$ 114,541	$ 114,541	$ 114,541	$ 3,402,091
Estimated Achieved Annual Savings		$ 94,968	$ 302,553	$ 482,577	$ 548,299	$ 595,158	$ 630,392	$ 661,912	$ 695,008	$ 729,758	$ 4,740,624
Estimated Incentives	$ -	$ 185,248	$ 33,944	$ 12,681	$ 7,479	$ -	$ -	$ -	$ -	$ -	$ 239,352
Annual Savings and Incentives	$ -	$ 280,216	$ 336,496	$ 495,258	$ 555,778	$ 595,158	$ 630,392	$ 661,912	$ 695,008	$ 729,758	$ 4,979,975
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 396	-$ 27,477	-$ 34,821	-$ 37,024	-$ 37,993	-$ 27,241	-$ 6,607	$ -	$ -	-$ 171,558
Net Cash Flow incl borrowing costs	-$ 9,900	-$ 677,420	-$ 211,069	-$ 89,902	-$ 61,252	$ 230,812	$ 488,610	$ 540,764	$ 580,466	$ 615,216	$ 1,406,326
Cumulative Net Cash Flow	-$ 9,900	-$ 686,924	-$ 870,516	-$ 925,597	-$ 949,825	-$ 681,020	-$ 165,169	$ 382,202	$ 962,668	$ 1,577,884	

Table 63: Cash Flow for 10-Year Implementation Plan

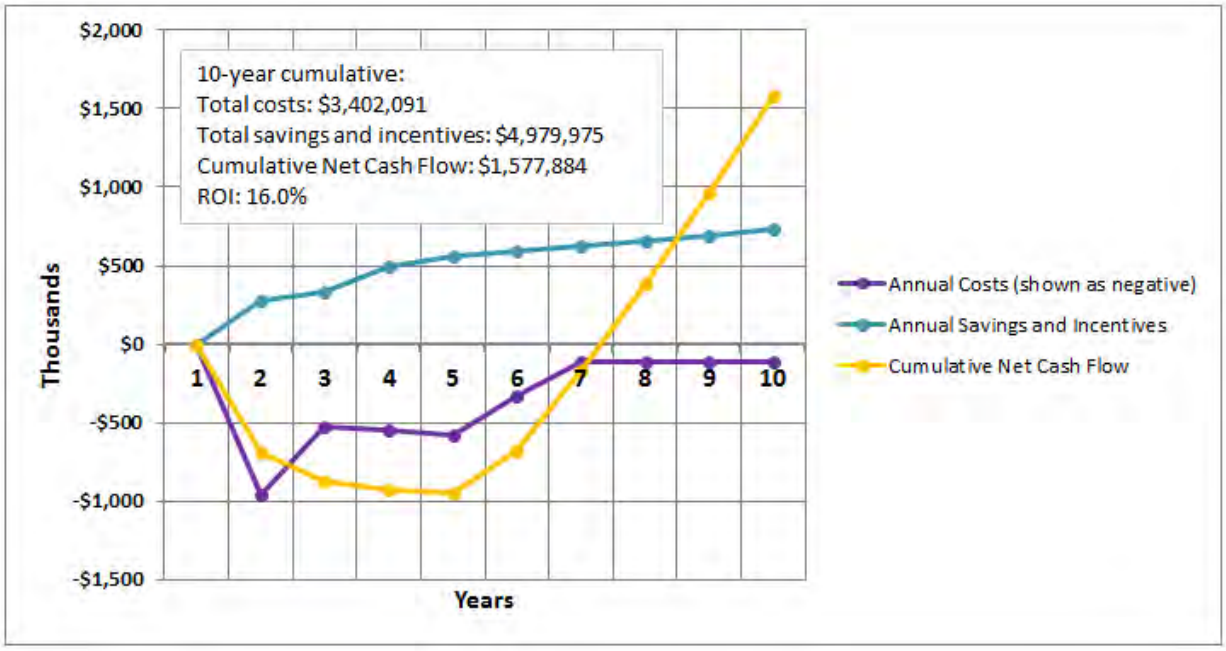

Figure 39: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above) and facilities of the same type from other municipalities. Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for cultural facilities is determined as the average kWh/day for March, April, October and November multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from May to September, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-

standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload (ekWh/ft^2)

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2)

Garage: Add 20 ekWh/ft^2 to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Indoor Recreational Facilities:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant (ekWh/ft^2 of ice/week) * Months ice-in * 52 weeks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool (ekWh/ft^2 of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Heating for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Cultural facilities
- Performing arts facilities

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	2.25	100%	6.5	2.9	
Mechanical	1.50	30%	6	0.6	0.7
Electrical	0.25	100%	8	0.3	
Envelope	0.50	0%	10		0.2
Process	0.15	0%	5		0.1
Total	**4.65**		**6.7**	**3.77**	**1.02**

Table 64: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls. They also include lighting audits.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process (domestic hot water) measures include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers
- Performance based target setting customized for your building
- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and

low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Cultural Facilities

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 20 cultural facility buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Allan Gardens	160 Gerrard St E.	25,177
Casa Loma Building	1 Austin Terrace	83,938
Casa Loma Hunt Lodge	328 Walmer Rd	4,381
Civic Garden Centre	755 Lawrence Ave E	36,952
Colborne Lodge (inc. Coachhouse)	1 Colborne Lodge Dr	8,547
Don Valley Brickwork	550 Bayview Ave	186,239
Edwards Gardens	755 Lawrence Ave E	10,021
Gibson House Museum	5172 Yonge St	8,364
Historic Fort York	100 Garrison Rd	22,819
Lakeshore Assembly Hall	1 Colonel Samuel Dr	14,596
Mackenzie House Museum	82 Bond St	2,573
Martin Grove House / Bungalow	410 Martin Grove Rd	18,140
Montgomery's Inn	4709 Dundas St W	7,642
Neilson Pk Creative Arts	56 Neilson Dr	12,346
Riverdale Farm	201 Winchester St	23,713
Spadina House Museum	285 Spadina Rd	27,588
St Lawrence Market South	95 Front St E	99,115
William Goodwin House	355 Lesmill Rd	818
Zion Methodist Church	1650 Finch Ave E	2,002
Zion School House	1091 Finch Ave E	1,582

Table 65: Cultural Facility Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 20 cultural facility buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft^2)	2012 Total Gas Intensity ($ekWh/ft^2$)	2012 Total Energy Intensity ($ekWh/ft^2$)
Martin Grove House / Bungalow	0.52	0.91	1.43
Don Valley Brickwork	0.96	1.21	2.18
Riverdale Farm	3.60	5.05	8.65

Historic Fort York	11.47	0.00	11.47
Gibson House Museum	11.89	0.00	11.89
Spandina House Museum	3.48	18.73	22.21
Casa Loma Building	9.07	16.67	25.74
Neilson Pk Creative Arts	14.17	12.12	26.29
Casa Loma Hunt Lodge	0.42	26.46	26.88
Civic Garden Centre	12.18	15.46	27.65
Colborne Lodge (inc. Coachhouse)	14.62	15.92	30.53
Zion School House	15.73	20.60	36.33
Montgomery's Inn	33.06	5.76	38.83
Edwards Gardens	5.73	34.48	40.22
Zion Methodist Church	10.82	32.72	43.54
Lakeshore Assembly Hall	24.03	23.90	47.93
Mackenzie House Museum	13.22	37.13	50.35
Allan Gardens	7.93	61.02	68.95
St Lawrence Market South	54.63	19.54	74.16
William Goodwin House	38.84	58.02	96.85

Table 66: Cultural Facility 2012 Energy Intensity

5.3 Target-setting Method and Metrics

3 cultural facilities were determined to be ineligible for determination of energy components or target-setting. See Appendix A. The excluded facilities are listed below.

Facility	Days in 2012	Energy type
Zion Methodist Church	Huge negative consumption in February	Electricity
Casa Loma Hunt Lodge	396	Electricity
Casa Loma Building	396	Electricity

Table 67: Excluded Facilities

After excluding these 3 facilities, 17 City of Toronto facilities were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component.

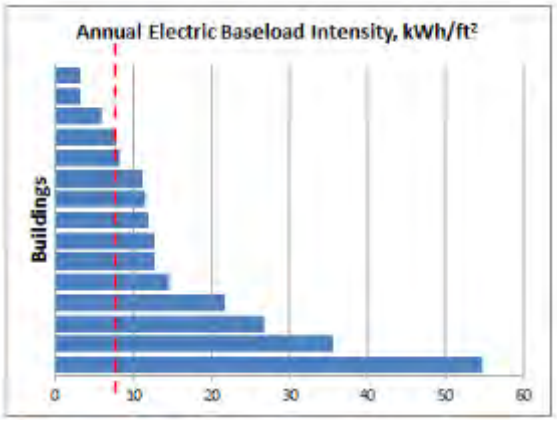

Figure 40: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for cultural facilities ranges from 0.5 to 54.7 ekWh/ft^2 and the top-quartile is 8.1 ekWh/ft^2.

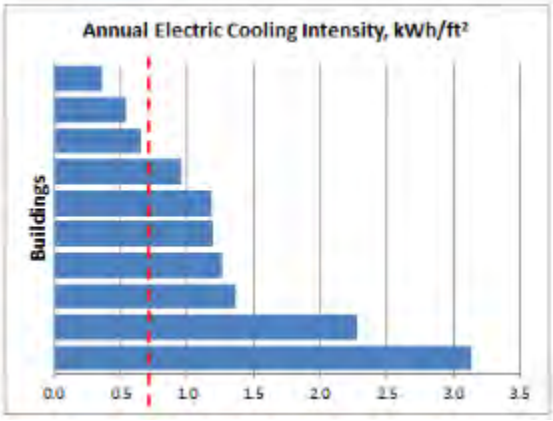

Figure 41: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for cultural facilities ranges from 0.4 to 3.1 ekWh/ft^2 and the top-quartile is 0.7 ekWh/ft^2.

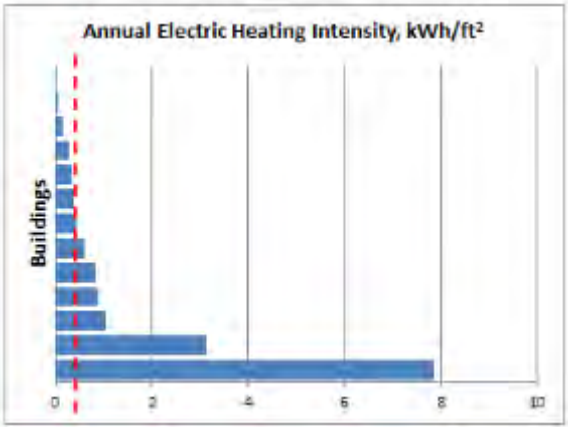

Figure 42: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for cultural facilities ranges from 0.3 to 7.9 ekWh/ft^2 and the top-quartile is 0.4 ekWh/ft^2.

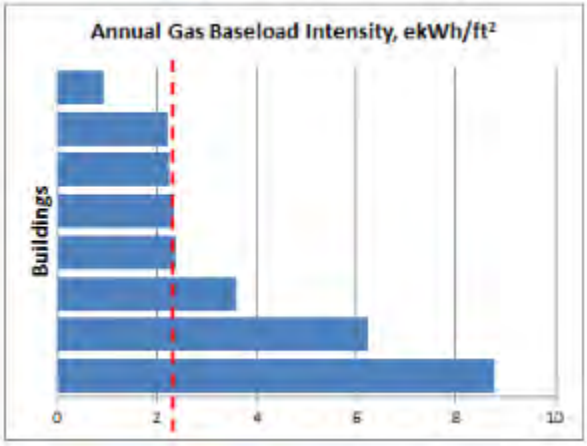

Figure 43: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for cultural facilities ranges from 0.9 to 8.8 ekWh/ft^2 and the top-quartile is 2.2 ekWh/ft^2.

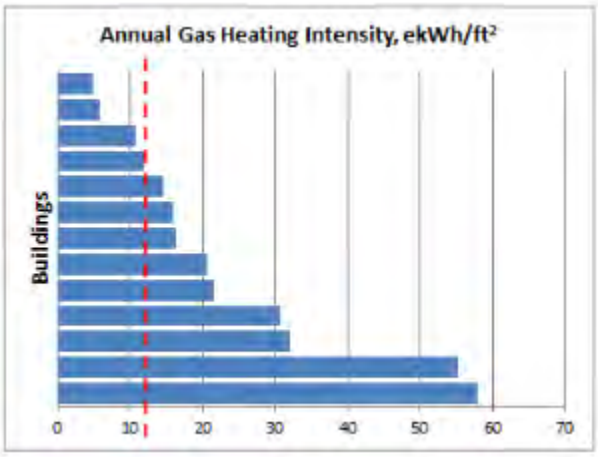

Figure 44: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for cultural facilities ranges from 4.8 to 57.9 ekWh/ft^2 and the top-quartile is 11.96 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of cultural facilities, the factors are % of the facility area served by electric heat, %of DHW heated by electricity, use of ground-source or water-source heat pumps and % of the area served by electric air conditioning.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from Total Electricity use (or Total Gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 1 High-Savings Potential Cultural Facility

Buildings are sorted by total annual savings potential, starting with the highest saving potential buildings.

There is one cultural facility with over $100,000 in annual savings potential.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
High potential savings facilities (1)	30%	56%	00%	31%	$251,868	100%	00%	45%	$ 21,870	35%	$273,738	$143,925	$ 8,412	99,115	355,950
St Lawrence Market South	30%	56%		31%	$251,868	100%		45%	$ 21,870	35%	$273,738	$143,925	$ 8,412	99,115	355,950

Table 68: Savings Potential for 1 High Savings Potential Cultural Facility

Savings Potential by Energy Use Component for the 9 Mid-Savings Potential Cultural Facilities

Buildings are sorted by total annual savings potential, starting with the highest saving potential buildings.

There are 9 cultural facilities with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (9)	35%	60%	46%	26%	$ 95,352	41%	58%	50%	$ 61,958	42%	$157,310	$ 54,487	$23,830	237,280	522,684
Lakeshore Assembly Hall	63%	43%	63%	62%	$ 30,379	0%	44%	40%	$ 3,510	51%	$ 33,889	$ 17,359	$ 1,350	14,596	49,237
Allan Gardens				0%	$ -	38%	85%	82%	$ 31,811	72%	$ 31,811	$ -	$12,235	25,177	229,896
Montgomery's Inn	70%		66%	69%	$ 25,470			0%	$ -	59%	$ 25,470	$ 14,554	$ -	7,642	20,012
Civic Garden Centre	27%	75%		33%	$ 21,117		18%	17%	$ 2,400	24%	$ 23,517	$ 12,067	$ 923	36,952	33,935
Casa Loma Building				0%	$ -			33%	$ 11,534	33%	$ 11,534	$ -	$ 4,436	83,938	83,354
Historic Fort York	30%			28%	$ 11,134				$ -	28%	$ 11,134	$ 6,362	$ -	22,819	8,748
Colborne Lodge (inc. Coachhouse)	36%	100%	35%	42%	$ 7,252		25%	25%	$ 865	33%	$ 8,117	$ 4,144	$ 333	8,547	11,949
Spandina House Museum				0%	$ -	100%	45%	52%	$ 6,722	44%	$ 6,722	$ -	$ 2,585	27,588	48,577
Edwards Gardens				0%	$ -	6%	63%	59%	$ 5,116	50%	$ 5,116	$ -	$ 1,968	10,021	36,976

Table 69: Savings Potential for 9 Medium Savings Potential Cultural Facilities

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 10 Low-Savings Potential Cultural Facilities

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 10 cultural facilities with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (10)	13%	22%	01%	13%	$ 11,647	41%	14%	23%	$ 5,313	19%	$ 16,960	$ 6,656	$ 2,043	260,157	47,548
Neilson Pk Creative Arts	22%			20%	$ 4,861	100%		2%	$ 73	12%	$ 4,934	$ 2,778	$ 28	12,346	4,345
William Goodwin House	77%	40%	56%	75%	$ 3,318		78%	75%	$ 892	75%	$ 4,209	$ 1,896	$ 343	818	9,050
Mackenzie House Museum	32%			30%	$ 1,377	64%	61%	62%	$ 1,477	53%	$ 2,854	$ 787	$ 568	2,573	11,757
Casa Loma Hunt Lodge				0%	$ -			55%	$ 1,596	55%	$ 1,596	$ -	$ 614	4,381	11,533
Zion School House	33%		14%	32%	$ 1,094	100%	42%	42%	$ 344	37%	$ 1,438	$ 625	$ 132	1,582	3,345
Zion Methodist Church				9%	$ 267			57%	$ 932	57%	$ 1,199	$ 152	$ 358	2,002	6,945
Gibson House Museum		100%		3%	$ 423				$ -	3%	$ 423	$ 242	$ -	8,364	333
Don Valley Brickwork		100%		1%	$ 307			0%	$ -	1%	$ 307	$ 175	$ -	186,239	241
Riverdale Farm				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	23,713	0
Martin Grove House / Bungalow				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	18,140	0

Table 70: Savings Potential for 10 Low-Savings Potential Cultural Facilities

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use - Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Ambulance Stations and Associated Offices/Facilities

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1. Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 24 ambulance stations in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B. The majority of the buildings are ambulance stations, but also included are the Ambulance Headquarters and associated office type facilities.

The total area for all of the buildings is 216,311 ft^2. The ambulance stations range in size from just over 1,500 ft^2 to over 100,000 ft^2 (Ambulance Headquarters).

None of the ambulance stations (or associated offices/facilities) are equipped with renewable energy systems.

The majority of the ambulance stations have air conditioning serving approximately 50% of the building. Only the Ambulance Headquarters has air-conditioning serving 100% of the building. Only one facility (EMS station 47) is fully served by electric heat. Even though they are not reported to be using electric heat, the electricity profiles show that the majority of the other ambulance stations have significant additional use of electricity in winter months. While some of this usage may be due to longer hours of lighting or electric motors, use of electric heaters is indicated and should be further explored. Identifying and limiting electricity use associated with space heating will be one of the first measures recommended in the plan (see section on proposed energy efficiency measures). None of the ambulance stations are served by ground or water source heat pumps.

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use from monthly utility bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities. Total energy use and costs are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	5,149,579	$720,941
Natural Gas (m^3)	404,139	$105,076
Total		**$826,017**

Table 71: Energy Use and Costs for 24 City of Toronto Ambulance Stations

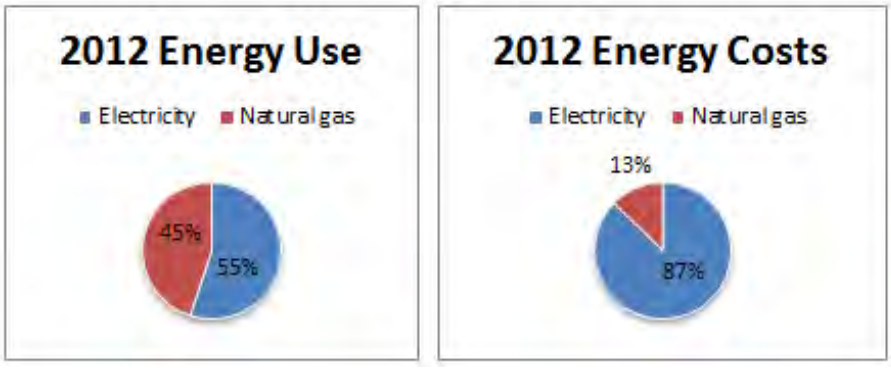

Figure 45: 2012 Energy Use and Cost Breakdown for 24 City of Toronto Ambulance Stations

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the buildings. Total energy use intensity ranges from less than 20 to over 80 ekWh/ft^2. The ranges for electricity and gas use per ft^2 are even greater. Note that no 2012 data was available for EMS Station 54 and therefore it was not analyzed and reported on.

The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

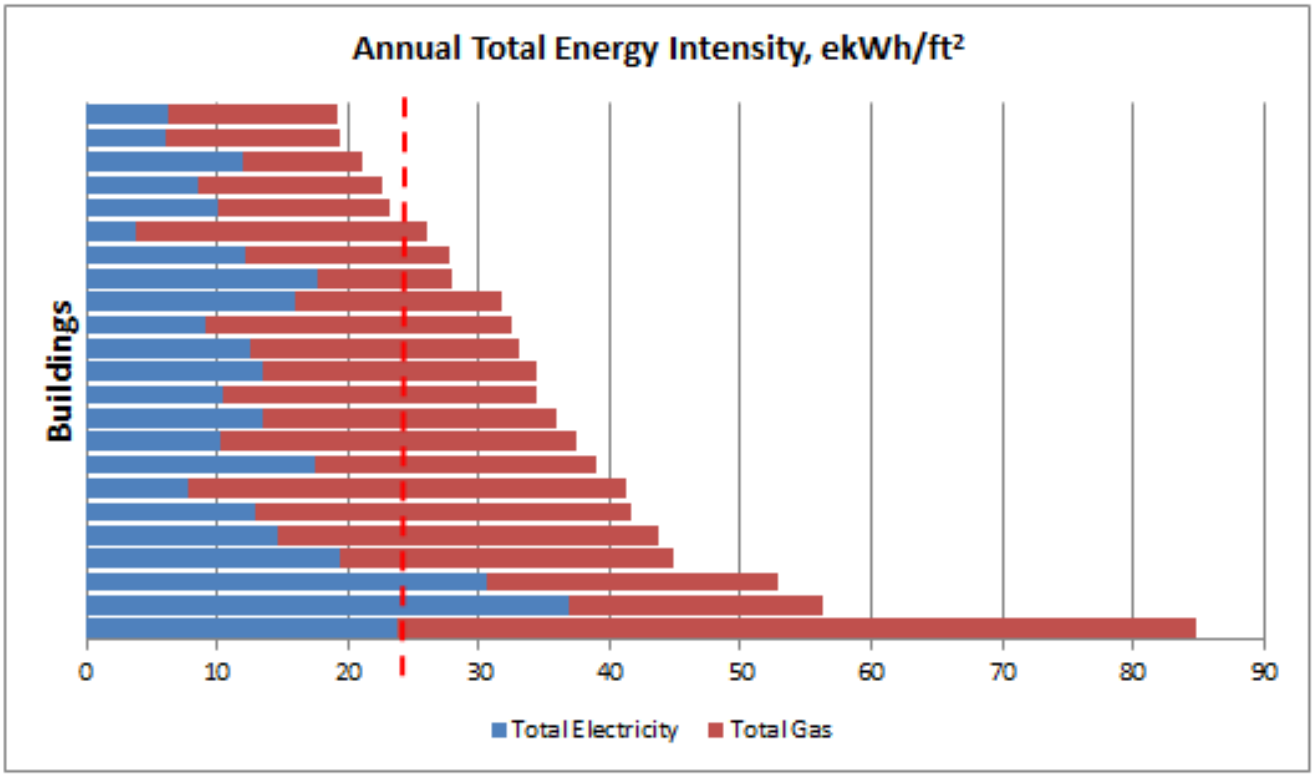

Figure 46: 2012 Total Energy Intensity Benchmark

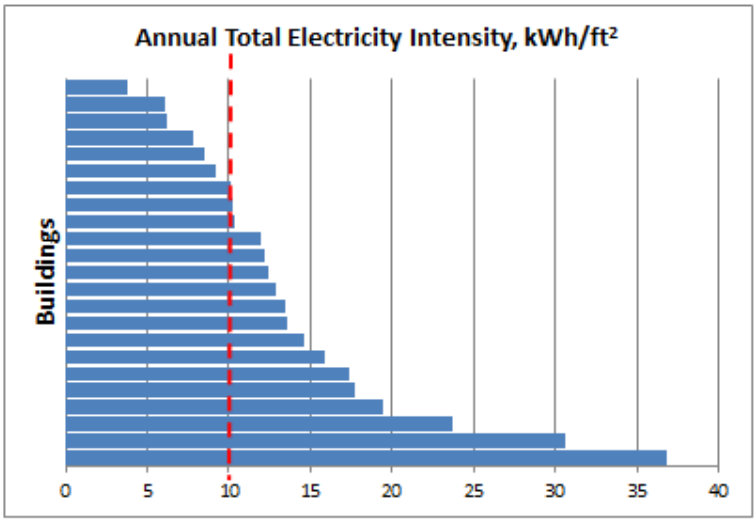

Figure 47: 2012 Total Electricity Intensity Benchmark

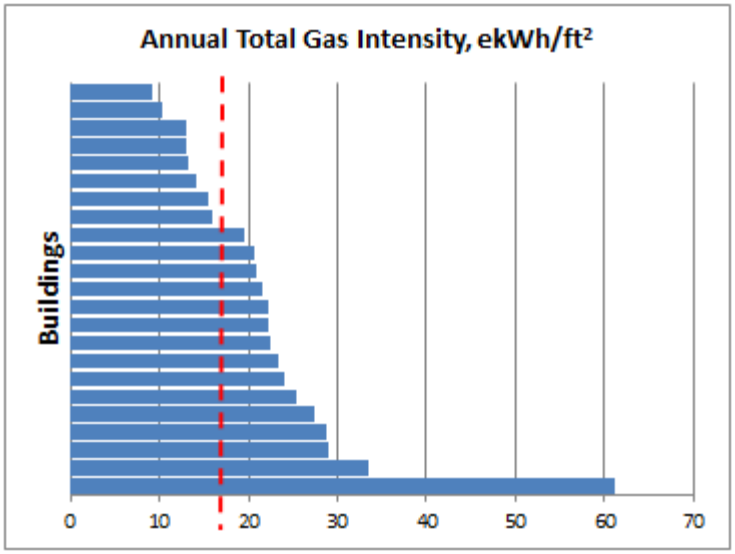

Figure 48: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for ambulance stations are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each ambulance station to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	7.7	kWh/ft²/year
	Cooling	0.3	kWh/ft²/year
	Heating	2.3	kWh/ft²/year
	Total	10.3	kWh/ft²/year
Gas	Base	0.9	ekWh/ft²/year
	Heating	15.3	ekWh/ft²/year
	Total	16.2	ekWh/ft²/year
Total energy	Total	26.5	ekWh/ft²/year

Table 72: Top Quartile Targets

The data set for target-setting is made up of the 20 ambulance stations with complete and reliable data, all of which are City of Toronto buildings, from the larger group included in this Plan. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)), and % of the area which is air conditioned. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each ambulance station. The total savings potential for each ambulance station is determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 24 ambulance stations are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

The Ambulance Headquarters is the only building with annual savings potential greater than $100,000. 5 ambulance stations have annual savings potential between $5,000 and $100,000 and 18 ambulance stations have annual savings potential less than $5,000 (see Table 873).

The total annual savings potential for the 24 buildings is $347,515 ($324,524 for electricity and $22,991 for gas) with an average total energy savings of 35%.

For the 1 high-potential savings facility (Ambulance Headquarters), the total annual savings potential is $270,876 ($262,619 for electricity and $8,258 for gas) with an average total energy savings of 38%.

For the 5 mid-potential savings facilities, the total annual savings potential is $50,181 ($44,246 for electricity and $5,935 for gas) with an average total energy savings of 41%.

For the 18 low-potential savings facilities, the total annual savings potential is $26,457 ($17,659 for electricity and $8,798 for gas) with an average total energy savings of 21%.

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emis-sions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 24 facilities	**46%**	**54%**	**21%**	**45%**	**$324,524**	**52%**	**19%**	**22%**	**$ 22,991**	**35%**	**$347,515**	**$185,442**	**$ 8,843**	**216,311**	**421,137**
High potential savings facilities (1)	50%	54%	00%	50%	$262,619	51%	13%	17%	$ 8,258	38%	$270,876	$150,068	$ 3,176	101,719	266,020
Mid-potential savings facilities (5)	53%	68%	16%	50%	$ 44,246	58%	31%	33%	$ 5,935	41%	$ 50,181	$ 25,283	$ 2,283	34,584	77,659
Low potential savings facilities (18)	16%	37%	22%	16%	$ 17,659	50%	23%	23%	$ 8,798	21%	$ 26,457	$ 10,091	$ 3,384	80,008	77,459

Table 73: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 884 below shows the total potential savings for all 24 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	22.5	12.1	46%	$ 303,514
Electric Cooling (kWh/ft²)	1.1	0.5	54%	$ 14,370
Electric Heating (kWh/ft²)	2.1	1.6	21%	$ 6,092
Total Electricity (kWh/ft²) for facilities w/o component intensities	8.4	7.9	6%	$ 548
Gas Baseload (ekWh/ft²)	1.6	0.8	52%	$ 4,269
Gas Heating (ekWh/ft²)	17.9	14.4	19%	$ 18,230
Total Gas (ekWh/ft²) for facilities w/o component intensities	16.5	14.1	15%	$ 492
Total Energy (ekWh/ft²)	**43.1**	**28.2**	**35%**	**$ 347,515**

High savings | Moderate | Low savings

Table 74: Savings Potential based on Energy Use Component for 24 Ambulance Stations

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electrical Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and some of them will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Previous Energy Efficiency Initiatives

In 2008, the City of Toronto undertook a study to identify building improvement measures that would improve energy and water efficiency and reduce the operating cost and environmental impact of the Ambulance Headquarters building.

Table 85 below summarizes the estimated overall project costs, savings and estimated energy reduction as a result of the 2008 project.

			Project Cost & Savings (estimated)					Estimated Energy Reduction			
Project Name & Year	Num. of Bldgs	Total Floor Area (m2)	Retrofit Cost	Total $Savings	Total ekWh Savings	Total CO2 Savings (tonnes)	Payback	Electrcity Savings kWh	Electrcity Savings kW	Natural Gas Savings m3	
EMS Station 2008	1	9,450	$1,195,732	$187,744	2,301,783	531	6.4	1,689,234	192	59,231	

Table 75: 2008 Ambulance Headquarters Project Estimated Project Costs and Savings

The types of measures implemented at the Ambulance Headquarters building included the following:

- Lighting Retrofits
- Minor Mechanical Modifications
- Automated Building Controls
- Power Factor Corrections
- Variable Speed Drives

2.2 Proposed Energy Efficiency Measures

Table 6 shows the full range of possible energy efficiency measures for the entire portfolio of ambulance stations. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the facilities indicate that the largest percentage reductions will come from measures associated with electric cooling and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

⇓

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off machines, office and kitchen equipment when not needed	4	4	8	Year 1	Annual Review	Building Occupants
B2	Unplug machines, office and kitchen equipment if not actively used	4	4	8	Year 1	Annual Review	Building Occupants
B3	Turn off computer monitors when not in use	4	4	8	Year 1	Annual Review	Building Occupants
B4	Enable ENERGY STAR power settings on your computer	4	4	8	Year 1	Annual Review	Building Occupants
B5	Unplug chargers when not in use	4	4	8	Year 1	Annual Review	Building Occupants
B6	Turn off lights when areas not in use	4	4	8	Year 1	Annual Review	Building Occupants
B7	Make use of natural light instead of turning on lights where possible	4	4	8	Year 1	Annual Review	Building Occupants
M1	Optimize operating schedules for fans and pumps	3	4	7	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	4	7	Year 2	Seasonal Review	
EL4	Install power factor correction	3	4	7	Year 2	15+	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	4	5	Year 3	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	4	5	Year 3	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	4	5	Year 3	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	4	5	Year 3	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	4	5	Year 3	10 to 15	
L6	Replace festive lighting with LED	1	4	5	Year 3	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	4	5	Year 3	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	4	5	Year 3	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	4	5	Year 3	4 to 6	
EL3	Install controls on vending machines	1	4	5	Year 3	10 to 15	
EL5	Submeter data and call centres	1	4	5	Year 3	Seasonal Review	
M3	Install variable frequency drives (VFDs) on suitable fans and pumps	1	4	5	Year 3	10 to 20	
M4	Convert electric hot water heaters to natural gas	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B8	Adjust blinds (to retain heat in winter)	4	2	6	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	2	6	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	2	6	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	2	5	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	2	4	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	2	3	Year 4	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	2	3	Year 4	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	2	3	Year 4	seasonal review	
M10	Install controls on vehicle plug-in heaters	1	2	3	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementatio	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B11	Winterize room air-conditioners	4	4	8	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	4	8	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	4	8	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1		Building Occupants
M11	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M13	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M14	Test and tune the air conditioning units	3	4	7	Year 2	3	
M12	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B17	Optimize dishwasher operation (only run when full)	4	4	8	Year 1		Building Occupants
P1	Optimize DHW temperature control	2	4	6	Year 2	annual review	
P3	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M17	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P2	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	4	5	Year 3	10 to 15	
M15	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M16	Replace DHW boilers with more efficient models	1	4	5	Year 3	10 to 15	
	Other:_____						
	_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B18	Check and clear baseboard heaters of obstructions	4	1	5	Year 1		Building Occupants
B19	Adjust blinds (to retain heat in winter)	4	1	5	Year 1		Building Occupants
B20	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	1	5	Year 1		Building Occupants
M19	Optimize operating periods of ventilation systems supplying heated spaces	2	1	3	Year 2	seasonal review	
M20	Test and adjust ventilation systems to optimize outside air volumes	3	1	4	Year 2	seasonal review	
M23	Test and tune boiler efficiency	3	1	4	Year 2	seasonal review	
M25	Check heating system for flow balancing and air venting	3	1	4	Year 2	seasonal review	
EN1	Check and seal exterior walls and openings	3	1	4	Year 2	10 to 15	
EN5	Seal window and door frames	3	1	4	Year 2	5	
M26	Optimize fan-coil unit and entrance heater controls	3	1	4	Year 2	seasonal review	
M27	Consider heating system zoning	2	1	3	Year 2	n/a	
M22	Test, repair, replace and right-size heating control valves and outside air dampers	2	1	3	Year 5	10 to 15	
M18	Use controls to prevent heaters from running when overhead doors are open	1	1	2	Year 2	seasonal review	
M21	Apply CO control to vehicle area exhaust fans	1	1	2	Year 5	10 to 15	
M24	Upgrade heating system control to optimize space temperatures and operating periods	1	1	2	Year 5	10 to 15	
EN2	Insulate the attic adequately	1	1	2	Year 5	10 to 15	
EN3	Reclad the building's exterior	1	1	2	Year 5	20 to 24	
EN4	Replace single-pane windows with double-pane windows	1	1	2	Year 5	20 to 24	
EN6	If replacing the roof, ensure R-value at least 22	1	1	2	Year 5	n/a	
M28	Install high efficiency burners	1	1	2	Year 5	15 to 20	
M29	Replace boilers with more efficient models	1	1	2	Year 5	15 to 20	
M30	Replace old rooftop units with energy efficient units	1	1	2	Year 5	15 to 20	
M31	Install heat recovery or solar heating units	1	1	2	Year 5	10 to 15	
	Other:_____						
	_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 76: Energy Saving Measures for Ambulance Stations

The specific measures and implementation timeline for each individual ambulance station will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
EMS Station 46	105 Cedarvale Ave	Solar PV	10	kW
EMS Station 29	4560 Sheppard Ave E	Solar PV	10	kW
EMS Station 16	4330 Dufferin St	Solar PV	40	kW
EMS Station 55	5700 Bathurst St	Geothermal	70	kW
EMS Station 35	265 Manitoba Drive	Geothermal	10	kW

Table 77: Proposed Renewable Energy Systems for EMS Facilities

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities is $4.20/ft^2 (see Appendix A). The budget allows for lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high-potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low-potential buildings is set at 40 percent of the basic amount to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium and low-potential ambulance stations are summarized in Table 78 below.

Annual Savings Potential	Number of facilities	Average area (ft²)	Estimated Implementation Cost $/ft²	Estimated Implementation Cost $	Estimated Savings potential $	Estimated Savings potential %	Payback
> $100,000	1	101,719	5.04	$ 512,663	$ 270,876	77.9%	1.89
$5,000 - $100,000	5	6,917	4.20	$ 145,255	$ 50,181	14.4%	2.89
< $5,000	18	4,445	1.68	$ 134,414	$ 26,457	7.6%	5.08
	24			**$ 792,331**	**$ 347,515**		**2.28**

Table 78: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the Specific Measures for Each Building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.
- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 79 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	1	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	5	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	18	$ 150	< $5,000	Division Champion and staff
		24			

Table 79: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There is one high-potential savings facility with over $100,000 in annual energy saving potential (Ambulance Headquarters). The total annual energy savings are estimated to be over $270,000 and the annual GHG savings are approximately 266,000 kg.

The Ambulance Headquarters can save an average of 50% of its total electricity use (50% Electric Baseload and 54% Electric Cooling). The total annual electricity savings are estimated to be approximately $260,000.

The Ambulance Headquarters can save an average of 17% of its total gas use (51% Gas Baseload and 13% Gas Heating). The total annual gas savings are estimated to be approximately $8,300.

The Ambulance Headquarters will undergo a Building Performance Audit (see the Implementation Plan for further details). For a complete description of the Building Performance Audit, refer to Appendix A.

Approximately 75% of the total energy savings for all ambulance stations and associated offices/facilities can be found at the Ambulance Headquarters.

See Appendix B for the associated energy savings potential by energy use component for the Ambulance Headquarters.

The highest percentage reductions for the Ambulance Headquarters can be found in Electric Baseload, Electric Cooling and Gas Baseload. After the implementation of the proposed measures, the Ambulance Headquarters is eligible to receive over $150,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 5 ambulance stations with between $5,000 and $100,000 in annual energy saving potential. Approximately 14% of the total energy savings for all 24 ambulance stations and associated offices/facilities can be found in these 5 facilities.

These 5 ambulance stations can save an average of 41% of their total energy use. The total annual energy savings are estimated to be over $50,000 and individual building annual savings range from approximately $5,000 to over $23,000. The annual GHG savings are approximately 77,700 kg.

These 5 ambulance stations can save an average of 50% of their total electricity use (53% Electric Baseload, 68% Electric Cooling and 16% Electric Heating). The total annual electricity savings are estimated to be approximately $44,000 and individual building annual savings range from just over $3,500 to approximately $22,000.

These 5 ambulance stations can save an average of 33% of their total gas use (58% Gas Baseload and 31% Gas Heating). The total annual gas savings are estimated to be approximately $5,900 and individual building annual savings range from no savings to over $2,000.

These 5 facilities will undergo an Energy Assessment with highest potential ambulance stations focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 5 ambulance stations and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 5 ambulance stations can be found in Electric Baseload, Electric Cooling and Gas Baseload. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these ambulance stations are eligible to receive almost $27,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 18 ambulance stations with less than $5,000 in savings potential. Approximately 7% of the total energy savings for all 24 ambulance stations can be found in these 18 facilities.

These 18 ambulance stations can save an average of 21% of their total energy use. The total annual energy savings are estimated to be approximately $26,000 and individual building annual savings range from $0 to approximately $4,000. The annual GHG savings are approximately 77,000 kg.

These 18 ambulance stations can save an average of 16% of their total electricity use (16% Electric Baseload, 37% Electric Cooling and 22% Electric Heating). The total annual electricity savings are estimated to be approximately $18,000 and individual building annual savings range from $0 to over $4,000.

These 18 ambulance stations can save an average of 23% of their total gas use (50% Gas Baseload and 23% Gas Heating). The total annual gas savings are estimated to be approximately $8,800 and individual building annual savings range from $0 to almost $2,400.

These 18 facilities will undergo a checklist approach with highest potential ambulance stations focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 18 ambulance stations and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 18 ambulance stations can be found in Electric Cooling and Gas Baseload.

The energy savings checklist will be used by the Division Champion for the ambulance stations in conjunction with the building operator and/or service contractor for each ambulance station. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 80 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 24 facilities. The total costs to implement the energy management and retrofit plan for ambulance stations is estimated to be $806,281. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	7,500
Energy Assessment	$	3,750
Checklist	$	2,700
Implementation	$	792,331
Total	**$**	**806,281**

Table 80: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 81 and Figure 49 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from the Building Performance Audit of Ambulance Headquarters will occur in Year 1 and the implementation of the measures will occur in Year 2. Identification of measures from Energy Assessments will begin in Year 1, with all 5 Energy Assessments completed by the end of Year 5. The implementation of these measures will begin in Year 2, and be completed by the end of Year 6. Identification of measures from the Checklists will begin in Year 2, with all 18 Checklists completed by the end of Year 6. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $2,608,934. The cumulative net cash flow becomes positive in Year 5.

The implementation plan includes the following assumptions:

- Approximately 76% of the project budget will be spent in the first 5 years, and the other 24% in the following 5 years.
- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 76% of facilities will be retrofitted in the first 5 years and 24% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.
- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).
- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
High Potential - Building Performance Audit	1	0	0	0	0	0	0	0	0	0	1
Mid Potential - Energy Assessment	1	1	1	1	1	0	0	0	0	0	5
Low Potential - Checklist	0	4	4	4	4	2	0	0	0	0	18
Assessment Costs	$ 8,250	$ 1,374	$ 1,387	$ 1,399	$ 1,412	$ 338	$ -	$ -	$ -	$ -	$ 14,161
Implementation Costs	$ -	$ 563,599	$ 62,527	$ 63,778	$ 65,053	$ 66,354	$ 17,155	$ -	$ -	$ -	$ 838,466
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 825	$ 56,497	$ 6,391	$ 6,518	$ 6,647	$ 6,669	$ 1,716	$ -	$ -	$ -	$ 85,263
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 28,180	$ 31,306	$ 34,495	$ 37,748	$ 41,066	$ 41,923	$ 41,923	$ 41,923	$ 41,923.32	
Annual Costs	$ 9,075	$ 649,651	$ 101,611	$ 106,190	$ 110,860	$ 114,427	$ 60,794	$ 41,923	$ 41,923	$ 41,923	$ 1,278,378
Estimated Achieved Annual Savings		$ 81,056.16	$ 249,395.26	$ 381,586.63	$ 420,301.00	$ 455,463.06	$ 486,613.03	$ 513,437.61	$ 539,109.49	$ 566,064.97	$ 3,693,027
Estimated Incentives	$ -	$ 166,282	$ 11,690	$ 7,556	$ 5,420	$ 3,337	$ -	$ -	$ -	$ -	$ 194,285
Annual Savings and Incentives	$ -	$ 247,338	$ 261,085	$ 389,143	$ 425,721	$ 458,800	$ 486,613	$ 513,438	$ 539,109	$ 566,065	$ 3,887,312
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 363	-$ 16,456	-$ 10,077	$ -	$ -	$ -	$ -	$ -	$ -	-$ 26,895
Net Cash Flow incl borrowing costs	-$ 9,075	-$ 402,676	$ 143,018	$ 272,876	$ 314,861	$ 344,373	$ 425,819	$ 471,514	$ 497,186	$ 524,142	$ 2,582,039
Cumulative Net Cash Flow	-$ 9,075	-$ 411,388	-$ 251,914	$ 31,039	$ 345,900	$ 690,273	$ 1,116,092	$ 1,587,606	$ 2,084,792	$ 2,608,934	

Table 81: Cash Flow for 10-Year Implementation Plan

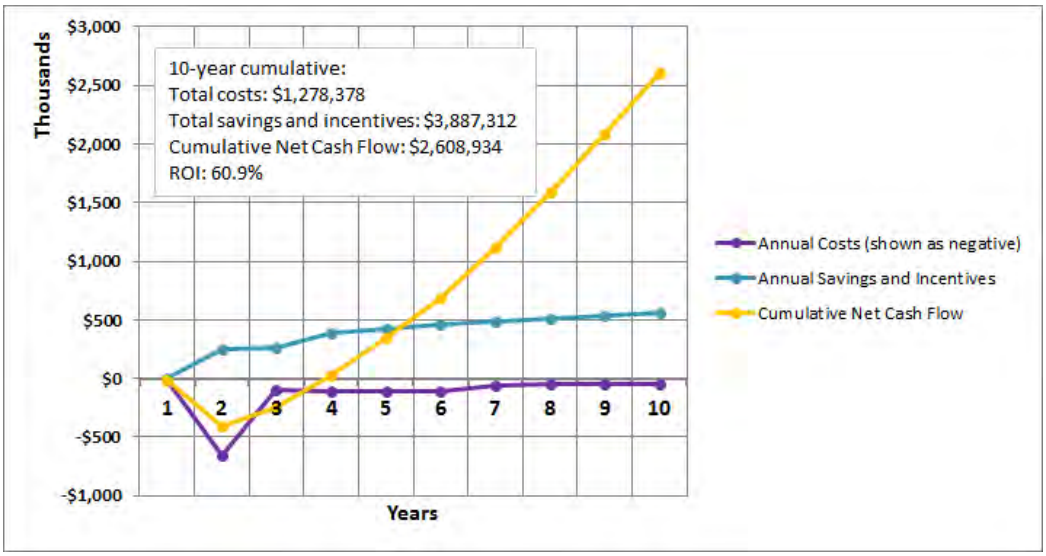

Figure 49: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above) and facilities of the same type from other municipalities. Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for ambulance stations is determined as the average kWh/day for April, May, September and October multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from June to August, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February, March, November and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-

standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload (ekWh/ft^2).

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2).

Garage: Add 20 ekWh/ft^2 to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Indoor Recreational Facilities:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant (ekWh/ft^2 of ice/week) * Months ice-in * 52 weeks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool (ekWh/ft^2 of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Heating for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Fire stations
- Shelter, Support and Housing Administration
- Ambulance stations and associated offices and facilities
- Storage facilities where equipment or vehicles are maintained, repaired or stored
- Public libraries
- Long-Term Care Homes and Services
- Police stations and associated offices and facilities
- Children's Services
- Administrative offices and related facilities, including municipal council chambers

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	1.80	100%	6.5	2.3	
Mechanical	1.50	30%	6	0.6	0.7
Electrical	0.25	100%	8	0.3	
Envelope	0.50	0%	10		0.2
Process	0.15	0%	5		0.1
Total	**4.20**		**6.8**	**3.19**	**1.02**

Table 82: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process (domestic hot water) measures include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved, and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers
- Performance based target setting customized for your building

- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Ambulance stations

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 24 ambulance station buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
2430 Lawrence Ave E	2430 Lawrence Ave E	7,782
50 Toryork	50 Toryork	13,153
Ambulance Headquarters	4330 Dufferin St	101,719
EMS Workshop West	866 Richmond St W	1,658
EMS Station 10	2015 Lawrence Ave W	5,005
EMS Station 11	1135 Caledonia Rd	3,574
EMS Station 14	321 Rexdale Blvd	4,252
EMS Station 24	3061 Birchmount Rd	2,659
EMS Station 28	2900 Lawrence Ave E	1,905
EMS Station 31	4219 Dundas St W	2,831
EMS Station 32	9 Clendenan Ave	3,218
EMS Station 33	760 Dovercourt Rd	3,132
EMS Station 34 (save-a-life)	674 Markham St	13,939
EMS Station 37	1288 Queen St W	4,413
EMS Station 38	259 Horner Ave	5,102
EMS Station 40	58 Richmond St E	12,798
EMS Station 42	1535 Kingston Rd	6,997
EMS Station 44	887 Pharmacy Ave	2,799
EMS Station 45	135 Davenport Rd	11,496
EMS Station 46	105 Cedarvale Ave	1,572
EMS Station 47	3600 St Clair Ave E	1,787
EMS Station 49	3100 Eglinton Ave E	2,583
EMS Station 12	1535 Albion Rd.	1,938
EMS Station 54		no data

Table 83: Ambulance Station Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 24 ambulance station buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
EMS Station 32	6.18	13.00	19.18
EMS Station 45	6.02	13.41	19.44
EMS Station 40	12.12	9.26	21.38
EMS Station 33	8.49	14.07	22.56
EMS Station 37	9.76	13.03	22.79
EMS Station 34 (save-a-life)	3.80	22.24	26.05
EMS Station 47	16.53	10.26	26.80
50 Toryork	12.00	15.39	27.39
EMS Station 49	15.35	15.76	31.11
EMS Station 24	9.07	23.25	32.32
EMS Station 14	12.10	20.54	32.64
EMS Station 11	9.86	24.04	33.89
EMS Station 10	13.70	21.07	34.77
EMS Station 44	10.08	26.35	36.43
EMS Station 31	14.13	22.63	36.77
EMS Station 42	17.49	21.70	39.19
EMS Workshop West	7.06	33.45	40.51
EMS Station 46	12.90	28.66	41.55
EMS Station 12	17.29	25.26	42.54
EMS Station 38	14.82	29.33	44.16
2430 Lawrence Ave E	30.67	22.03	52.71
Ambulance Headquarters	36.31	19.46	55.77
EMS Station 28	23.42	61.07	84.49
EMS Station 54	no data	no data	no data

Table 84: Ambulance Station 2012 Energy Intensity

5.3 Target-setting Method and Metrics

4 EMS stations were determined to be ineligible for determination of energy components or target-setting. See Appendix A. The excluded facilities are listed below.

Facility	Days in 2012	Energy type
EMS Station 32	333	Electricity
EMS Station 33	329	Electricity
EMS Station 46	333	Electricity
EMS Station 13	Negative consumption	Electricity

Table 85: Excluded Facilities

After excluding these facilities, 20 City of Toronto facilities were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component.

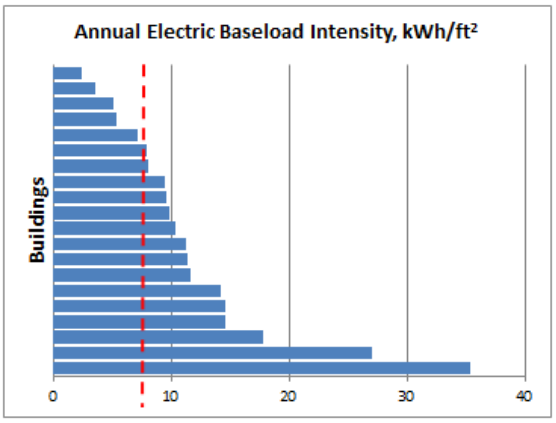

Figure 50: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for ambulance stations ranges from 2.5 to 35.3 ekWh/ft^2 and the top-quartile is 7.7 ekWh/ft^2.

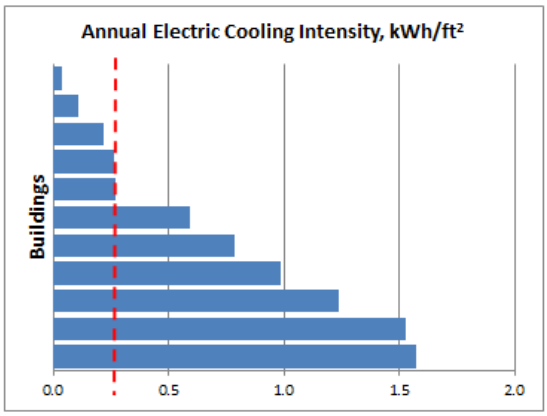

Figure 51: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for ambulance stations ranges from 0 to 1.6 ekWh/ft^2 and the top-quartile is 0.3 ekWh/ft^2.

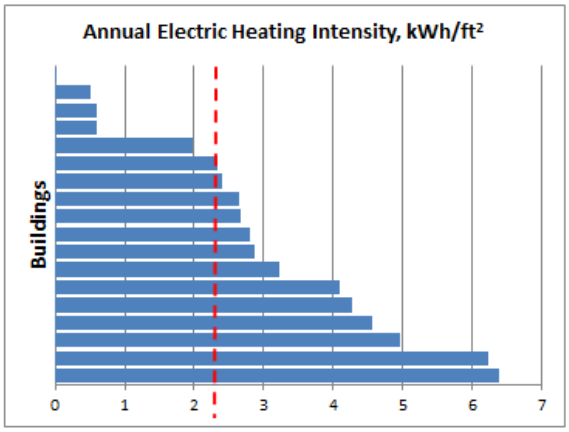

Figure 52: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for ambulance stations ranges from 0 to 6.4 ekWh/ft^2 and the top-quartile is 2.3 ekWh/ft^2.

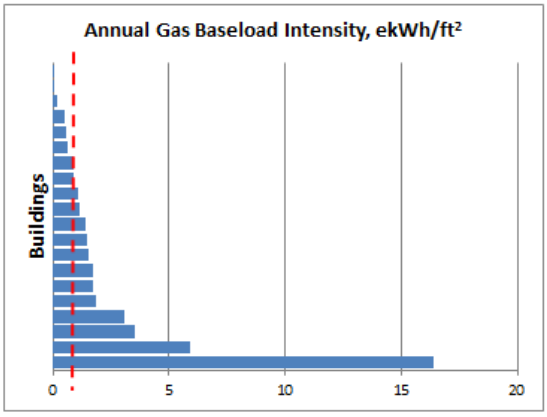

Figure 53: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for ambulance stations ranges from 0.03 to 16.4 ekWh/ft^2 and the top-quartile is 0.9 ekWh/ft^2.

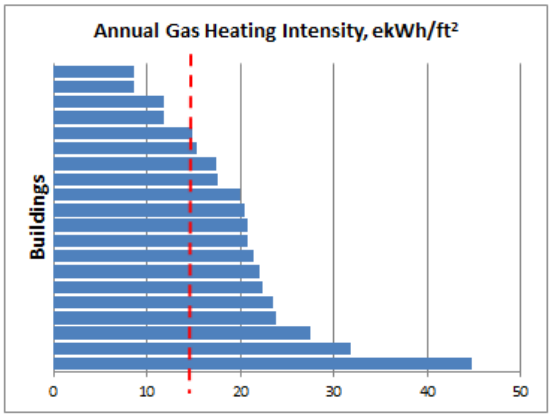

Figure 54: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for ambulance stations ranges from 8.6 to 44.7 ekWh/ft^2 and the top-quartile is 15.3 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of ambulance stations, the factors are % of the facility area served by electric heat, %of DHW heated by electricity, use of ground-source or water-source heat pumps, and % of the area served by electric air conditioning.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from total electricity use (or total gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 1 High Savings Potential Ambulance Station

Ambulance Headquarters is the only facility with more than $100,000 in annual savings potential.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
High potential savings facilities (1)	50%	54%	00%	50%	$262,619	51%	13%	17%	$ 8,258	38%	$270,876	$150,068	$ 3,176	101,719	266,020
Ambulance Headquarters	50%	54%		50%	$262,619	51%	13%	17%	$ 8,258	38%	$270,876	$150,068	$ 3,176	101,719	266,020

Table 86: Savings Potential for 1 High Savings Potential Ambulance Station

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 5 Mid Savings Potential Ambulance Stations

Buildings are sorted by total annual savings potential, starting with the highest saving potential buildings.

There are 5 ambulance stations with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (5)	53%	68%	16%	50%	$ 44,246	58%	31%	33%	$ 5,935	41%	$ 50,181	$ 25,283	$ 2,283	34,584	77,659
2430 Lawrence Ave E	72%	54%	16%	66%	$ 22,016	38%	27%	27%	$ 1,189	50%	$ 23,205	$ 12,581	$ 457	7,782	25,889
Station #42	46%	82%		43%	$ 7,360	17%	25%	25%	$ 944	33%	$ 8,304	$ 4,206	$ 363	6,997	12,606
Station #38	47%			47%	$ 4,916	41%	44%	44%	$ 1,651	45%	$ 6,568	$ 2,809	$ 635	5,102	15,795
Station #40	32%			30%	$ 6,409			0%	$ -	17%	$ 6,409	$ 3,662	$ -	12,798	5,036
Station #28	57%	63%	53%	56%	$ 3,544	94%	66%	74%	$ 2,151	69%	$ 5,695	$ 2,025	$ 827	1,905	18,332

Table 87: Savings Potential for 5 Medium Savings Potential Ambulance Stations

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 18 Low Savings Potential Ambulance Stations

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 18 ambulance stations with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (18)	16%	37%	22%	16%	$ 17,659	50%	23%	23%	$ 8,798	21%	$ 26,457	$ 10,091	$ 3,384	80,008	77,459
50 Toryork	22%		2%	18%	$ 4,011		1%	1%	$ 37	8%	$ 4,048	$ 2,292	$ 14	13,153	3,418
Station #11		76%	63%	50%	$ 2,605		35%	34%	$ 740	39%	$ 3,345	$ 1,488	$ 285	3,574	7,394
Station #10	18%		43%	26%	$ 2,427		27%	27%	$ 698	26%	$ 3,124	$ 1,387	$ 268	5,005	6,948
Station #12	47%			36%	$ 1,877	70%	66%	66%	$ 818	53%	$ 2,694	$ 1,072	$ 314	1,938	7,383
Station #34 (save-a-life)				0%	$ -		31%	31%	$ 2,394	26%	$ 2,394	$ -	$ 921	13,939	17,301
Station #49	34%		45%	37%	$ 2,112			0%	$ -	18%	$ 2,112	$ 1,207	$ -	2,583	1,659
Station #14	20%		19%	20%	$ 1,448		24%	23%	$ 510	22%	$ 1,958	$ 828	$ 196	4,252	4,824
Station #31	25%		27%	26%	$ 1,383		29%	28%	$ 442	27%	$ 1,825	$ 790	$ 170	2,831	4,282
Station #47	27%			17%	$ 762	100%	100%	100%	$ 464	48%	$ 1,226	$ 436	$ 178	1,787	3,949
Station #46				19%	$ 548			43%	$ 492	43%	$ 1,040	$ 313	$ 189	1,572	3,984
Station #44	2%	100%		2%	$ 69	74%	36%	41%	$ 782	30%	$ 851	$ 39	$ 301	2,799	5,704
EMS Workshop West				0%	$ -	46%	57%	56%	$ 783	46%	$ 783	$ -	$ 301	1,658	5,661
Station #24	5%	39%		7%	$ 223	84%	12%	30%	$ 473	24%	$ 696	$ 127	$ 182	2,659	3,594
Station #37			12%	3%	$ 194	19%		2%	$ 23	2%	$ 218	$ 111	$ 9	4,413	321
Station #45				0%	$ -	35%		4%	$ 143	3%	$ 143	$ -	$ 55	11,496	1,036
Station #32				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	3,218	0
Station #33				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	3,132	0
Station #54					$ -				$ -	0%	$ -	$ -	$ -	0	0

Table 88: Savings Potential for 18 Low Savings Potential Ambulance Stations

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use – Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Fire Stations and Associated Offices/Facilities

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1 Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 88 fire station buildings in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B. The majority of the 88 buildings are fire stations, but also included are 3 training centres (including the Fire Academy), a museum, and an office type facility.

The total area for all of the buildings is 836,816 ft^2. The fire stations range in size from less than 2,500 ft^2 to almost 25,000 ft^2. The Toryork Office and Fire Academy are both over 40,000 ft^2.

Five of the fire stations are equipped with renewable energy systems, as summarized below.

Building Name	Building Address	Renewable Installation	System Size	Unit
Fire Hall 212	8500 Sheppard Ave East	Solar Hot Water	11	kW
Fire Hall 231	740 Markham Rd	Solar Hot Water	11	kW
Fire Hall 334	339 Queens Quay West	Solar Photovoltaic	3.2	kW
Fire Hall 424	462 Runnymede Rd	Solar Photovoltaic	1.2	kW
Fire Hall 426	140 Lansdowne Ave	Solar Hot Water	11	kW

Table 89: Current Renewable Energy Systems at City of Toronto Fire Stations

The majority of the fire stations have air conditioning serving approximately 50% of the building. Only the Fire Training Centre and Toryork Office have air-conditioning serving over 50% of the building. Only one facility (Fire Station former TO #35) is reported to be served by electric heat. Even though they are not reported to be using electric heat, the electricity profiles show that the majority of the other fire stations have significant additional use of electricity in winter months. While some of this usage may be due to longer hours of lighting or electric motors, use of electric heaters is indicated and should be further explored. Identifying and limiting electricity use associated with space heating will be one of the first measures recommended in the plan (see section on proposed energy efficiency measures). None of the fire stations are served by ground or water source heat pumps.

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for

calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 88 buildings are summarized below.

	2012 Energy Use	
	Unit	$
Electricity (kWh)	9,693,353	$1,357,069
Natural Gas (m^3)	1,716,046	$446,172
Total		**$1,803,241**

Table 90: 2012 Energy Use and Costs for 88 City of Toronto Fire Stations

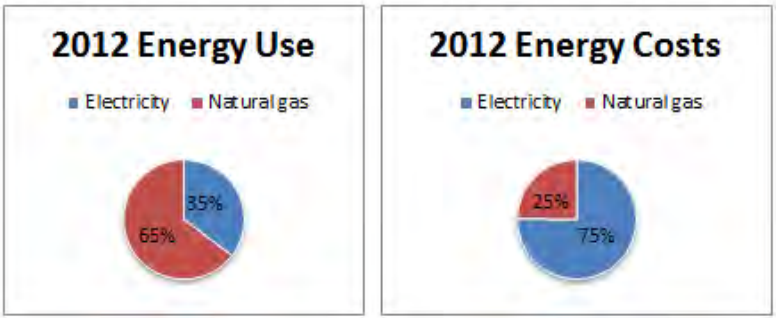

Figure 55: 2012 Energy Use and Cost Breakdown for 88 City of Toronto Fire Stations

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 88 buildings. Total energy use ranges from less than 20 to over 80 ekWh/ft^2. The ranges for electricity and gas use per ft^2 are even greater. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in

Appendix B.

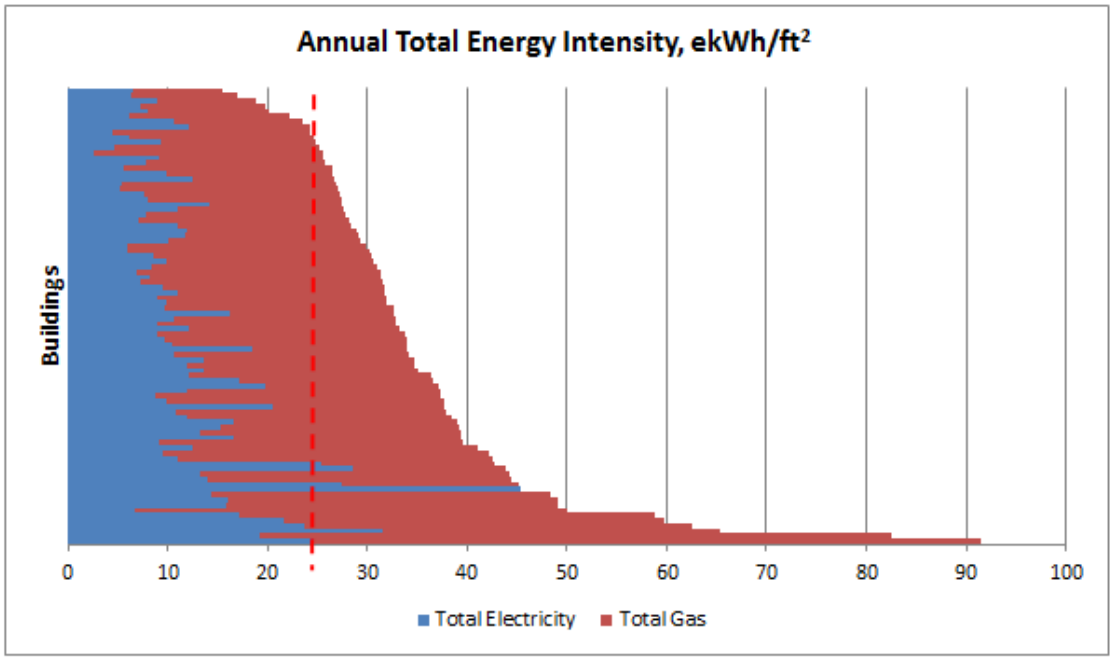

Figure 56: 2012 Total Energy Intensity Benchmark

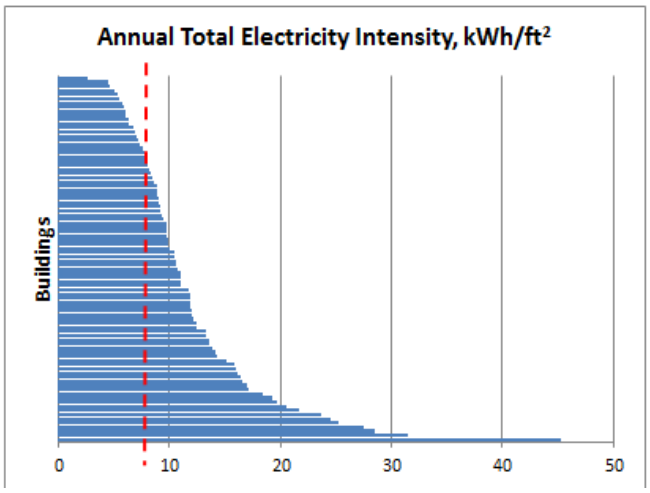

Figure 57: 2012 Total Electricity Intensity Benchmark

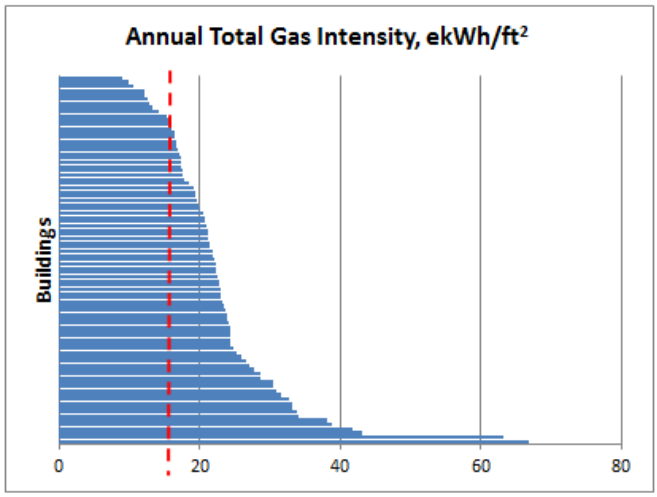

Figure 58: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for fire stations are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each fire station to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Baseload	7.4	kWh/ft²/year
	Cooling	0.5	kWh/ft²/year
	Heating	0.6	kWh/ft²/year
	Total	8.5	kWh/ft²/year
Gas	Baseload	1.7	ekWh/ft²/year
	Heating	14.7	ekWh/ft²/year
	Total	16.5	ekWh/ft²/year
Total energy	Total	24.9	ekWh/ft²/year

Table 91: Top Quartile Targets

76 fire stations made up the data set for target-setting, 68 of which are City of Toronto buildings with complete and reliable data from the 88 which are part of this Plan, with 8 additional buildings from other municipalities. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)), and % of the area which is air conditioned. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each fire station. The total savings potential for each fire station is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 88 fire stations are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There are no fire stations with annual savings potential greater than $100,000. 34 fire stations have annual savings potential between $5,000 and $100,000 and 54 fire stations have annual savings potential less than $5,000 (see Table 92).

The total annual savings potential for the 88 buildings is $581,115 ($457,980 for electricity and $123,134 for gas) with an average total energy savings of 30%.

For the 34 mid-potential savings facilities, the total annual savings potential is $459,713 ($387,007 for electricity and $72,706 for gas) with an average total energy savings of 38%.

For the 54 low-potential savings facilities, the total annual savings potential is $121,402 ($70,973 for electricity and $50,429 for gas) with an average total energy savings of 20%.

	Electricity Savings Potential		Gas Savings Potential		Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %	$/yr	Average %	$/yr	Average %	$/yr	Electricity	Gas	ft²	kg/yr
TOTAL: 88 facilities	**34%**	**$ 457,980**	**28%**	**$ 123,134**	**30%**	**$ 581,115**	**$ 261,703**	**$ 47,359**	**836,816**	**1,249,723**
Mid-potential savings facilities (34)	46%	$ 387,007	33%	$ 72,706	38%	$ 459,713	$ 221,147	$ 27,964	383,732	829,515
Low potential savings facilities (54)	14%	$ 70,973	22%	$ 50,429	20%	$ 121,402	$ 40,556	$ 19,396	453,085	420,208

Table 92: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures), and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 93 below shows the total potential savings for all 88 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	10.5	6.9	34%	$ 330,068
Electric Cooling (kWh/ft²)	0.8	0.5	41%	$ 27,387
Electric Heating (kWh/ft²)	1.0	0.5	48%	$ 32,716
Total Electricity (kWh/ft²) for facilities w/o component intensities	10.1	7.4	27%	$ 67,809
Gas Baseload (ekWh/ft²)	2.6	1.5	43%	$ 18,753
Gas Heating (ekWh/ft²)	18.8	14.0	26%	$ 79,926
Total Gas (ekWh/ft²) for facilities w/o component intensities	20.7	15.3	26%	$ 24,455
Total Energy (ekWh/ft²)	**32.8**	**23.0**	**30%**	**$ 581,115**

High savings | Moderate | Low savings

Table 93: Savings Potential Based on Energy Use Component for 88 Fire Stations

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling, Electric Heating (i.e. higher electricity use in winter months as described above under Building Characteristics) and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electrical Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Previous Energy Efficiency Initiatives

In 2003, the City of Toronto undertook a study to identify building improvement measures that would improve energy and water efficiency and reduce the operating cost and environmental impact of fire hall facilities located throughout the City of Toronto. Measures were categorized into one of three programs, namely, Energy Savings Program, Capital Program and Renewable Program.

Table 94 below summarizes the estimated overall project costs, savings and estimated energy reduction for the 88 fire hall facilities as a result of the 2003 project.

			Estimated Project Cost & Savings					Estimated Energy Reduction			
Project Name & Year	# of Bldgs	Total Floor Area (m2)	Retrofit Cost	Total $Savings	Total ekWh Savings	Total CO2 Savings (tonnes)	Payback (years)	Electrcity Savings kWh	Electrcity Savings kW	Natural Gas Savings m3	Water Savings m3
Fire Hall 2003	88	66,722	$2,611,319	$334,594	5,473,597	1,115	7.8	1,048,843	2,897	427,856	12,702

Table 94: 2003 Fire HProject Estimated Project Costs and Savings

The types of measures implemented included the following (may not apply to all buildings):

- Lighting Retrofits
  - retrofitted all fixtures that contained T12 lamps with electromagnetic ballasts to fixtures with T8 lamps and electronic ballasts

- Major Mechanical Modifications
  - solar air heating (Fire Stations 326, 334)
  - solar water heating (Fire Stations 212, 231)
  - boiler replacement
  - replaced electric DHW tanks with gas-fired DHW tanks (Fire Stations 424, 425, 444)
  - installed thermostatic mixing valves

- Minor Mechanical Modifications
  - replaced refrigerators and freezers with energy efficient models
  - optimized vending machines (installed motion sensor controllers to reduce compressor cycling during periods of low to no occupancy)
  - installed apparatus door heater interlock so that heaters automatically shut off when bay doors are open
  - insulation of uninsulated or poorly insulated DHW tanks

- Automated Building Controls
  - commissioned and expanded the building automation controls at the South Command Training Centre
  - boiler controls added to hot water boilers

- programmable thermostats and over-ride buttons installed to provide temperature setback in the apparatus bays
- installed programmable thermostats to allow for space temperature setback during unoccupied hours

➢ Required Capital Upgrades
- boiler, furnace and condenser replacement
- AHU, RTU replacement, HVAC modifications
- DHW heater, unit heater replacement
- CO/NOx monitoring system

➢ Building Envelope Upgrades
- sealed doors, windows and envelope cracks to reduce air leakage
- added or repaired existing attic insulation
- upgraded single glazed overhead doors, replaced old leaky windows with new double-glazed low 'E' windows (Fire Stations 424, 425)

➢ Water Conservation
- upgraded or replaced selected domestic water fixtures with new low-flow technology

➢ Training, re-commissioning and green roof installation (Fire Stations 332, 334)

2.2 Proposed Energy Efficiency Measures

Table 24: Energy Saving Measures for Children's Services Buildings

below shows the full range of possible energy efficiency measures for the entire portfolio of fire stations. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 88 facilities indicate that the largest percentage reductions will come from measures associated with electric cooling, electric heating and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

⇓

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off machines, office and kitchen equipment when not needed	4	3	7	Year 1	Annual Review	Building Occupants
B2	Unplug machines, office and kitchen equipment if not actively used	4	3	7	Year 1	Annual Review	Building Occupants
B3	Turn off computer monitors when not in use	4	3	7	Year 1	Annual Review	Building Occupants
B4	Enable ENERGY STAR power settings on your computer	4	3	7	Year 1	Annual Review	Building Occupants
B5	Unplug chargers when not in use	4	3	7	Year 1	Annual Review	Building Occupants
B6	Turn off lights when areas not in use	4	3	7	Year 1	Annual Review	Building Occupants
B7	Make use of natural light instead of turning on lights where possible	4	3	7	Year 1	Annual Review	Building Occupants
M1	Optimize operating schedules for fans and pumps	3	3	6	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	3	6	Year 2	Seasonal Review	
EL4	Install power factor correction	3	3	6	Year 3	15+	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	3	4	Year 4	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	3	4	Year 4	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	3	4	Year 4	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	3	4	Year 4	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	3	4	Year 4	10 to 15	
L6	Replace festive lighting with LED	1	3	4	Year 4	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	3	4	Year 4	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	3	4	Year 4	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	3	4	Year 4	4 to 6	
EL3	Install controls on vending machines	1	3	4	Year 4	10 to 15	
EL5	Submeter data and call centres	1	3	4	Year 4	Seasonal Review	
M3	Install variable frequency drives (VFDs) on suitable fans and pumps	1	3	4	Year 4	10 to 20	
M4	Convert electric hot water heaters to natural gas	1	3	4	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B8	Adjust blinds (to retain heat in winter)	4	4	8	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	4	8	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	4	7	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	4	6	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	4	5	Year 3	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	4	5	Year 3	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	4	5	Year 3	seasonal review	
M10	Install controls on vehicle plug-in heaters	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementatio	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B11	Winterize room air-conditioners	4	4	8	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	4	8	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	4	8	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1		Building Occupants
M11	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M13	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M14	Test and tune the air conditioning units	3	4	7	Year 2	3	
M12	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 3	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B17	Optimize dishwasher operation (only run when full)	4	4	8	Year 1		Building Occupants
P1	Optimize DHW temperature control	2	4	6	Year 2	annual review	
P3	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M17	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P2	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	4	5	Year 3	10 to 15	
M15	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M16	Replace DHW boilers with more efficient models	1	4	5	Year 3	10 to 15	
	Other:_____						
	_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B18	Check and clear baseboard heaters of obstructions	4	2	6	Year 1		Building Occupants
B19	Adjust blinds (to retain heat in winter)	4	2	6	Year 1		Building Occupants
B20	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	2	6	Year 1		Building Occupants
M19	Optimize operating periods of ventilation systems supplying heated spaces	2	2	4	Year 2	seasonal review	
M20	Test and adjust ventilation systems to optimize outside air volumes	3	2	5	Year 2	seasonal review	
M23	Test and tune boiler efficiency	3	2	5	Year 2	seasonal review	
M25	Check heating system for flow balancing and air venting	3	2	5	Year 2	seasonal review	
EN1	Check and seal exterior walls and openings	3	2	5	Year 2	10 to 15	
EN5	Seal window and door frames	3	2	5	Year 2	5	
M26	Optimize fan-coil unit and entrance heater controls	3	2	5	Year 2	seasonal review	
M27	Consider heating system zoning	2	2	4	Year 2	n/a	
M22	Test, repair, replace and right-size heating control valves and outside air dampers	2	2	4	Year 4	10 to 15	
M18	Use controls to prevent heaters from running when overhead doors are open	1	2	3	Year 2	seasonal review	
M21	Apply CO control to vehicle area exhaust fans	1	2	3	Year 5	10 to 15	
M24	Upgrade heating system control to optimize space temperatures and operating periods	1	2	3	Year 5	10 to 15	
EN2	Insulate the attic adequately	1	2	3	Year 5	10 to 15	
EN3	Reclad the building's exterior	1	2	3	Year 5	20 to 24	
EN4	Replace single-pane windows with double-pane windows	1	2	3	Year 5	20 to 24	
EN6	If replacing the roof, ensure R-value at least 22	1	2	3	Year 5	n/a	
M28	Install high efficiency burners	1	2	3	Year 5	15 to 20	
M29	Replace boilers with more efficient models	1	2	3	Year 5	15 to 20	
M30	Replace old rooftop units with energy efficient units	1	2	3	Year 5	15 to 20	
M31	Install heat recovery or solar heating units	1	2	3	Year 5	10 to 15	
	Other:__						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 95: Energy Saving Measures for Fire Stations

The specific measures and implementation timeline for each individual fire station will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
Fire Hall 341	555 Oakwood Ave	Geothermal	31	kW
Fire Hall 112	5700 Bathurst St	Geothermal	70	kW
Fire Hall 123	143 Bond Ave	Geothermal	25	kW
Fire Hall 245	1600 Birchmount Rd	Geothermal	53	kW
Fire Hall 145	20 Beffort Rd	Solar PV	10	kW
Fire Hall 213	37 Lapsley	Solar PV	10	kW
Fire Hall 231	740 Markham Rd	Solar PV	10	kW
Fire Hall 234	40 Coronation Dr	Solar PV	10	kW
Fire Hall 235 & Special Operation Training Centre	220 Bermondsey Rd	Solar PV	10	kW
Fire Hall 243	4560 Sheppard Ave E	Solar PV	10	kW
Fire Hall 311	20 Balmoral	Solar PV	10	kW
Fire Hall 325	475 Dundas St E	Solar PV	10	kW
Fire Hall 441 and West Fire Training	947 Martin Grove Rd	Solar PV	10	kW
Fire Headquarters	4330 Dufferin St	Solar PV	40	kW

Table 96: Proposed Renewable Energy Systems on Fire Stations and Associated Facilities

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities, is $4.20/ft^2 (see Appendix A). The budget allows for lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high-potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low potential buildings is set at 40 percent of the basic amount to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium and low potential fire stations are summarized in Table 97 below.

Annual Savings Potential	Number of facilities	Average Area (ft^2)	Estimated Implementation Cost $/ft^2	Estimated Implementation Cost $	Estimated Savings potential $	Estimated Savings potential %	Payback
>$100,000	0	-	5.04	$ -	$ -	0.0%	
$5,000-$100,000	34	11,286	4.20	$ 1,611,673	$ 459,713	79.1%	3.51
<$5,000	54	8,390	1.68	$ 761,183	$ 121,402	20.9%	6.27
	88			**$ 2,372,855**	**$ 581,115**		**4.08**

Table 97: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the Specific Measures for Each Building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.

- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 98 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	34	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	54	$ 150	< $5,000	Division Champion and staff
		88			

Table 98: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Energy Assessment

There are 34 fire stations with between $5,000 and $100,000 in annual energy saving potential. Approximately 80% of the total energy savings for all 88 fire stations can be found in these 34 facilities.

These 34 fire stations can save an average of 38% of their total energy use. The total annual energy savings are estimated to be over $450,000 and individual building annual savings range from approximately $5,000 to over $55,000. The annual GHG savings are approximately 830,000 kg.

These 34 fire stations can save an average of 46% of their total electricity use (46% Electric Baseload, 41% Electric Cooling and 53% Electric Heating). The total annual electricity savings are estimated to be approximately $387,000 and individual building annual savings range from just over $1,200 to almost $48,000.

These 34 fire stations can save an average of 33% of their total gas use (49% Gas Baseload and 29% Gas Heating). The total annual gas savings are estimated to be approximately $72,700 and individual building annual savings range from $0 to approximately $7,000.

These 34 facilities will undergo an Energy Assessment with highest potential fire stations focused on first (see the Implementation Plan for further details).

Approximately 30% of the total energy savings can be found at the top 5 buildings with the highest savings potential (Toryork Office, Fire Station 334, the Fire Academy, Fire Station 112 and Fire Station 114).

Over 50% of the total energy savings can be found at the top 15 buildings with the highest savings potential.

See Appendix B for a list of these 34 fire stations and their associated energy savings potential by energy use component.

Highest percentage reductions for this group of 34 fire stations can be found in Electric Heating, Electric Baseload and Gas Baseload. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these fire stations are eligible to receive almost $250,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Savings Checklist

There are 54 fire stations with less than $5,000 in savings potential. Approximately 20% of the total energy savings for all 88 fire stations can be found in these 54 facilities.

These 54 fire stations can save an average of 20% of their total energy use. The total annual energy savings are estimated to be approximately $121,000 and individual building annual savings range from $0 to just under $5,000. The annual GHG savings are approximately 420,000 kg.

These 54 fire stations can save an average of 14% of their total electricity use (11% Electric Baseload, 41% Electric Cooling and 36% Electric Heating). The total annual electricity savings are estimated to be approximately $71,000 and individual building annual savings range from $0 to over $4,300.

These 54 fire stations can save an average of 22% of their total gas use (35% Gas Baseload and 22% Gas Heating). The total annual gas savings are estimated to be approximately $50,000 and individual building annual savings range from $0 to over $2,500.

These 54 facilities will undergo a checklist approach with highest potential fire stations focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 54 fire stations and their associated energy savings potential by energy use component.

The majority of the savings for this group of 54 fire stations can be found in Electric Heating, Electric Cooling and Gas Baseload.

The energy savings checklist will be used by the Division Champion for the fire stations in conjunction with the building operator and/or service contractor for each fire station. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 99 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 88 facilities. The total costs to implement the energy management and retrofit plan for Fire Halls is estimated to be $2,406,455. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	25,500
Checklist	$	8,100
Implementation	$	2,372,855
Total	**$**	**2,406,455**

Table 99: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 100 and Figure 49 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from Energy Assessments will begin in Year 1, with all 34 Energy Assessments completed by the end of Year 5. The implementation of these measures will begin in Year 2, and be completed by the end of Year 6. Identification of measures from the Checklists will begin in Year 2, with all 54 Checklists completed by the end of Year 10. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $2,168,318. The cumulative net cash flow becomes positive in Year 8.

The implementation plan includes the following assumptions:

- Approximately 75% of the project budget will be spent in the first 5 years, and the other 25% in the following 5 years.

- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 75% of medium and low potential savings facilities will be retrofitted in the first 5 years and 25% in the following 5 years.

- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.

- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).

- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
Mid Potential - Energy Assessment	8	8	8	8	2	0	0	0	0	0	34
Low Potential - Checklist	0	14	14	13	13	0	0	0	0	0	54
Assessment Costs	$ 6,000	$ 8,185	$ 8,229	$ 8,111	$ 3,653	$ -	$ -	$ -	$ -	$ -	$ 34,177
Implementation Costs	$ -	$ 394,538	$ 611,851	$ 624,088	$ 621,007	$ 313,132	$ -	$ -	$ -	$ -	$ 2,564,614
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 600	$ 40,272	$ 62,008	$ 63,220	$ 62,466	$ 31,313	$ -	$ -	$ -	$ -	$ 259,879
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 19,727	$ 50,319	$ 81,524	$ 112,574	$ 128,231	$ 128,231	$ 128,231	$ 128,231	$ 128,231	
Annual Costs	$ 6,600	$ 462,721	$ 732,407	$ 776,942	$ 799,700	$ 472,676	$ 128,231	$ 128,231	$ 128,231	$ 128,231	$ 3,763,969
Estimated Achieved Annual Savings		$ 62,108.19	$ 233,166.09	$ 453,854.91	$ 618,421.13	$ 737,596.42	$ 811,432.80	$ 858,570.92	$ 901,499.47	$ 946,574.44	$ 5,623,224
Estimated Incentives	$ -	$ 124,301	$ 86,760	$ 54,837	$ 34,424	$ 8,741	$ -	$ -	$ -	$ -	$ 309,062
Annual Savings and Incentives	$ -	$ 186,409	$ 319,926	$ 508,692	$ 652,845	$ 746,337	$ 811,433	$ 858,571	$ 901,499	$ 946,574	$ 5,932,287
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 264	-$ 11,316	-$ 27,816	-$ 38,546	-$ 44,420	-$ 33,473	-$ 6,145	$ -	$ -	-$ 161,981
Net Cash Flow incl borrowing costs	-$ 6,600	-$ 276,576	-$ 423,797	-$ 296,066	-$ 185,400	$ 229,242	$ 649,729	$ 724,195	$ 773,269	$ 818,344	$ 2,006,337
Cumulative Net Cash Flow	-$ 6,600	-$ 282,912	-$ 695,393	-$ 963,644	-$ 1,110,498	-$ 836,837	-$ 153,635	$ 576,706	$ 1,349,974	$ 2,168,318	

Table 100: Cash Flow for 10-Year Implementation Plan

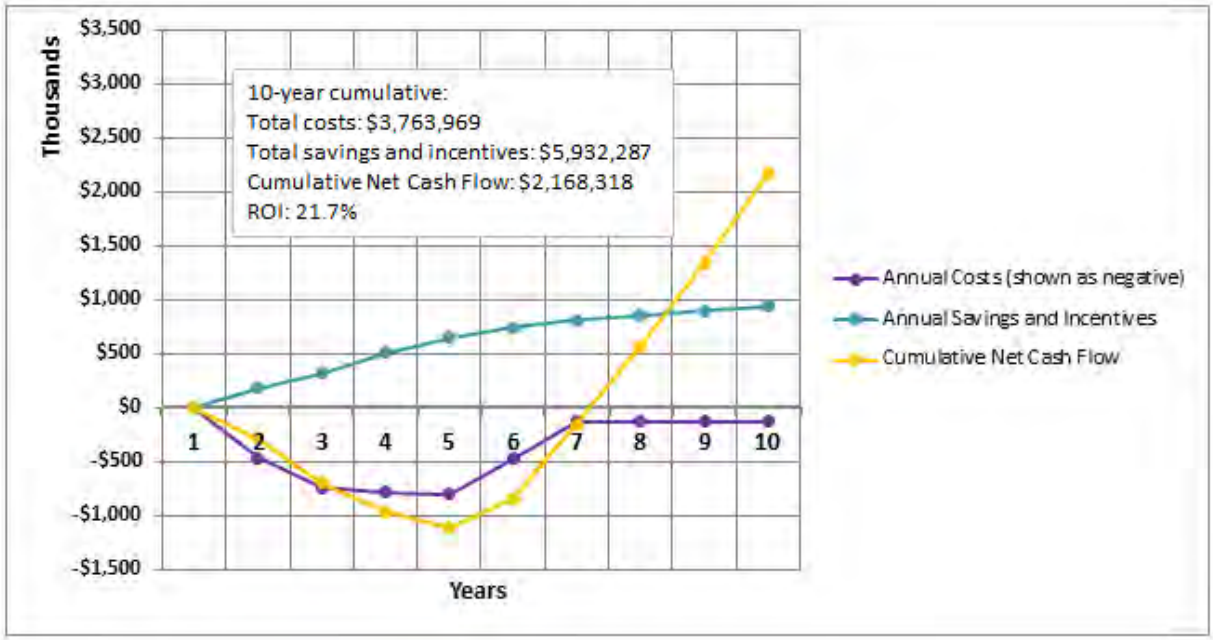

Figure 59: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above) and facilities of the same type from other municipalities. Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for fire stations is determined as the average kWh/day for April, May, September and October multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from June to August, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February, March, November and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload ($ekWh/ft^2$)

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2)

Garage: Add 20 $ekWh/ft^2$ to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Indoor Recreational Facilities:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility ($ekWh/ft^2$ of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant ($ekWh/ft^2$ of ice/week) * Months ice-in * 52 weeks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool ($ekWh/ft^2$ of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, $ekWh/ft^2$ of total area = Gas Baseload for Composite Recreational Facility ($ekWh/ft^2$ of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas ($ekWh/ft^2$ of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools ($ekWh/ft^2$ of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, $ekWh/ft^2$ of total area = Gas Heating for Composite Recreational Facility ($ekWh/ft^2$ of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas ($ekWh/ft^2$ of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools ($ekWh/ft^2$ of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Fire stations and associated offices and facilities
- Shelter, Support and Housing Administration
- Ambulance stations and associated offices and facilities
- Storage facilities where equipment or vehicles are maintained, repaired or stored
- Public libraries
- Long-Term Care Homes and Services
- Police stations and associated offices and facilities
- Children's Services
- Administrative offices and related facilities, including municipal council chambers

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	1.80	100%	6.5	2.3	
Mechanical	1.50	30%	6	0.6	0.7
Electrical	0.25	100%	8	0.3	
Envelope	0.50	0%	10		0.2
Process	0.15	0%	5		0.1
Total	**4.20**		**6.8**	**3.19**	**1.02**

Table 101: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process (domestic hot water) measures include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver

the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved, and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers
- Performance based target setting customized for your building
- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Fire Stations

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 88 fire station buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Fire Station 111	3300 Bayview Ave	5,662
Fire Station 112	5700 Bathurst St	7,018
Fire Station 113	700 Seneca Hill Dr	4,833
Fire Station 114	12 Canterbury Place	8,633
Fire Station 115	115 Parkway Forest Dr	5,985
Fire Station 116	2755A Old Leslie St	11,776
Fire Station 121	10 William Carson Cres	4,219
Fire Station 122	2545 Bayview Ave	3,046
Fire Station 123	145 Bond Ave	2,497
Fire Station 125	1109 Leslie Street	5,813
Fire Station 131	3135 Yonge St	5,845
Fire Station 132	476 Lawrence Ave W	7,664
Fire Station 133	1505 Lawrence Ave W	8,062
Fire Station 134	16 Montgomery Ave	7,126
Fire Station 135	641 Eglinton Ave W	10,592
Fire Station 141	4100 Keele St	12,000
Fire Station 142	2753 Jane Street	5,586
Fire Station 143	1009 Sheppard Ave W	2,895
Fire Station 145	20 Beffort Rd	11,001
Fire Station 146	2220 Jane St	7,535
Fire Station 211	900 Tapscott Rd	5,005
Fire Station 212	8500 Sheppard Ave East	16,501
Fire Station 213	7 Lapsley Rd	5,048
Fire Station 214	745 Meadowvale Rd	4,887
Fire Station 215	5318 Lawrence Ave E	5,737
Fire Station 222	755 Warden Ave	6,910
Fire Station 223	116 Dorset Rd	7,459
Fire Station 224	1313 Woodbine Ave	3,767
Fire Station 225	3600 Danforth Ave	9,085
Fire Station 226	85 Main St	11,808
Fire Station 227	1904 Queen St E	10,484
Fire Station 231	740 Markham Rd	14,241

Building	Address	Building Area (ft^2)
Fire Station 232	1550 Midland Ave	5,350
Fire Station 233	59 Curlew Dr	11,001
Fire Station 234	40 Coronation Dr	5,350
Fire Station 235	200 Bermondsey Rd	8,902
Fire Station 241	3325 Warden Ave	5,500
Fire Station 242	2733 Brimley Rd	5,500
Fire Station 243	4560 Sheppard Ave E	5,350
Fire Station 244	2340 Birchmount Rd	5,350
Fire Station 245	1600 Birchmount Rd	5,608
Fire Station 311	20 Balmoral Ave	12,755
Fire Station 312	34 Yorkville Ave	9,806
Fire Station 313	441 Bloor St E	12,099
Fire Station 314	12 Grosvenor St	11,937
Fire Station 315	132 Bellevue Ave	7,244
Fire Station 321	231 McCrae Ave	7,535
Fire Station 322	256 Cosburn Ave	7,535
Fire Station 323	153 Chatham Ave	10,236
Fire Station 324	840 Gerrard St E	13,153
Fire Station 325	475 Dundas St E	10,129
Fire Station 331	31 Claremont St	10,979
Fire Station 332	260 Adelaide St W	24,865
Fire Station 333	201 Front St E	12,723
Fire Station 334	339 Queens Quay West	13,003
Fire Station 335	235 Cibola Ave	4,402
Fire Station 341	555 Oakwood Ave	9,268
Fire Station 342	106 Ascot Ave	3,057
Fire Station 343	65 Hendrick Ave	9,827
Fire Station 344	240 Howland Ave	11,238
Fire Station 345	1287 Dufferin St	12,809
Fire Station 411	75 Toryork Dr	8,762
Fire Station 412	267 Humberline Dr	7,029
Fire Station 413	1549 Albion Rd	3,929
Fire Station 415	2120 Kipling Ave	7,804
Fire Station 421	6 Lambton Ave	9,461
Fire Station 422	590 Jane St	7,944
Fire Station 423	358 Keele St	12,335
Fire Station 424	462 Runnymede Rd	5,866

Building	Address	Building Area (ft^2)
Fire Station 425	83 Deforest Rd	7,955
Fire Station 426	140 Lansdowne Ave	12,486
Fire Station 431	308 Prince Edward Dr	3,907
Fire Station 432	155 The East Mall	13,692
Fire Station 433	615 Royal York Rd	5,038
Fire Station 434	3 Lunness Rd	5,188
Fire Station 435	130 Eighth St	6,889
Fire Station 441	947 Martin Grove Rd	19,472
Fire Station 442	2015 Lawrence Ave W	15,478
Fire Station 443	1724 Islington Ave	3,929
Fire Station 444	666 Renforth Dr	3,929
Fire Station 445	280 Burnhamthorpe Rd	11,765
Fire Stn former TO #35	11 Queens Quay W	3,143
Fire Academy	895 Eastern Ave	61,214
Fire Museum And Storage	351 Birchmount Rd	3,272
Fire Training Centre	4562 Sheppard Ave E	7,998
Husar Training Bldg	N/A	11,474
Rotherham Ave 15	15 Rotherham Ave	23,002
Toryork Office	40 Toryork	42,625

Table 102: Fire Station Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 88 fire station buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft^2)	2012 Total Gas Intensity ($ekWh/ft^2$)	2012 Total Energy Intensity ($ekWh/ft^2$)
Fire Station 425	6.40	9.04	15.44
Fire Station 441	6.31	10.56	16.87
Fire Station 411	8.94	9.78	18.72
Rotherham Ave 15	7.21	12.56	19.76
Fire Training Centre	8.04	12.05	20.09
Fire Station 223	6.12	16.02	22.14
Fire Station 432	2.56	20.45	23.01
Fire Station 445	10.58	12.83	23.41
Fire Station 332	12.05	12.19	24.24

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Fire Station 314	4.45	19.87	24.31
Fire Station 324	6.10	18.67	24.76
Fire Station 243	9.42	15.57	24.98
Fire Station 311	4.69	20.41	25.10
Fire Station 415	9.14	16.35	25.50
Fire Station 331	7.89	17.84	25.73
Fire Station 435	12.14	14.16	26.30
Fire Station 231	9.78	16.53	26.32
Fire Station 434	5.68	21.15	26.83
Fire Station 322	5.36	21.57	26.93
Fire Station 343	5.01	21.95	26.96
Fire Station 233	7.95	19.27	27.22
Fire Station 146	7.56	19.68	27.24
Fire Station 442	14.21	13.29	27.49
Fire Station 125	11.07	16.61	27.68
Fire Station 245	7.80	19.93	27.73
Fire Station 421	10.65	17.09	27.74
Fire Station 227	7.10	21.10	28.20
Fire Station 133	11.93	17.03	28.96
Fire Academy	11.82	17.41	29.23
Fire Station 431	10.03	19.26	29.29
Fire Station 226	5.88	24.24	30.11
Fire Station 134	5.88	24.41	30.28
Fire Station 423	8.52	21.94	30.46
Fire Station 413	9.87	20.71	30.58
Fire Station 422	7.94	22.68	30.62
Fire Station 222	8.55	22.66	31.21
Fire Station 241	8.25	23.06	31.31
Fire Station 344	6.76	24.62	31.38
Fire Station 444	7.29	24.30	31.59
Fire Station 145	9.28	22.33	31.61
Fire Station 215	10.98	20.91	31.90
Fire Station 312	9.85	22.30	32.15
Fire Station 325	8.92	23.46	32.39
Fire Station 116	16.21	16.47	32.68
Fire Station 234	9.02	23.68	32.70
Fire Station 333	9.98	22.75	32.73

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Fire Station 242	10.33	22.40	32.73
Fire Station 132	12.07	21.16	33.24
Fire Station 244	9.68	23.98	33.66
Fire Station 443	8.85	24.93	33.78
Fire Station 211	18.44	15.58	34.02
Fire Station 225	10.54	23.75	34.29
Fire Station 135	12.94	21.60	34.54
Fire Station 232	13.54	21.11	34.65
Fire Station 321	11.87	22.85	34.73
Fire Station 235	12.02	23.97	36.00
Fire Station 115	17.08	19.47	36.56
Fire Station 433	19.63	17.60	37.23
Fire Station 341	8.68	28.76	37.44
Fire Station 214	11.95	25.51	37.46
Husar Training Bldg	20.66	17.00	37.66
Fire Station 424	9.78	27.98	37.77
Fire Station 412	10.71	27.09	37.80
Fire Station 426	14.10	23.95	38.05
Fire Station 213	11.86	26.64	38.50
Toryork Office	16.50	22.14	38.65
Fire Station 212	13.29	25.95	39.24
Fire Station 224	16.45	22.86	39.32
Fire Station 345	9.68	30.55	40.23
Fire Station 313	13.02	28.69	41.71
Fire Station 342	9.26	32.97	42.23
Fire Station 334	27.34	15.23	42.58
Fire Station 323	10.99	31.60	42.59
Fire Station 121	25.38	17.47	42.85
Fire Station 335	25.73	17.67	43.39
Fire Stn former TO #35	43.83	0.00	43.83
Fire Station 141	13.24	30.98	44.22
Fire Station 131	13.87	30.79	44.66
Fire Station 315	14.32	34.20	48.51
Fire Station 111	16.04	33.33	49.37
Fire Station 113	16.51	33.25	49.76
Fire Museum And Storage	6.78	43.50	50.28
Fire Station 122	17.07	41.71	58.78

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Fire Station 142	21.43	38.17	59.59
Fire Station 114	23.72	39.04	62.76
Fire Station 112	31.48	34.03	65.51
Fire Station 123	19.29	63.23	82.52
Fire Station 143	24.59	66.94	91.53

Table 103: Fire Station 2012 Energy Intensity

5.3 Target-setting Method and Metrics

20 fire stations were determined to be ineligible for determination of energy components or target-setting. See Appendix A. The excluded facilities are listed below.

Facility	Days in 2012	Energy type
Fire Station 116	335	Gas
Fire Station 122	333	Electricity
Fire Station 123	394	Electricity
Fire Station 132	398	Electricity
Fire Station 134	396	Electricity
Fire Station 141	336	Gas
Fire Station 143	399	Electricity
Fire Station 146	399	Electricity
Fire Station 211	454	Electricity
Fire Station 223	334	Gas
Fire Station 227	334	Electricity
Fire Station 311	452	Electricity
Fire Station 314	399	Electricity
Fire Station 321	460	Electricity
Fire Station 412	327	Electricity
Fire Station 423	333	Electricity
Fire Station 431	397	Electricity
Fire Station 441	728	Gas
Fire Station 442	395	Electricity
Fire Station 445	394	Electricity

Table 104: Excluded Facilities

After excluding these 20 facilities, 68 City of Toronto facilities and 8 from other municipalities were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component.

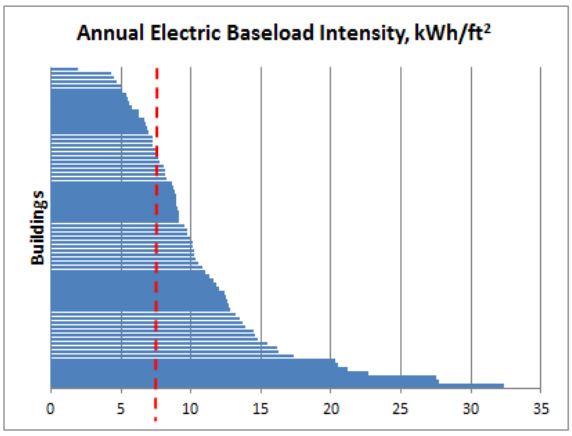

Figure 60: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for fire stations ranges from 1.9 to 32.4 ekWh/ft^2 and the top-quartile is 7.4 ekWh/ft^2.

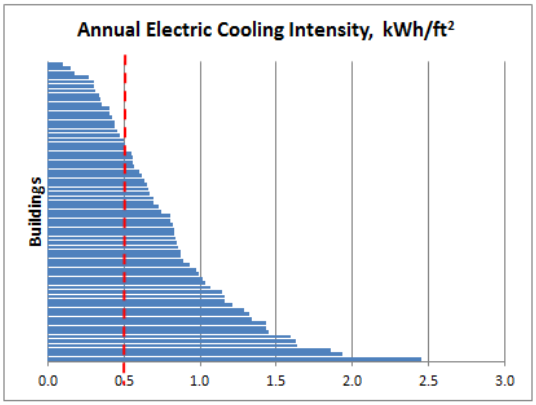

Figure 61: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for fire stations ranges from 0 to 2.5 ekWh/ft^2 and the top-quartile is 0.5 ekWh/ft^2.

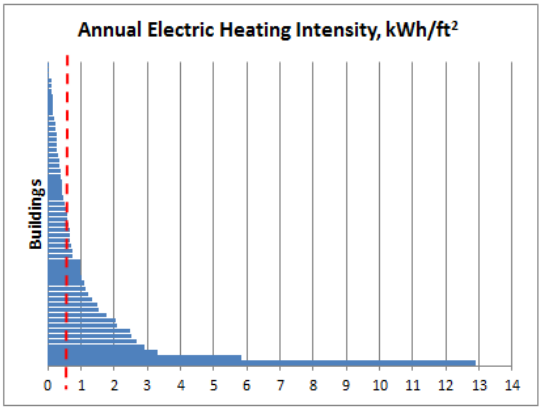

Figure 62: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for fire stations ranges from 0 to 12.9 ekWh/ft^2 and the top-quartile is 0.6 ekWh/ft^2.

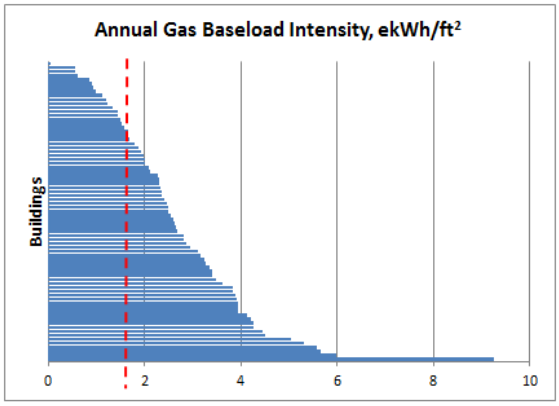

Figure 63: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for fire stations ranges from 0 to 9.3 ekWh/ft^2 and the top-quartile is 1.7 ekWh/ft^2.

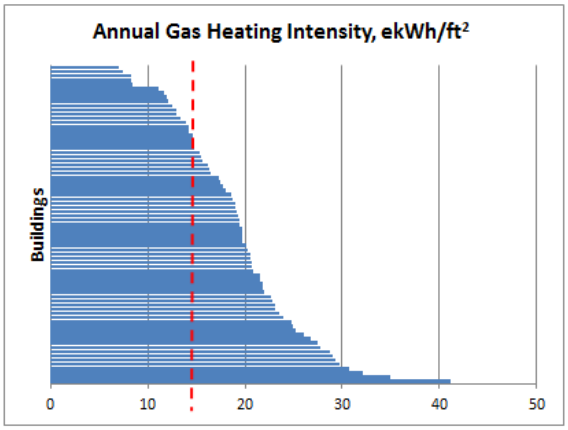

Figure 64: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for fire stations ranges from 7.0 to 41.2 ekWh/ft^2 and the top-quartile is 14.7 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of fire stations, the factors are

% of the facility area served by electric heat, % of DHW heated by electricity, use of ground-source or water-source heat pumps, and % of the area served by electric air conditioning.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from Total Electricity use (or Total Gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 34 Mid Savings Potential Fire Stations

Buildings are sorted by total annual savings potential, starting with the highest saving potential buildings.

There are 34 fire stations with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (34)	46%	41%	53%	46%	$387,007	49%	29%	33%	$ 72,706	38%	$459,713	$221,147	$27,964	383,732	829,515
Toryork Office	52%			49%	$ 47,797		31%	30%	$ 7,228	38%	$ 55,026	$ 27,313	$ 2,780	42,625	89,792
Fire Station 334	69%		90%	76%	$ 37,903	28%		4%	$ 220	50%	$ 38,123	$ 21,659	$ 85	13,003	31,371
Fire Academy	27%	44%	24%	28%	$ 28,709	49%		9%	$ 2,511	17%	$ 31,220	$ 16,405	$ 966	61,214	40,705
Fire Station 112	73%	64%	77%	73%	$ 22,648	59%	50%	51%	$ 3,075	62%	$ 25,723	$ 12,942	$ 1,183	7,018	40,016
Fire Station 114	64%	67%	68%	64%	$ 18,483	56%	58%	57%	$ 4,865	60%	$ 23,348	$ 10,562	$ 1,871	8,633	49,682
Husar Training Bldg	57%		79%	58%	$ 19,382		10%	10%	$ 478	36%	$ 19,860	$ 11,076	$ 184	11,474	18,682
Fire Station 332	34%	42%		35%	$ 14,723	56%		18%	$ 1,378	27%	$ 16,101	$ 8,413	$ 530	24,865	21,530
Fire Station 212	40%	22%		38%	$ 11,803	47%	37%	38%	$ 4,131	38%	$ 15,934	$ 6,745	$ 1,589	16,501	39,128
Fire Station 426	47%	56%		51%	$ 12,633	10%	33%	31%	$ 2,335	39%	$ 14,968	$ 7,219	$ 898	12,486	26,801
Fire Station 142	63%	44%		62%	$ 10,326	71%	54%	57%	$ 3,035	58%	$ 13,361	$ 5,900	$ 1,167	5,586	30,048
Fire Station 116				48%	$ 12,803			0%	$ 7	24%	$ 12,810	$ 7,316	$ 3	11,776	10,107
Fire Station 335	73%			78%	$ 12,368	49%		10%	$ 186	50%	$ 12,554	$ 7,067	$ 72	4,402	11,062
Fire Station 141				36%	$ 8,067			47%	$ 4,380	44%	$ 12,447	$ 4,610	$ 1,684	12,000	37,989
Fire Station 442				39%	$ 11,988			0%	$ -	20%	$ 11,988	$ 6,851	$ -	15,478	9,419
Fire Station 313	37%	36%		35%	$ 7,821	69%	36%	42%	$ 3,700	40%	$ 11,521	$ 4,469	$ 1,423	12,099	32,882
Fire Stn former TO #35	73%		10%	57%	$ 10,982				$ -	57%	$ 10,982	$ 6,275	$ -	3,143	8,629
Fire Station 143				66%	$ 6,545			75%	$ 3,673	73%	$ 10,218	$ 3,740	$ 1,413	2,895	31,685
Fire Station 121	65%	71%	77%	66%	$ 9,953	35%	0%	5%	$ 101	42%	$ 10,054	$ 5,687	$ 39	4,219	8,552
Fire Station 135	41%		41%	43%	$ 8,267	5%	25%	23%	$ 1,338	31%	$ 9,605	$ 4,724	$ 514	10,592	16,162
Fire Station 315	41%		63%	42%	$ 6,089	81%	41%	51%	$ 3,201	49%	$ 9,290	$ 3,480	$ 1,231	7,244	27,916
Fire Station 111	49%	45%	9%	47%	$ 5,917	56%	50%	50%	$ 2,389	49%	$ 8,306	$ 3,381	$ 919	5,662	21,915
Fire Station 323	27%	33%		27%	$ 4,217	55%	47%	48%	$ 3,876	42%	$ 8,093	$ 2,410	$ 1,491	10,236	31,323
Fire Station 433	54%		81%	57%	$ 7,859	39%		6%	$ 138	33%	$ 7,997	$ 4,491	$ 53	5,038	7,175
Fire Station 115	42%	56%	83%	51%	$ 7,247		22%	22%	$ 632	35%	$ 7,879	$ 4,141	$ 243	5,985	10,261
Fire Station 113	46%	75%		46%	$ 5,167	62%	49%	50%	$ 2,030	49%	$ 7,197	$ 2,953	$ 781	4,833	18,728
Fire Station 131	44%	33%		43%	$ 4,934		49%	46%	$ 2,100	46%	$ 7,034	$ 2,819	$ 808	5,845	19,054
Fire Station 211				54%	$ 7,004			0%	$ -	29%	$ 7,004	$ 4,002	$ -	5,005	5,503
Fire Station 123				56%	$ 3,792			74%	$ 2,935	70%	$ 6,727	$ 2,167	$ 1,129	2,497	24,189
Fire Station 235	31%	53%		32%	$ 4,870		36%	34%	$ 1,822	33%	$ 6,692	$ 2,783	$ 701	8,902	16,990
Fire Station 325	28%			32%	$ 4,105	58%	24%	30%	$ 1,807	31%	$ 5,913	$ 2,346	$ 695	10,129	16,285
Fire Station 345	2%	50%	14%	7%	$ 1,211	55%	45%	46%	$ 4,530	37%	$ 5,741	$ 692	$ 1,742	12,809	33,687
Fire Station 122				51%	$ 3,679			61%	$ 1,933	58%	$ 5,612	$ 2,103	$ 743	3,046	16,859
Fire Station 333	19%	9%		18%	$ 3,162	47%	25%	28%	$ 2,065	25%	$ 5,227	$ 1,807	$ 794	12,723	17,411
Fire Station 224	49%	76%		52%	$ 4,549	56%	22%	28%	$ 609	38%	$ 5,158	$ 2,600	$ 234	3,767	7,974

Table 105: Savings Potential for 34 Medium Savings Potential Fire Stations

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 54 Low Savings Potential Fire Stations

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 54 fire stations with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (54)	11%	41%	36%	14%	$ 70,973	35%	22%	22%	$ 50,429	20%	$121,402	$ 40,556	$19,396	453,085	420,208
Fire Station 344		62%	57%	22%	$ 2,350		38%	37%	$ 2,580	34%	$ 4,930	$ 1,343	$ 992	11,238	20,492
Fire Station 421	24%	56%		29%	$ 4,044	68%		21%	$ 855	24%	$ 4,899	$ 2,311	$ 329	9,461	9,355
Fire Station 321				29%	$ 3,621			28%	$ 1,212	28%	$ 4,832	$ 2,069	$ 466	7,535	11,601
Fire Station 132				30%	$ 3,895			22%	$ 908	25%	$ 4,803	$ 2,226	$ 349	7,664	9,620
Fire Station 232	36%	71%		40%	$ 4,020	34%	21%	22%	$ 631	29%	$ 4,651	$ 2,297	$ 243	5,350	7,716
Fire Station 225	19%	52%		21%	$ 2,843	46%	28%	31%	$ 1,653	28%	$ 4,497	$ 1,625	$ 636	9,085	14,184
Fire Station 435	33%		62%	37%	$ 4,353	27%		4%	$ 109	20%	$ 4,462	$ 2,487	$ 42	6,889	4,206
Fire Station 231	18%	48%		21%	$ 4,118	14%	4%	4%	$ 266	11%	$ 4,384	$ 2,353	$ 102	14,241	5,156
Fire Station 412				22%	$ 2,282			39%	$ 1,879	34%	$ 4,161	$ 1,304	$ 723	7,029	15,373
Fire Station 145	16%	25%		17%	$ 2,466	40%	24%	26%	$ 1,601	23%	$ 4,067	$ 1,409	$ 616	11,001	13,506
Fire Station 133	27%	44%	43%	29%	$ 3,923	26%		3%	$ 121	14%	$ 4,044	$ 2,242	$ 46	8,062	3,955
Fire Station 213	30%	60%		32%	$ 2,702	56%	35%	38%	$ 1,290	36%	$ 3,992	$ 1,544	$ 496	5,048	11,446
Fire Station 341	10%			10%	$ 1,114	31%	44%	42%	$ 2,827	35%	$ 3,941	$ 636	$ 1,087	9,268	21,309
Fire Station 214	22%		73%	30%	$ 2,473	25%	36%	35%	$ 1,089	33%	$ 3,562	$ 1,413	$ 419	4,887	9,811
Fire Station 445				19%	$ 3,325			0%	$ -	9%	$ 3,325	$ 1,900	$ -	11,765	2,613
Fire Station 424	19%	32%		20%	$ 1,644	34%	42%	41%	$ 1,676	35%	$ 3,320	$ 940	$ 645	5,866	13,402
Fire Station 312	9%	59%		14%	$ 1,902	27%	25%	25%	$ 1,392	22%	$ 3,294	$ 1,087	$ 535	9,806	11,555
Fire Station 242	24%	47%		27%	$ 2,119	61%	17%	26%	$ 802	26%	$ 2,921	$ 1,211	$ 308	5,500	7,461
Fire Station 215	28%	6%		26%	$ 2,289	59%	11%	21%	$ 623	22%	$ 2,913	$ 1,308	$ 240	5,737	6,304
Fire Station 226		29%		3%	$ 319	24%	32%	31%	$ 2,257	26%	$ 2,575	$ 182	$ 868	11,808	16,559
Fire Station 244		81%		20%	$ 1,486	51%	29%	33%	$ 1,047	29%	$ 2,534	$ 849	$ 403	5,350	8,736
Fire Station 432			12%	3%	$ 149		32%	33%	$ 2,334	30%	$ 2,484	$ 85	$ 898	13,692	16,988
Fire Museum And Storage		9%		1%	$ 20	14%	64%	61%	$ 2,199	53%	$ 2,219	$ 11	$ 846	3,272	15,907
Fire Station 125	17%	68%	14%	24%	$ 2,137	8%		1%	$ 20	10%	$ 2,157	$ 1,221	$ 8	5,813	1,826
Fire Station 222	4%	60%		12%	$ 980	30%	28%	29%	$ 1,129	24%	$ 2,109	$ 560	$ 434	6,910	8,931
Fire Station 342	15%	28%		17%	$ 655	13%	52%	49%	$ 1,251	42%	$ 1,906	$ 374	$ 481	3,057	9,556
Fire Station 233		54%		7%	$ 855		18%	17%	$ 892	14%	$ 1,747	$ 489	$ 343	11,001	7,119
Fire Station 423				0%	$ -			25%	$ 1,701	18%	$ 1,701	$ -	$ 654	12,335	12,293
Fire Training Centre			72%	18%	$ 1,643			0%	$ -	7%	$ 1,643	$ 939	$ -	7,998	1,291
Fire Station 422	4%	9%		4%	$ 393		29%	27%	$ 1,224	21%	$ 1,618	$ 225	$ 471	7,944	9,158
Fire Station 234	0%		54%	8%	$ 516	17%	32%	31%	$ 998	25%	$ 1,514	$ 295	$ 384	5,350	7,618
Fire Station 343				0%	$ -		29%	27%	$ 1,490	22%	$ 1,490	$ -	$ 573	9,827	10,765
Fire Station 134				0%	$ -			33%	$ 1,424	26%	$ 1,424	$ -	$ 548	7,126	10,292
Fire Station 413	17%	31%		18%	$ 983	18%	21%	21%	$ 429	20%	$ 1,413	$ 562	$ 165	3,929	3,874
Fire Station 241			49%	7%	$ 428	44%	27%	29%	$ 929	23%	$ 1,357	$ 244	$ 357	5,500	7,051
Fire Station 311				0%	$ -			19%	$ 1,269	16%	$ 1,269	$ -	$ 488	12,755	9,171
Fire Station 227				0%	$ -			22%	$ 1,225	16%	$ 1,225	$ -	$ 471	10,484	8,854
Fire Station 415	9%	34%		11%	$ 1,089	25%		4%	$ 113	6%	$ 1,202	$ 622	$ 43	7,804	1,669
Fire Station 322		30%		4%	$ 214	60%	15%	24%	$ 961	20%	$ 1,174	$ 122	$ 370	7,535	7,112
Fire Station 443	8%			7%	$ 342	70%	23%	34%	$ 831	27%	$ 1,173	$ 195	$ 320	3,929	6,277
Fire Station 431				15%	$ 806			15%	$ 275	15%	$ 1,081	$ 461	$ 106	3,907	2,623
Fire Station 314				0%	$ -			17%	$ 1,024	14%	$ 1,024	$ -	$ 394	11,937	7,404
Fire Station 243		55%	41%	10%	$ 724	49%		11%	$ 226	11%	$ 949	$ 414	$ 87	5,350	2,200
Fire Station 245		42%	17%	6%	$ 355	33%	15%	18%	$ 495	14%	$ 850	$ 203	$ 190	5,608	3,853
Fire Station 444				0%	$ -	66%	24%	32%	$ 776	25%	$ 776	$ -	$ 299	3,929	5,612
Fire Station 324				0%	$ -	41%	6%	11%	$ 704	9%	$ 704	$ -	$ 271	13,153	5,091
Fire Station 411		22%	41%	6%	$ 694			0%	$ -	3%	$ 694	$ 397	$ -	8,762	545
Fire Station 434				0%	$ -		25%	24%	$ 654	19%	$ 654	$ -	$ 251	5,188	4,725
Fire Station 146				0%	$ -			16%	$ 611	12%	$ 611	$ -	$ 235	7,535	4,419
Fire Station 331		18%		1%	$ 152		9%	8%	$ 396	6%	$ 548	$ 87	$ 152	10,979	2,982
Rotherham Ave 15		28%		2%	$ 365	100%		0%	$ 29	1%	$ 394	$ 208	$ 11	23,002	498
Fire Station 425			23%	3%	$ 186			0%	$ -	1%	$ 186	$ 106	$ -	7,955	146
Fire Station 223				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	7,459	0
Fire Station 441				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	19,472	0

Table 106: Savings Potential for 54 Low Savings Potential Fire Stations

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use - Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Indoor Recreational Facilities

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1 Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 46 indoor recreational facilities in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B.

The total area for all of the buildings is 1,477,712 ft^2. Indoor recreational facilities range in size from just over 1,000 ft^2 to almost 140,000 ft^2.

Facilities equipped with renewable energy systems are presented in the following table:

Building Name	Building Address	Renewable Installation	System Size	Unit
Agincourt Rec Centre	31 Glen Watford Dr	Solar Pool Heating	166	kW
Jimmie Simpson Rec Centre	870 Queen St E	Solar Pool Heating	280	kW
Roding CC	600 Roding St	Solar Photovoltaic	75	kW
Goulding CC	45 Goulding Ave	Solar Photovoltaic	75	kW

Table 107: Current Renewable Energy Systems on Indoor Recreational Facilities

The facilities range from 0% to 100% air-conditioned. No facilities are fully served by electric heat and there are a number of other facilities using between 5 and 25% electric heat. No facilities are served by ground or water source heat pumps. There are food services at a number of facilities, ranging from 2 to 50% of building served.

The indoor recreational facilities fall into four types:

- Facilities with indoor ice rinks only
- Facilities with indoor pools only
- Facilities with both indoor rinks and indoor pools
- Facilities without indoor rinks or indoor pools

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 46 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	32,122,056	$4,497,088
Natural Gas (m^3)	3,783,217	$983,636
Total		**$5,480,724**

Table 108: 2012 Energy Use and Costs for 46 City of Toronto Indoor Recreational Facilities

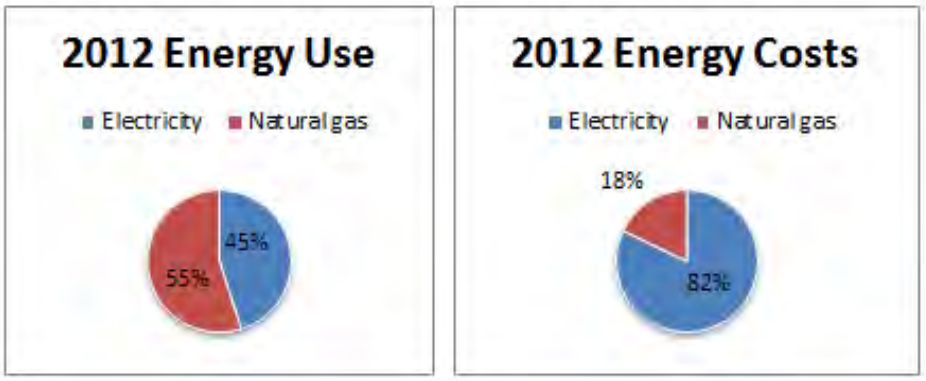

Figure 65: 2012 Energy Use and Cost Breakdown City of Toronto Indoor Recreational Facilities

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 46 buildings. Total energy use ranges from approximately 2.2 to 86.4 ekWh/ft2. There are also wide ranges for electricity and gas use per ft2. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

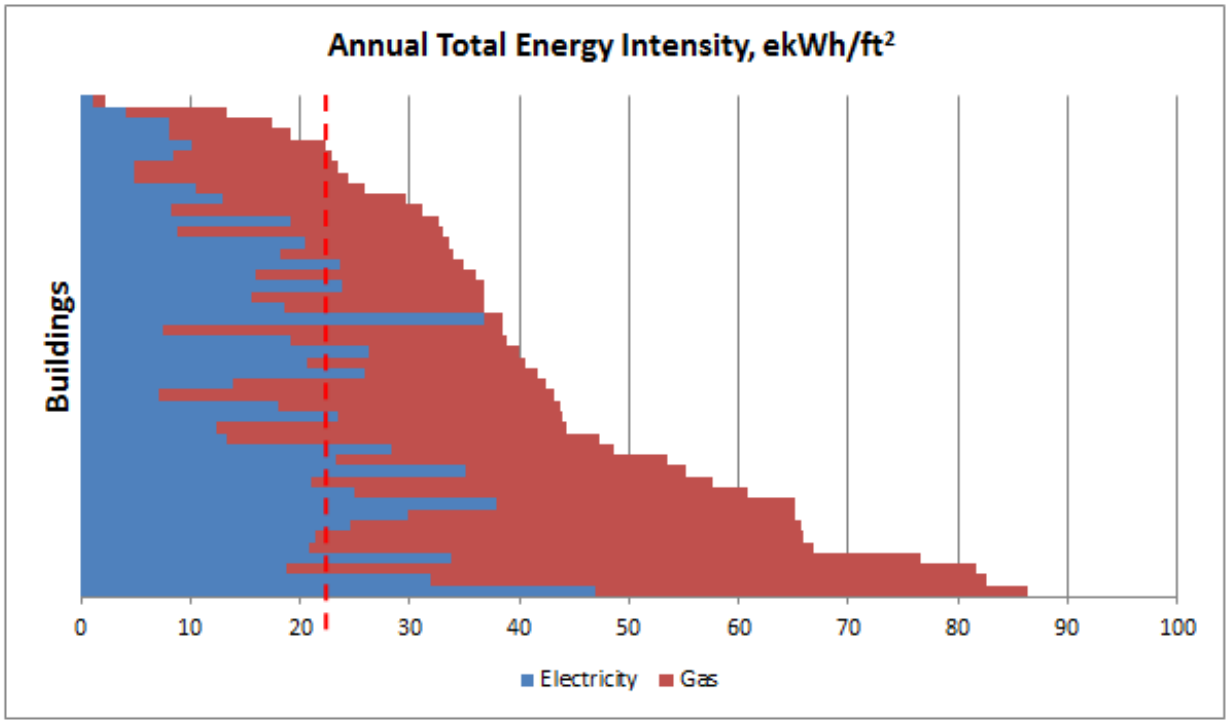

Figure 66: 2012 Total Energy Intensity Benchmark

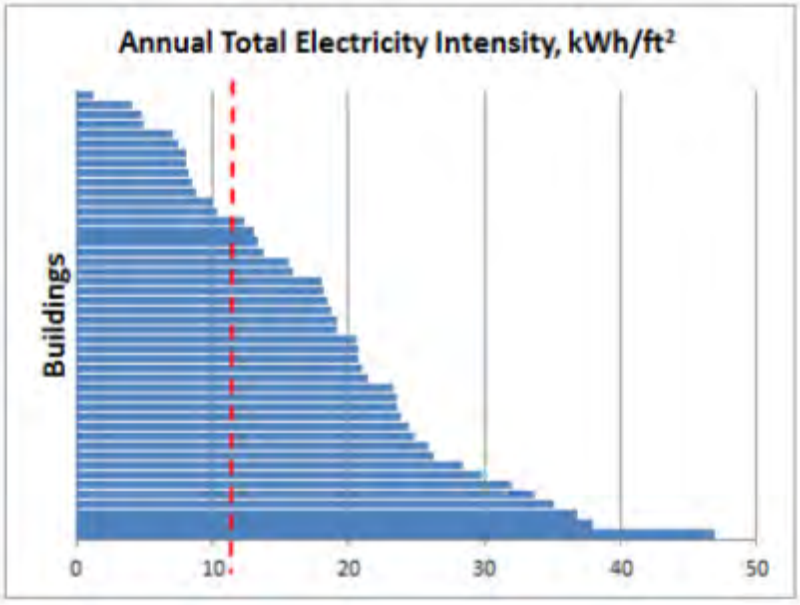

Figure 67: 2012 Total Electricity Intensity Benchmark

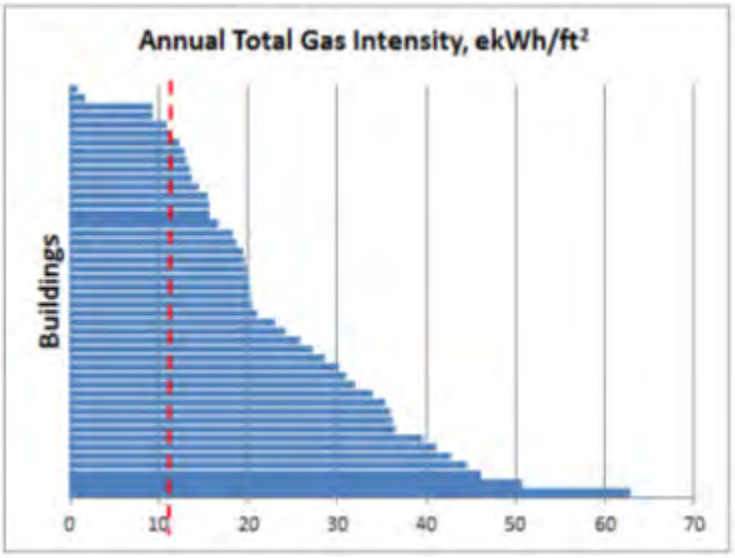

Figure 68: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for indoor recreational facilities are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each indoor recreational facility to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	9.2	kWh/sq ft/year
	Cooling	0.8	kWh/sq ft/year
	Heating	1.8	kWh/sq ft/year
	Total	11.8	kWh/sq ft/year
Gas	Base	1.8	ekWh/sq ft/year
	Heating	9.7	ekWh/sq ft/year
	Total	11.5	ekWh/sq ft/year
Total energy	Total	23.3	ekWh/sq ft/year

Table 109: Top Quartile Targets

The data set for target-setting is made up of 79 indoor recreational facilities and community centres with complete and reliable data, all of which are City of Toronto facilities. Recreational facilities and community centres were combined to provide a larger data set, since they are facilities of similar type. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water

(DHW)), % of the area which is air conditioned, % of the area served by food services. The targets for facilities with indoor rinks are adjusted for size of the ice surface and time period that the ice is in. The targets for facilities with indoor pools are adjusted for the size of the pool. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each indoor recreational facility. The total savings potential for each indoor recreational facility is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 46 indoor recreational facilities are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There are 8 indoor recreational facilities with annual savings potential greater than $100,000. 24 indoor recreational facilities have annual savings potential between $5,000 and $100,000, and 14 indoor recreational facilities have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 46 buildings is $2,633,308 ($2,121,029 for electricity and $512,279 for gas) with an average total energy savings of 50%.

For the 8 high-potential savings facilities, the total annual savings potential is $1,740,882 ($1,501,903 for electricity and $238,979 for gas) with an average total energy savings of 63%.

For the 24 mid-potential savings facilities, the total annual savings potential is $869,097 ($605,918 for electricity and $263,179 for gas) with an average total energy savings of 41%.

For the 14 low-potential savings facilities, the total annual savings potential is $23,329 ($13,208 for electricity and $10,121 for gas) with an average total energy savings of 20%.

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 46 facilities	**48%**	**64%**	**59%**	**47%**	**$2,121,029**	**65%**	**45%**	**52%**	**$512,279**	**50%**	**$2,633,308**	**$1,212,017**	**$197,030**	**1,477,712**	**5,368,725**
High potential savings facilities (8)	66%	100%	54%	66%	$1,501,903	85%	38%	59%	$238,979	63%	$1,740,882	$ 858,231	$ 91,915	573,857	2,907,148
Mid-potential savings facilities (24)	27%	46%	62%	29%	$ 605,918	43%	50%	49%	$263,179	41%	$ 869,097	$ 346,239	$101,223	775,356	2,378,053
Low potential savings facilities (14)	08%	100%	08%	10%	$ 13,208	02%	38%	27%	$ 10,121	20%	$ 23,329	$ 7,547	$ 3,893	128,499	83,524

Table 110: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 4 below shows the total potential savings for all 46 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	22.5	11.7	48%	$ 1,960,904
Electric Cooling (kWh/ft²)	1.1	0.4	64%	$ 69,756
Electric Heating (kWh/ft²)	1.2	0.5	59%	$ 49,457
Total Electricity (kWh/ft²) for facilities w/o component intensities	8.9	7.3	18%	$ 40,912
Gas Baseload (ekWh/ft²)	10.5	3.6	65%	$ 222,100
Gas Heating (ekWh/ft²)	17.3	9.5	45%	$ 254,664
Total Gas (ekWh/ft²) for facilities w/o component intensities	17.4	9.8	44%	$ 35,514
Total Energy (ekWh/ft²)	**48.2**	**24.2**	**50%**	**$ 2,633,308**

High savings | Moderate savings | Low savings

Table 111: Savings Potential based on Energy Use Component for Indoor Recreational Facilities

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electric Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Previous Energy Efficiency Initiatives

In 2008, the City of Toronto undertook a study to identify lighting improvement measures that would improve energy efficiency and reduce the operating cost and environmental impact of recreation centres located throughout the City of Toronto.

Table 5 below summarizes the estimated overall project costs, savings and estimated energy reduction for 124 recreation centres as a result of the 2008 lighting project.

			Project Cost & Annual Savings (estimated)					Estimated Energy Reduction			
Project Name & Year	Num. of Bldgs	Total Floor Area (m2)	Retrofit Cost	Total $Savings	Total ekWh Savings	Total CO2 Savings (tonnes)	Payback	Electrcity Savings kWh	Electrcity Savings kW	Natural Gas Savings m3	Water Savings m3
Recreation Center Lighting 2008	124	30,000	$1,750,000	$218,750	2,302,600	562	8.0	2,302,600	700	0	0

Table 112: 2008 Recreation Centre Lighting Project Estimated Project Costs and Savings

In 2004, the City of Toronto undertook a study to identify building improvement measures that would improve energy and water efficiency and reduce the operating cost and environmental impact of arenas located throughout the City of Toronto. The following measures are only applicable to the indoor recreational facilities that have arenas.

The design and construction of the measures took place from January 2005 to June 2007. Various Energy Conservation Measures (ECMs) were installed in 89 ice arenas, outdoor rinks and community centres. The majority of the indoor arenas in this ECDM Plan were part of this 2004 project. These measures included design and retrofit of energy efficient lighting, lighting controls, improved temperature controls, ventilation controls, insulation, building envelope and refrigeration controls. Training and energy awareness was also provided as part of this project.

2.2 Proposed Energy Efficiency Measures

Table 6 below shows the full range of possible energy efficiency measures for the entire portfolio of indoor recreational facilities. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 46 facilities indicate that the largest percentage reductions will come from measures associated with electric cooling, electric heating and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

⇓

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).

	Electric Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC BASELOAD - refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent						
B1	Turn off/unplug machines, office and kitchen equipment, chargers when not needed	4	4	8	Year 1	Annual Review	Building Occupants
B2	Enable ENERGY STAR power settings, turn off computers when not in use	4	4	8	Year 1	Annual Review	Building Occupants
B3	Turn off lights when areas not in use	4	4	8	Year 1	Annual Review	Building Occupants
B4	Make use of natural light instead of turning on lights where possible	4	4	8	Year 1	Annual Review	Building Occupants
P1	Upgrade control of under-pad heating	4	4	8	Year 1	Seasonal Review	
P3	Upgrade/adjust ice temperature control	4	4	8	Year 1	Seasonal Review	
P6	Repair low-emissivity ceiling	4	4	8	Year 1	Seasonal Review	
P10	Install compressor head pressure control	4	4	8	Year 1	Seasonal Review	
P2	Lower water use for ice resurfacing	4	4	8	Year 2	Seasonal Review	
P4	Implement ice temperature reset based on types of use	4	4	8	Year 2	Seasonal Review	
P5	Reduce ice thickness	4	4	8	Year 2	Seasonal Review	
P7	Reduce brine pump operation	4	4	8	Year 2	Seasonal Review	
M1	Optimize operating schedules for fans and pumps	3	4	7	Year 2	Seasonal Review	
M2	Test and adjust ventilation systems to reduce fan power	3	4	7	Year 2	Seasonal Review	
P8	Reduce rink lighting operation	4	4	8	Year 2	Seasonal Review	
EL4	Install power factor correction	3	4	7	Year 2	15+	
P11	Insulate brine headers	3	4	7	Year 2	5 to 10	
P9	Install/make better use of multi-level rink lighting control	2	4	6	Year 3	Seasonal Review	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	4	5	Year 4	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut	1	4	5	Year 4	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	4	5	Year 4	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	4	5	Year 4	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	4	5	Year 4	10 to 15	
L6	Replace festive lighting with LED	1	4	5	Year 4	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	4	5	Year 4	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	4	5	Year 4	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	4	5	Year 4	4 to 6	
EL3	Install controls on vending machines	1	4	5	Year 4	10 to 15	
EN1	Install low-emissivity ceiling	1	4	5	Year 4	10 to 12	
M3	Replace/right-size pumps	1	4	5	Year 4	10 to 20	
M4	Install variable speed drive on brine pump	1	4	5	Year 4	10 to 15	
M5	Install multi-pass refrigerant pipe configuration	1	4	5	Year 4	20 to 30	
M6	Install de-ionized water system	1	4	5	Year 4	5 to 10	
M7	Replace ice resurfacer with high efficiency unit	1	4	5	Year 4	10 to 15	
M8	Replace ice plant with high efficiency unit	1	4	5	Year 4	15 to 20	
M9	Install variable frequency drives (VFDs) on suitable fans and pumps	1	4	5	Year 4	10 to 20	
M10	Convert electric hot water heaters to natural gas	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC HEATING (IF APPLICABLE) - refers to electricity use for heating purposes						
B5	Adjust blinds (to retain heat in winter)	4	4	8	Year 1	annual review	Building Occupants
B6	Avoid use of electric heaters	4	4	8	Year 1	annual review	Building Occupants
B7	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1	annual review	Building Occupants
M11	Control fan coil and entrance heaters to optimize run-times	3	4	7	Year 2	seasonal review	
M12	Evaluate conversion from electric heating to natural gas	2	4	6	Year 2	n/a	
M13	Convert electric to gas dehumidifiers	1	4	5	Year 2	15 to 20	
P12	Control car plug-in outlets	3	4	7	Year 2	seasonal review	
M14	Install snow sensors to control the snow-melting system	1	4	5	Year 4	seasonal review	
M15	Upgrade base building heating system to avoid use of electric heaters	1	4	5	Year 4	seasonal review	
M16	Upgrade electric heating controls to optimize space temperatures and operating periods	1	4	5	Year 4	seasonal review	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Electric Cooling Measures	Ease of Implementatio	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	ELECTRIC COOLING (IF APPLICABLE) - refers to electricity use for cooling purposes						
B8	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	4	8	Year 1	annual review	Building Occupants
B9	Only cool rooms that are being used	4	4	8	Year 1	annual review	Building Occupants
B10	Install and use energy efficient ceiling fans	4	4	8	Year 1	annual review	Building Occupants
B11	Close blinds (to shade space from direct sunlight)	4	4	8	Year 1	annual review	Building Occupants
B12	Install window film, solar screens or awnings on south and west facing windows	4	4	8	Year 1	annual review	Building Occupants
P13	Upgrade/adjust dehumidifier controls	3	4	7	Year 2	seasonal review	
M18	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M19	Test and tune the air conditioning units	3	4	7	Year 2	3	
M17	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M20	Replace and right-size air conditioning units with ENERGY STAR rated units	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Baseload Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS BASELOAD - refers to the annual natural gas energy used for domestic hot water and other equipment that runs year round						
B13	Optimize dishwasher operation (only run when full)	4	4	8	Year 1	annual review	Building Occupants
P16	Identify and repair hot water leaks	4	4	8	Year 1	annual review	
P15	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M21	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P19	Optimize pool water temperature control, reset based on use	4	4	8	Year 2	seasonal review	
P14	Optimize DHW temperature control	2	4	6	Year 2	annual review	
M22	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
P17	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
P18	Install low flow showerheads and faucet aerators	1	4	5	Year 4	10 to 15	
M23	Install ice plant heat recovery	1	4	5	Year 4	10 to 15	
M24	Install solar hot water heating	1	4	5	Year 4	10 to 15	
M25	Install heat recovery dehumidification system	1	4	5	Year 4	10 to 15	
M26	Replace DHW boilers with more efficient models	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

	Gas Heating Measures	Ease of Implementation	Energy Savings Potential	Total Score	Timeline	Life Expectancy (yrs)	Responsibility
	GAS HEATING - refers to the additional energy used in winter for heating and humidification						
B14	Check and clear baseboard heaters of obstructions	4	4	8	Year 1	annual review	Building Occupants
B15	Adjust blinds (to retain heat in winter)	4	4	8	Year 1	annual review	Building Occupants
B16	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	4	8	Year 1	annual review	Building Occupants
P21	Isolate idle boilers	4	4	8	Year 1	seasonal review	
P22	Reduce circulating pump operation in mild weather	4	4	8	Year 1	seasonal review	
M27	Optimize operating periods of ventilation systems	2	4	6	Year 2	seasonal review	
M28	Test and adjust ventilation systems to optimize outside air volumes	3	4	7	Year 2	seasonal review	
M29	Test and tune boiler efficiency	3	4	7	Year 2	seasonal review	
M30	Check heating system for flow balancing and air venting	3	4	7	Year 2	seasonal review	
EN2	Check and seal exterior walls and openings	3	4	7	Year 2	10 to 15	
EN3	Seal window and door frames	3	4	7	Year 2	5	
EN4	Insulate and seal dividing walls between arena and heated areas	3	4	7	Year 2	5	
M29	Optimize fan-coil unit and entrance heater controls	3	4	7	Year 2	seasonal review	
P20	Control loading dock heating	4	4	8	Year 2	annual review	
M32	Test, repair, replace and right-size heating control valves and outside air dampers	2	4	6	Year 3	10 to 15	
M31	Replace spectator heating system with radiant heat	1	4	5	Year 4	10 to 15	
M33	Upgrade heating system control to optimize space temperatures and operating periods	1	4	5	Year 4	10 to 15	
EN5	Replace single-pane windows with double-pane windows	1	4	5	Year 4	20 to 25	
EN6	If replacing the roof, ensure R-value at least 22	1	4	5	Year 4	n/a	
M34	Install high efficiency burners	1	4	5	Year 4	15 to 20	
M35	Replace boilers with more efficient models	1	4	5	Year 4	15 to 20	
M36	Replace old rooftop units with energy efficient units	1	4	5	Year 4	15 to 20	
M37	Install heat recovery or solar heating units	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

Table 113: Energy Saving Measures for Indoor Recreational Facilities

The specific measures and implementation timeline for each individual indoor recreational facility will be determined from the results of the Energy Assessments and Checklists (explained in the Implementation section of this plan).

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
Etobicoke Olympium Pool	590 Rathburn Rd	Geothermal	700	kW
Etobicoke Olympium Pool	590 Rathburn Rd	Solar PV	150	kW
East York Curling Club	901 Cosburn Ave	Solar PV	50	kW
Gord & Irene Risk CC	2650 Finch Ave W	Solar PV	112	kW
Leaside Memorial Gardens Pool	1073 Millwood Rd	Solar PV	156	kW
McCormick RC/Pool	66 Sheridan Ave	Solar PV	150	kW
North Toronto Memorial Arena	200 Eglinton Ave W	Solar PV	170	kW
Oriole CRC	2975 Don Mills Rd	Solar PV	183	kW
Scarborough Centennial RC	1967 Ellesmere Ave	Solar PV	120	kW

Table 114: Proposed Renewable Energy Systems on Indoor Recreational Facilities

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings

The average budgeted cost for implementing suggested measures, based on previous experience with similar facilities, is $9.38/ft^2 (see Appendix A). The budget allows for lighting audits, lighting retrofits and controls, mechanical system efficiency improvements, appliance replacement and controls and localized efficiency measures for the building envelope. The budget does not allow for major plant or equipment replacement or substantial building upgrades such as roof or window replacement. These items may be included if appropriate in projects for individual buildings, but would not provide rational Return on Investments (ROIs) based on energy savings alone and would therefore be budgeted separately.

Similar measures for consideration apply to high and medium potential buildings. A 20 percent premium is included for high potential buildings to ensure that all improvements necessary to achieve the targets are covered. Still, the ROIs for high potential buildings will be better than the rest.

Low potential buildings do not merit the more in-depth investigations planned for the other two categories. Rather, a checklist approach, guided by the indicated component energy savings potential, would identify the particular measures for each building. The budget allowance for low potential buildings is set $0.75 to provide a rational ROI for this group.

The total implementation costs, payback and cash flows for the portfolios of high, medium and low potential indoor recreational facilities are summarized in Table 7 below.

Annual Savings Potential	Number of facilities	Average Area (ft^2)	Estimated Implementation Cost $/ft^2	Estimated Implementation Cost $	Estimated Savings potential $	% of total savings	Payback
> $100,000	8	71,732	11.25	$ 6,455,887	$ 1,740,882	66.1%	3.71
$5,000 - $100,000	24	32,307	9.38	$ 7,268,963	$ 869,097	33.0%	8.36
< $5,000	14	9,179	0.75	$ 96,375	$ 23,329	0.9%	4.13
	46			**$ 13,821,224**	**$ 2,633,308**		**5.25**

Table 115: Estimated Implementation Costs and Modeled Savings

Paybacks are determined by actual current implementation costs divided by first year savings (so costs are not adjusted for inflation and utility prices are not adjusted for escalation).

3.2 Implementation Process and Tools – Determining the Specific Measures for Each Building

Three types of tools are recommended to enable identification of specific measures in individual buildings:

- High Potential Buildings will undergo a Building Performance Audit incorporating measurement and testing to define retrofits and operational improvements. This also includes interval meter analysis and water consumption.

- Mid Potential Buildings will undergo an Energy Assessment including more in-depth analysis of monthly utility billing data for a number of years and analysis of interval meter or data-logger recordings of daily electricity use.
- Low Potential Buildings will use a simple Checklist to identify priority measures based on the conservation potential profile in this Plan.

The three approaches, budgeted analysis cost and numbers of buildings to which they apply are summarized in Table 8 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	8	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	24	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	14	$ 150	< $5,000	Division Champion and staff
		46			

Table 116: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There are 8 indoor recreational facilities with over $100,000 in annual energy saving potential. Over 67% of the total energy savings for all indoor recreational facilities can be found at these 8 facilities.

These 8 indoor recreational facilities can save an average of 63% of their total energy use. The total annual energy savings are estimated to be over $1,740,880 and individual building annual savings range from approximately $115,500 to over $297,000. The annual GHG savings are estimated to be approximately 2,907,000 kg.

These 8 indoor recreational facilities can save an average of 66% of their total electricity use (66% Electric Baseload, 100% Electric Cooling and 54% Electric Heating). The total annual electricity savings are estimated to be approximately $1,501,900 and individual building annual savings range from $111,880 to over $274,400.

These 8 indoor recreational facilities can save an average of 59% of their total gas use (85% Gas Baseload and 38% Gas Heating). The total annual gas savings are estimated to be approximately $239,000 and individual building annual savings range from approximately $3,600 to over $22,650.

These 8 indoor recreational facilities will undergo Building Performance Audits (see the Implementation Plan for further details). For a complete description of the Building Performance Audit, refer to Appendix A.

See Appendix B for the associated energy savings potential by energy use component.

The highest percentage reductions for these facilities can be found in Gas Baseload and Electric Cooling. After the implementation of the proposed measures, these facilities are eligible to receive over $950,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 23 indoor recreational facilities with between $5,000 and $100,000 in annual energy saving potential. Approximately 31% of the total energy savings for all 46 indoor recreational facilities can be found in these 23 facilities.

These 23 indoor recreational facilities can save an average of 38% of their total energy use. The total annual energy savings are estimated to be over $818,000 and individual building annual savings range from approximately $6,500 to almost $97,000. The annual GHG savings are approximately 2,029,000 kg.

These 23 indoor recreational facilities can save an average of 31% of their total electricity use (30% Electric Baseload, 50% Electric Cooling and 62% Electric Heating). The total annual electricity savings are estimated to be approximately $603,000 and individual building annual savings range from $0 to over $86,000.

These 23 indoor recreational facilities can save an average of 42% of their total gas use (34% Gas Baseload and 45% Gas Heating). The total annual gas savings are estimated to be approximately $215,000 and individual building annual savings range from $0 to over $47,600.

These 23 facilities will undergo an Energy Assessment with highest potential indoor recreational facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 23 indoor recreational facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 23 indoor recreational facilities can be found in Electric Cooling and Gas Baseload. For each individual building, the energy components with highest percentage savings potential will be the focus of the Energy Assessment in order to maximize energy savings. For a complete description of the Energy Assessment, refer to Appendix A.

After the implementation of the proposed measures, these indoor recreational facilities are eligible to receive over $427,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 15 indoor recreational facilities with less than $5,000 in savings potential. Approximately 1% of the total energy savings for all 46 indoor recreational facilities can be found in these 15 facilities.

These 15 indoor recreational facilities can save an average of 10% of their total energy use. The total annual energy savings are estimated to be approximately $26,000 and individual building annual savings range from $0 to over $4,600. The annual GHG savings are approximately 85,800 kg.

These 15 indoor recreational facilities can save an average of 6% of their total electricity use (2% Electric Baseload, 51% Electric Cooling and 8% Electric Heating). The total annual electricity savings are estimated to be approximately $16,000 and individual building annual savings range from $0 to over $3,200.

These 15 indoor recreational facilities can save an average of 14% of their total gas use (all in Gas Heating). The total annual gas savings are estimated to be approximately $10,000 and individual building annual savings range from $0 to over $1,800.

These 15 facilities will undergo a checklist approach with highest potential indoor recreational facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 15 indoor recreational facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 15 indoor recreational facilities can be found in Electric Cooling and Gas Heating.

The energy savings checklist will be used by the Division Champion for the indoor recreational facilities in conjunction with the building operator and/or service contractor for each indoor recreational facility. They will focus on measures related to energy components with high potential savings (colour-coded red) in order to maximize savings.

3.3 Implementation Budget

Table 9 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 46 facilities. The total costs to implement the energy management and retrofit plan for indoor recreational facilities are estimated to be $13,296,716. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	60,000
Energy Assessment	$	18,000
Checklist	$	2,100
Implementation	$	13,821,224
Total	**$**	**13,901,324**

Table 117: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 10 and Figure 5 below.

The plan will roll-out over 10 years, and the buildings with the highest savings potential will be focused on first.

Identification of measures from the Building Performance Audit will occur in Year 1, with all 8 Building Performance Audits completed by the end of Year 4. The implementation of these measures will begin in Year 2 and will be completed by the end of Year 5. Identification of measures from Energy Assessments will begin in Year 1, with all 23 Energy Assessments completed by the end of Year 5. The implementation of these measures will begin in Year 2, and will be completed by the end of Year 6. Identification of measures from the Checklists will begin in Year 2, with all 15 Checklists completed by the end of Year 4. The implementation of these measures will begin in Year 3.

Annual Costs refer to the assessment and implementation costs, training, measurement and verification (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $5,465,829. The cumulative net cash flow becomes positive in Year 9.

The implementation plan includes the following assumptions:

- Approximately 78% of the project budget will be spent in the first 5 years, and the other 22% in the following 5 years.
- The percentage of facilities to be retrofitted in each year is proportional to the percentage of the budget spent in that year. 78% of facilities will be retrofitted in the first 5 years and 22% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities is achieved in the first year, 75% in the second year, and 100% in each of the following years.
- Project costs are adjusted for inflation (2% annually) and energy savings are adjusted for utility price escalation (5% annually).
- 100% of incentives are achieved in the year when facilities are retrofitted, and incentives are NOT adjusted for utility price escalation.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
High Potential - Building Performance Audit	2	2	2	2	0	0	0	0	0	0	8
Mid Potential - Energy Assessment	5	5	5	5	4	0	0	0	0	0	24
Low Potential - Checklist	0	5	5	4	0	0	0	0	0	0	14
Assessment Costs	$ 18,750	$ 19,530	$ 19,546	$ 19,399	$ 3,000	$ -	$ -	$ -	$ -	$ -	$ 80,226
Implementation Costs	$ -	$ 3,254,724	$ 3,356,345	$ 3,423,471	$ 3,484,340	$ 1,364,339	$ -	$ -	$ -	$ -	$ 14,883,219
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 1,875	$ 327,425	$ 337,589	$ 344,287	$ 348,734	$ 136,434	$ -	$ -	$ -	$ -	$ 1,496,344
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 162,736	$ 330,553	$ 501,727	$ 675,944	$ 744,161	$ 744,161	$ 744,161	$ 744,161	$ 744,160.95	
Annual Costs	$ 20,625	$ 3,764,416	$ 4,044,033	$ 4,288,885	$ 4,512,019	$ 2,244,934	$ 744,161	$ 744,161	$ 744,161	$ 744,161	$ 21,851,555
Estimated Achieved Annual Savings		$ 268,328.83	$ 1,022,210.40	$ 2,021,776.95	$ 2,802,839.16	$3,370,099.09	$ 3,692,634.63	$3,890,595.49	$ 4,085,125.26	$4,289,381.52	$ 25,442,991
Estimated Incentives	$ -	$ 522,036	$ 403,958	$ 272,731	$ 193,338	$ 16,984	$ -	$ -	$ -	$ -	$ 1,409,047
Annual Savings and Incentives	$ -	$ 790,365	$ 1,426,168	$ 2,294,508	$ 2,996,177	$ 3,387,083	$ 3,692,635	$ 3,890,595	$ 4,085,125	$ 4,289,382	$ 26,852,038
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 825	-$ 119,787	-$ 224,502	-$ 304,277	-$ 364,910	-$ 319,224	-$ 201,285	-$ 75,428	$ -	-$ 1,610,239
Net Cash Flow incl borrowing costs	-$ 20,625	-$ 2,974,876	-$ 2,737,652	-$ 2,218,878	-$ 1,820,118	$ 777,239	$ 2,629,249	$ 2,945,149	$ 3,265,536	$ 3,545,221	$ 3,390,245
Cumulative Net Cash Flow	-$ 20,625	-$ 2,994,676	-$ 5,612,541	-$ 7,606,917	-$ 9,122,759	-$ 7,980,609	-$ 5,032,136	-$ 1,885,701	$ 1,455,263	$ 5,000,484	

Table 118: Cash Flow for 10-Year Implementation Plan

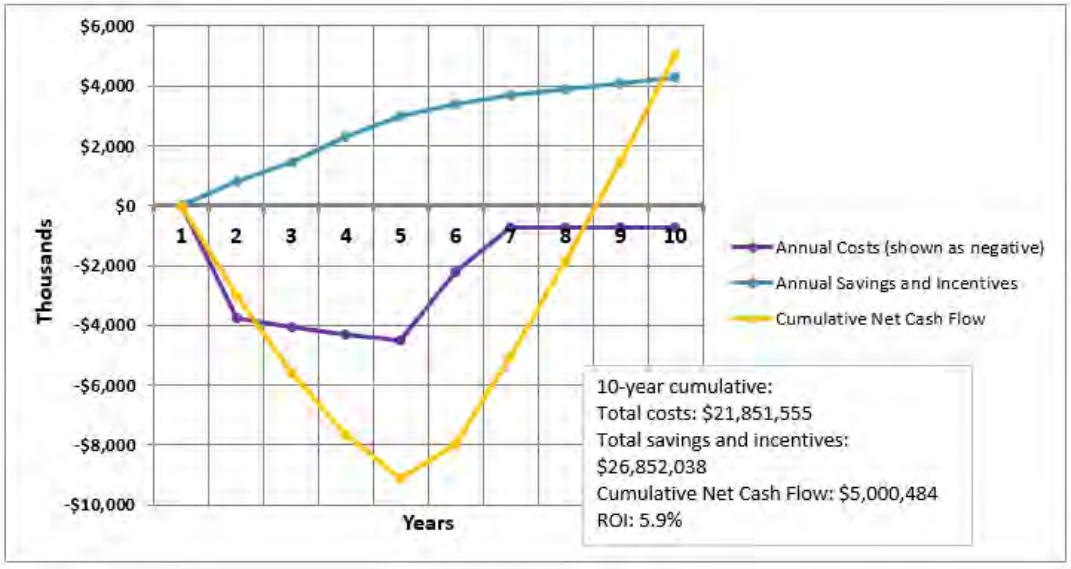

Figure 69: Cash Flow for 10-Year Implementation Plan

4 Appendix A

4.1 Selection of 2012 Utility Bills for Calculation of Actual Energy Use Intensities

Utility bills were used covering the period from January to December 2012.

If the total number of days in the combined bills was greater than 385 or less than 345 (because of adjustment bills spanning a few months), the facility was excluded from the dataset used to determine energy use components and targets.

To calculate 2012 actual energy use, the combined usage was normalized for the number of days in the calendar year 2012 (366).

4.2 Determining Energy Use Components

The energy use components and targets were calculated using data available for eligible facilities at the City of Toronto (see above). Energy use components were determined as follows:

Electric Baseload: Relates to systems which run year-round such as lighting, fans and equipment. Electric Baseload for indoor recreational facilities is determined as the average kWh/day for March, April, October and November multiplied by 366 days.

Electric Cooling: Was determined as the additional electricity use above the year-round base from May to September, and relates to air conditioning.

Electric Heating: Was determined as the additional use in January, February and December, and relates to electric heat or electricity use for heating systems (pumps, blowers etc.).

Gas Baseload: Relates to systems which run year-round (domestic hot water) and is determined as the average m^3/day for June, July and August multiplied by 366 days.

Gas Heating: Was determined as the additional gas use to heat the building from January to May, and September to December.

4.3 Determining Targets

Component energy targets were set based on the top quartile intensity of the eligible data set. Thus achievement of the targets anticipates all buildings with component energy intensities greater than the top quartile will reach that level already attained by one quarter of the buildings.

All values less than 5% of the average of the top 3 facilities were removed for the calculation of the component energy targets.

Before the calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type. Individual targets are adjusted for energy types, non-standard space types or equipment, and high energy intensity spaces or equipment. The target adjustments are listed below.

Target Adjustments

Electric Heating: Add Gas Heating multiplied by % of area served and 75% efficiency to Electric Heating AND Multiply Gas Heating by (100% - % of area served)

GSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating AND Subtract Gas Heating * 0.13 * % of area served from Gas Heating

WSHP: Add Gas Heating * 0.19 * % of area served to Electric Heating Electricity AND Subtract Gas Heating * 0.75 * % of area served from Gas Heating

Electric DHW: Add Gas Baseload * % of area served * 75% efficiency to Electric Baseload AND Multiply Gas Baseload by (100% - % of area served)

Air-Conditioning: Divide Electric Cooling by Average % of building served by A/C for all facilities of the type and multiply by % of the facility area served by A/C

Data Centre: Add 50 kWh/ft^2 * % of building occupied by Data Centre to Electric Baseload

Food Services: Add 30 kWh/ft^2 * % of facility area occupied by Food Services (including seating area) to Electric Baseload

Outdoor Rink: If rink has associated ice plant, add (1.04 kWh/ft^2 of ice/week * ft^2 of ice surface area * 16 weeks/year) divided by ft^2 of the total building area to Electric Baseload

Solar Hot Water: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh (t)/kW) divided by the facility area (ft^2) from Gas Baseload (ekWh/ft^2)

Solar Photovoltaic: Subtract the product of System Power Rating (kW thermal) and (Average Actual) Annual Performance (kWh(t)/kW) divided by the facility area (ft^2) from Electric Baseload (kWh/ft^2)

Garage: Add 20 ekWh/ft^2 to Gas Heating

High-intensity electric equipment: Add 30 kWh/ft^2 to Electric Baseload

Indoor Rink(s) and/or Indoor Pool(s) within Community Centres and Indoor Recreational Facilities:

Adjustment for Electric Baseload – Electric Baseload adjusted for Indoor Rink and/or Indoor Pool, kWh/ft^2 of total area = (Electric Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2))+ Assumed Electricity Requirement of Ice Plant (ekWh/ft^2 of ice/week) * Months ice-in * 52wks a year /12 months a year * Rink area, ft^2 + Electric Baseload for Pool (ekWh/ft^2 of pool) * Pool area, ft^2) / Total Area, ft^2

Adjustment for Gas Baseload – Gas Baseload adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Baseload for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Baseload for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Baseload for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

Adjustment for Gas Heating – Gas Heating adjusted for Indoor Rink and/or Indoor Pool, ekWh/ft^2 of total area = Gas Heating for Composite Recreational Facility (ekWh/ft^2 of total facility) * (Total area, ft^2 - (Rink area, ft^2 + Pool area, ft^2)) + Gas Heating for Indoor Sports Arenas (ekWh/ft^2 of rink) * Rink area, ft^2 + Gas Heating for Indoor Swimming Pools (ekWh/ft^2 of pool) * Pool area, ft^2

4.4 Calculating Potential Savings

The difference between the actual energy use component intensity and adjusted target represents potential annual savings for the component after multiplication by the facility area (and conversion from ekWh to m^3 in the case of gas).

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated based on total electricity and gas use (normalized to 366 days) compared with total adjusted electricity and natural gas targets.

4.5 Implementation Costs by Measure Type and Modeled Savings

The following table summarizes the implementation costs and savings estimates for measures under each type of operational system. Note that the costs are based on previous experience with similar projects.

These apply to the following building types:

- Indoor swimming pools
- Indoor sports arenas
- Community centres
- Recreational facilities

	Cost $/ft^2	% electric	Payback (yrs)	kWh/ft^2/yr	m^3/ft^2/yr
Lighting	2.25	100%	6.5	2.9	
Mechanical	1.88	30%	6	0.8	0.9
Electrical	0.25	100%	8	0.3	
Envelope	0.50	100%	10		0.0
Process	4.5	30%	5		2.5
Total	**9.38**		**5.9**	**3.93**	**3.40**

Table 119: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 20% fixture retrofits, replacement or relocation, along with selective, local occupancy and photo-controls. They also include lighting audits.

Costs for mechanical system measures include mechanical system testing and minor retrofits such as VFDs, re-balancing, right-sizing, tuning and repairs, along with upgraded controls.

Costs for electrical measures include appliance and equipment replacements and upgraded controls.

Costs for envelope measures include thermographic testing along with draft-proofing, re-insulation and roof/wall air sealing.

Costs for process measures (for facilities with rinks or pools) include cost effective retrofits to the pool circulation pump, dehumidification, heat recovery, retrofits to ice plant and related equipment and controls (if applicable). Costs for process measures (for facilities without rinks or pools) include low flow shower heads and aerators, controls on hot water use for vehicle washing and minor retrofits such as pipe insulation.

4.6 Assessment Tools

Building Performance Audit

The Building Performance Audit determines how well a building's existing systems and operational practices compare to other similar buildings, including top performers. The audit identifies problem areas in building systems, examines building operations, and determines improvements that will deliver the greatest energy savings and maximize return on investment. The outcome will be a clear, evidence-based picture of how much can be saved and what areas to focus on to optimize performance.

The Building Performance Audit includes:

- Benchmarking against comparable buildings including top-performers
- Performance based target setting customized for your building
- Interval meter analysis and examination of prior years' energy trends pinpointing specific system and operational inefficiencies
- Motor testing and equipment data-logging analysis
- Deeper understanding of operating practices through energy use profiles
- Power density and plant capacity analysis to identify retrofit opportunities
- Power factor analysis to uncover over-sized equipment
- Inventory and efficiency analysis of main energy-using equipment
- Verification and documentation of the proper operation of the building systems
- Payback and business case analysis

Initial Energy Targets

Initial energy targets are created by a mass screening tool which uses a standardized logic to produce a preliminary estimate of savings potential for every building, and thereby identify high-, medium- and low-potential buildings. This initial target-setting process creates the overall economic envelope for the program.

Energy Assessment

Medium-potential buildings are subjected to more in-depth analysis through an Energy Assessment which drills deeper into utility consumption data to refine the savings target and uncover more specific conservation measures. Regression analysis of monthly billing data against heating and cooling degree-days highlights billing anomalies such as estimated bills, and provides a more accurate breakdown of energy components, and hence component energy savings. Where multiple years of billing data are available, the Energy Assessment produces weather-normalized performance trends which can uncover changes in energy use and seasonal anomalies which point to specific energy saving opportunities. The Energy Assessment also analyzes electrical interval meter (or data-logger test results) to help identify operational improvements such as equipment running when the building is unoccupied.

5 Appendix B - Indoor Recreational Facilities

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 46 indoor recreational facility buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Agincourt Arena and R.C	31 Glen Watford Dr	93,398
Antibes Park	140 Antibes Dr	18,492
Bennington Heights Clubhouse	457 Heath Ave	1,432
Broadlands R.C & A.I.R	19 Castlegrove Blvd	10,667
Centennial R.C (Ice Galaxy)	1967 Ellesmere Rd	102,375
Central Arena	44 Montgomery Rd	45,446
Davisville Park/Tennis	218 Davisville Ave	2,777
Dovercourt B&G Club	155 Bartlett Ave	23,971
East York Clubhouse	323-525 Cosburn Ave	1,001
East York Curling Club House	901 Cosburn Ave	17,868
Etobicoke Olympium	590 Rathburn Rd	139,995
Fairfield Senior Centre	80 Lothian Ave	14,316
Flemingdon RC & Pool	29 St Dennis Dr	34,348
George Webster Clubhouse	30-40 Chapman Ave	1,302
Gord & Irene Risk Arena & R.C	2650 Finch Ave W	44,304
Goulding Arena & R.C	45 Goulding Ave	43,540
Grandravine Arena & R.C	25 Grandravine Dr	33,637
Horner Senior Centre	320 Horner Ave	4,252
Islington Senior Centre	4968 Dundas St W	9,967
Jimmie Simpson R.C	870 Queen St E	43,906
John Booth Arena & R.C	230 Gosford Blvd	27,007
Joseph J. Piccininni R.C	1369 St Clair Ave W	70,030
Keele St 1652	1652 Keele St	22,497
Leaside Gardens Curling Club	1073A Millwood Ave	27,814
Malvern R.C	30 Sewells Rd	106,466
Maple Leaf Cottage	62 Laing St	2,842
Markdale Rec & Daycare	41 Markdale Ave	30,516
Matty Eckler R.C	953 Gerrard St E	47,383
McCormick R.C	66 Sheridan Ave	43,099
Mililken Park Rec Center	4325 McCowan Rd	17,631
North Toronto Mem Rec Ctr	200 Eglinton Ave W	74,820
Oriole Arena & R.C	2975 Don Mills Rd	64,347

Pelmo Park Tennis	185 Pelmo Cres	2,573
Pleasantview Arena & R.C	545 Van Horne Ave	30,559
Roding Arena & R.C	600 Roding St	30,494
S.H Armstrong R.C	56 Woodfield Rd	18,277
St Albans Boys Club	843 Palmerston Ave	23,293
Stan Wadlow Clubhouse	373 Cedarvale Ave	10,323
Todmorden Mills Butler Building	67 Pottery Rd	17,707
Topham Park Clubhouse	1 Tiago Ave	3,283
Trace Manes Clubhouse	110 Rumsey Rd	6,329
Trinity Comm Rec Ctr	155 Crawford St	36,909
University Settlement House R.C	23 Grange Rd	47,566
W Acres Senior Ctr	10A Arbordell Rd	1,798
Whitlam Warehouse	25 Whitlam Ave	24,865
Willowdale Lawn Bowling	150 Beecroft Rd	2,293

Table 120: Indoor Recreational Facility Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 46 indoor recreational facility buildings included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity.

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Markdale Rec & Daycare	1.18	1.02	2.20
Maple Leaf Cottage	4.12	9.28	13.40
Islington Senior Centre	7.32	9.17	16.49
Horner Senior Centre	8.12	11.07	19.19
Leaside Gardens Curling Club	10.08	12.34	22.41
Whitlam Warehouse	8.50	14.47	22.97
Bennington Heights Clubhouse	4.78	18.70	23.48
Trace Manes Clubhouse	4.91	19.45	24.36
Stan Wadlow Clubhouse	10.42	15.31	25.73
S.H Armstrong R.C	13.08	16.69	29.77
Keele St 1652	29.02	1.67	30.69
Mililken Park Rec Center	17.37	13.51	30.88
Roding Arena & R.C	19.61	11.38	30.98
Matty Eckler R.C	8.19	22.98	31.17
Topham Park Clubhouse	8.83	23.90	32.73

Grandravine Arena & R.C	14.51	18.43	32.93
Flemingdon RC & Pool	20.01	12.95	32.96
Todmorden Mills Butler Building	17.38	15.72	33.10
Oriole Arena & R.C	21.84	12.87	34.72
Joseph J. Piccininni R.C	15.66	20.35	36.01
East York Clubhouse	15.59	21.14	36.73
John Booth Arena & R.C	22.99	13.75	36.73
Goulding Arena & R.C	17.45	19.64	37.10
Gord & Irene Risk Arena & R.C	17.79	20.06	37.84
Dovercourt B&G Club	7.50	31.06	38.56
East York Curling Club House	20.68	19.94	40.62
Malvern R.C	25.56	15.73	41.29
Davisville Park/Tennis	13.78	28.72	42.50
George Webster Clubhouse	17.40	25.49	42.89
Fairfield Senior Centre	7.02	36.37	43.39
St Albans Boys Club	12.74	32.01	44.75
University Settlement House R.C	13.30	34.03	47.33
Centennial R.C (Ice Galaxy)	27.32	20.22	47.54
North Toronto Mem Rec Ctr	23.10	30.24	53.34
Broadlands R.C & A.I.R	35.05	19.85	54.89
Antibes Park	21.03	36.67	57.69
Agincourt Arena and R.C	24.69	35.96	60.64
Pleasantview Arena & R.C	27.43	35.33	62.76
Pelmo Park Tennis	37.90	27.18	65.08
Etobicoke Olympium	21.09	44.58	65.66
Willowdale Lawn Bowling	24.62	41.46	66.07
W Acres Senior Ctr	20.47	46.23	66.70
Central Arena	32.64	42.83	75.47
Trinity Comm Rec Ctr	18.45	62.79	81.23
Jimmie Simpson R.C	31.43	50.73	82.16
McCormick R.C	46.76	39.60	86.36

Table 121: Indoor Recreational Facility 2012 Energy Intensity

5.3 Target-setting Method and Metrics

11 indoor recreational facilities were determined to be ineligible for determination of energy components or target-setting. See Appendix A. The excluded facilities are listed below.

Facility	Days in 2012	Energy type
Pelmo Park Tennis	215	Electricity
Dovercourt B&G Club	No 2012 data	Electricity

Bennington Heights Clubhouse	399	Electricity
East York Clubhouse	327	Electricity
East York Curling Club House	330	Electricity
Leaside Gardens Curling Club	264	Electricity
Markdale Rec & Daycare	399	Electricity
Matty Eckler R.C	402	Electricity
Trace Manes Clubhouse	Big negative consumption in February bill	Electricity
Whitlam Warehouse	Big negative consumption in September bill	Electricity
Davisville Park/Tennis	Significant adjustment in April bill	Electricity

Table 122: Excluded Facilities

After excluding these 11 facilities, 79 indoor recreational facilities and community centres were used to calculate the energy use components.

The following benchmark charts show the resulting electricity and gas use by component. Electricity use was broken down into baseload, cooling and heating electricity as described in Appendix A, and gas use was broken down into baseload and heating.

The red line on each chart indicates the top quartile for each component which is the target for that component.

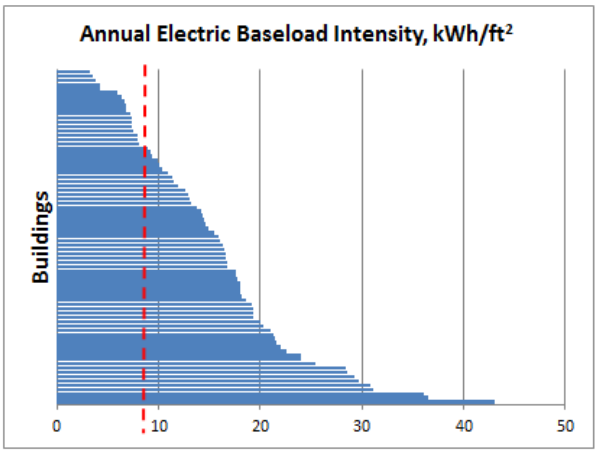

Figure 70: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for indoor recreational facilities ranges from 3.3 to 43.0 ekWh/ft^2 and the top-quartile is 9.21 ekWh/ft^2.

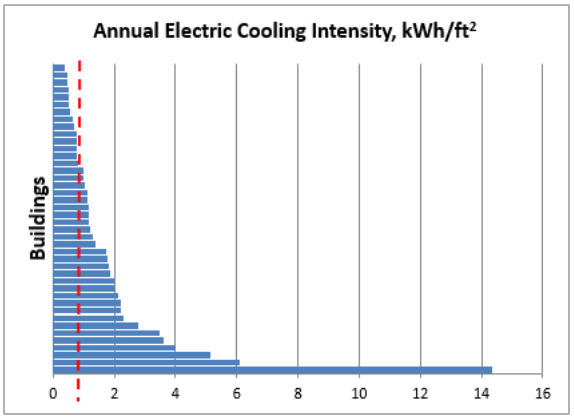

Figure 71: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for indoor recreational facilities ranges from 0.5 to 14.3 ekWh/ft^2 and the top-quartile is 0.77 ekWh/ft^2.

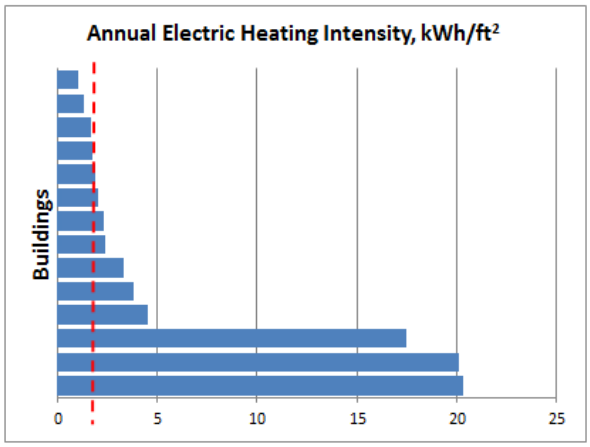

Figure 72: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for indoor recreational facilities ranges from 1.0 to 20.3 ekWh/ft^2 and the top-quartile is 1.76 ekWh/ft^2.

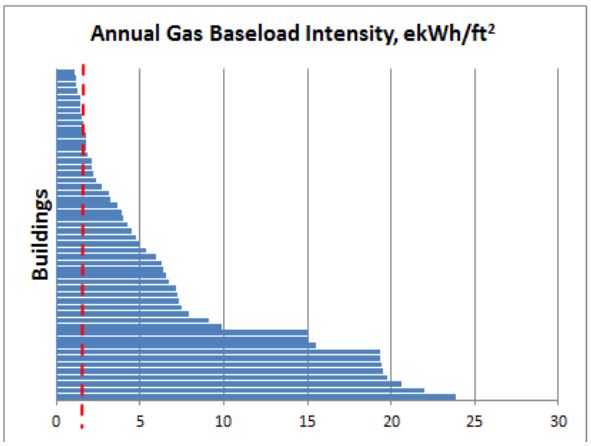

Figure 73: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for indoor recreational facilities ranges from 1.1 to 23.9 ekWh/ft^2 and the top-quartile is 1.83 ekWh/ft^2.

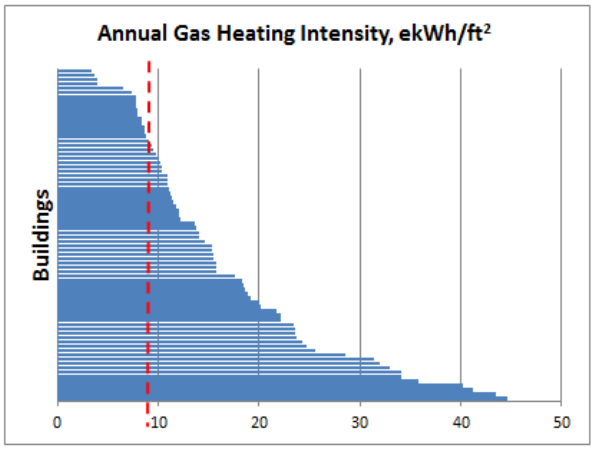

Figure 74: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for indoor recreational facilities ranges from 3.4 to 44.6 ekWh/ft^2 and the top-quartile is 9.71 ekWh/ft^2.

As explained in Appendix A, all values less than 5% of the average of the top 3 facilities were removed for the calculation of the energy use components.

The top quartile values for each energy use component were adopted as targets.

Before calculation of potential savings for each building, component targets were adjusted taking into account factors specific to the facility type (see Appendix A). In the case of indoor recreational facilities, the factors are % of the facility area served by electric heat, % of DHW heated by electricity, use of ground-source or water-source heat pumps, % of the area served by electric air conditioning, % of area

served by food services, presence and size of ice surface (including months of ice-in) and presence and size of indoor swimming pool.

For the facilities that were previously excluded from the dataset for setting targets, potential savings were calculated by subtraction of the sum of individual energy use component targets adjusted to specific characteristics of the facility from Total Electricity use (or Total Gas use).

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 8 High Savings Potential Indoor Recreational facilities

Buildings are sorted by total annual savings potential, starting with the highest savings potential buildings.

There are 8 indoor recreational facilities with over $100,000 in annual savings potential.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
High potential savings facilities (8)	66%	100%	54%	66%	$1,501,903	85%	38%	59%	$238,979	63%	$1,740,882	$ 858,231	$ 91,915	573,857	2,907,148
Centennial R.C (Ice Galaxy)	68%			70%	$ 274,484	71%	31%	44%	$ 22,659	59%	$ 297,143	$ 156,848	$ 8,715	102,375	379,422
Malvern R.C	64%	100%		65%	$ 248,918	50%	20%	27%	$ 11,181	51%	$ 260,099	$ 142,239	$ 4,300	106,466	276,383
McCormick R.C	80%	100%		80%	$ 227,077	85%	64%	71%	$ 30,306	76%	$ 257,383	$ 129,758	$ 11,656	43,099	397,436
Agincourt Arena and R.C	62%			62%	$ 199,440	90%	42%	68%	$ 57,263	65%	$ 256,703	$ 113,965	$ 22,024	93,398	570,539
Central Arena	73%			75%	$ 155,962	93%	42%	73%	$ 35,696	74%	$ 191,658	$ 89,121	$ 13,729	45,446	380,517
North Toronto Mem Rec Ctr	57%	100%		61%	$ 147,662	91%	7%	62%	$ 35,125	61%	$ 182,788	$ 84,379	$ 13,510	74,820	369,870
Jimmie Simpson R.C	69%		76%	71%	$ 136,480	91%	69%	77%	$ 43,140	75%	$ 179,620	$ 77,988	$ 16,592	43,906	419,003
Oriole Arena & R.C	52%			57%	$ 111,881	55%		17%	$ 3,608	42%	$ 115,489	$ 63,932	$ 1,388	64,347	113,979

Table 123: Savings Potential for 8 High Savings Potential Indoor Recreational Facilities

Savings Potential by Energy Use Component for the 24 Mid Savings Potential Indoor recreational facilities

Buildings are sorted by total annual savings potential, starting with the highest savings potential buildings.

There are 24 indoor recreational facilities with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Mid-potential savings facilities (24)	27%	46%	62%	29%	$ 605,918	43%	50%	49%	$263,179	41%	$ 869,097	$ 346,239	$101,223	775,356	2,378,053
Trinity Comm Rec Ctr	48%	100%		52%	$ 49,378	91%	78%	82%	$ 47,608	75%	$ 96,986	$ 28,216	$ 18,311	36,909	382,856
Pleasantview Arena & R.C	55%		67%	61%	$ 71,127	80%	64%	69%	$ 18,634	65%	$ 89,760	$ 40,644	$ 7,167	30,559	190,550
Keele St 1652	75%			94%	$ 86,145			0%	$ -	89%	$ 86,145	$ 49,226	$ -	22,497	67,685
Etobicoke Olympium		29%		2%	$ 7,628	25%	60%	47%	$ 73,277	32%	$ 80,905	$ 4,359	$ 28,183	139,995	535,559
Gord & Irene Risk Arena & R.C	37%			48%	$ 52,427		54%	45%	$ 10,064	46%	$ 62,491	$ 29,958	$ 3,871	44,304	113,925
John Booth Arena & R.C	54%			62%	$ 53,559		29%	26%	$ 2,422	48%	$ 55,981	$ 30,605	$ 931	27,007	59,584
Flemingdon RC & Pool	50%	53%		52%	$ 49,936	72%		36%	$ 4,046	46%	$ 53,982	$ 28,535	$ 1,556	34,348	68,475
Broadlands R.C & A.I.R	36%		97%	71%	$ 37,320	77%	19%	43%	$ 2,262	61%	$ 39,582	$ 21,326	$ 870	10,667	45,672
University Settlement House R.C	15%			14%	$ 12,275	88%	48%	66%	$ 26,943	52%	$ 39,218	$ 7,014	$ 10,363	47,566	204,362
East York Curling Club House				53%	$ 27,265			42%	$ 3,774	48%	$ 31,038	$ 15,580	$ 1,451	17,868	48,694
Roding Arena & R.C	32%			36%	$ 30,542			0%	$ -	23%	$ 30,542	$ 17,452	$ -	30,494	23,997
Milliken Park Rec Center	49%	100%		57%	$ 24,480	44%	5%	14%	$ 855	38%	$ 25,335	$ 13,989	$ 329	17,631	25,411
Goulding Arena & R.C	20%			21%	$ 22,594		19%	12%	$ 2,489	16%	$ 25,083	$ 12,911	$ 957	43,540	35,739
Todmorden Mills Butler Building	48%			49%	$ 20,989		38%	38%	$ 2,684	44%	$ 23,673	$ 11,994	$ 1,032	17,707	35,886
St Albans Boys Club	22%	100%		24%	$ 10,168	81%	56%	64%	$ 11,994	53%	$ 22,162	$ 5,810	$ 4,613	23,293	94,669
Antibes Park	22%	42%	3%	22%	$ 12,153	37%	44%	40%	$ 6,856	34%	$ 19,009	$ 6,945	$ 2,637	18,492	59,094
Grandravine Arena & R.C	11%		44%	16%	$ 11,188		29%	22%	$ 3,412	19%	$ 14,600	$ 6,393	$ 1,312	33,637	33,449
Matty Eckler R.C				0%	$ -			50%	$ 13,627	37%	$ 13,627	$ -	$ 5,241	47,383	98,478
Dovercourt B&G Club				0%	$ -			63%	$ 11,755	51%	$ 11,755	$ -	$ 4,521	23,971	84,949
Pelmo Park Tennis				74%	$ 10,128			58%	$ 1,011	67%	$ 11,138	$ 5,787	$ 389	2,573	15,263
S.H Armstrong R.C	16%	100%	32%	25%	$ 8,287	66%	14%	30%	$ 2,335	28%	$ 10,622	$ 4,735	$ 898	18,277	23,383
Fairfield Senior Centre		100%		5%	$ 738	13%	72%	68%	$ 8,885	58%	$ 9,623	$ 422	$ 3,417	14,316	64,792
Joseph J. Piccininni R.C		24%		2%	$ 2,871		26%	18%	$ 6,439	11%	$ 9,309	$ 1,640	$ 2,476	70,030	48,787
Willowdale Lawn Bowling	42%	100%	76%	60%	$ 4,723		76%	76%	$ 1,810	70%	$ 6,533	$ 2,699	$ 696	2,293	16,793

Table 124: Savings Potential for 24 Medium Savings Potential Indoor Recreational Facilities

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Savings Potential by Energy Use Component for the 14 Low Savings Potential Indoor Recreational Facilities

Buildings are sorted by total savings potential, starting with the highest saving potential buildings.

There are 14 indoor recreational facilities with less than $5,000 in savings potential. The highest potential buildings will be focused on first.

High savings | Moderate savings | Low savings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
Low potential savings facilities (14)	08%	100%	08%	10%	$ 13,208	02%	38%	27%	$ 10,121	20%	$ 23,329	$ 7,547	$ 3,893	128,499	83,524
Stan Wadlow Clubhouse		100%		21%	$ 3,203		37%	37%	$ 1,454	30%	$ 4,657	$ 1,830	$ 559	10,323	13,026
W Acres Senior Ctr	55%			54%	$ 2,797		78%	75%	$ 1,576	69%	$ 4,373	$ 1,598	$ 606	1,798	13,585
George Webster Clubhouse		100%		82%	$ 2,613	15%	59%	56%	$ 468	67%	$ 3,081	$ 1,493	$ 180	1,302	5,435
Davisville Park/Tennis				29%	$ 1,556			60%	$ 1,199	50%	$ 2,755	$ 889	$ 461	2,777	9,886
Whitlam Warehouse				0%	$ -			20%	$ 1,833	13%	$ 1,833	$ -	$ 705	24,865	13,244
Leaside Gardens Curling Club				3%	$ 1,150			6%	$ 560	5%	$ 1,710	$ 657	$ 215	27,814	4,949
Topham Park Clubhouse		100%		13%	$ 539		59%	58%	$ 1,140	46%	$ 1,678	$ 308	$ 438	3,283	8,659
Trace Manes Clubhouse				0%	$ -			41%	$ 1,258	32%	$ 1,258	$ -	$ 484	6,329	9,094
East York Clubhouse				37%	$ 814			45%	$ 242	42%	$ 1,056	$ 465	$ 93	1,001	2,385
Horner Senior Centre		100%		7%	$ 337		12%	11%	$ 135	10%	$ 472	$ 193	$ 52	4,252	1,243
Bennington Heights Clubhouse				0%	$ -			38%	$ 258	31%	$ 258	$ -	$ 99	1,432	1,861
Islington Senior Centre			14%	1%	$ 128			0%	$ -	1%	$ 128	$ 73	$ -	9,967	101
Maple Leaf Cottage		100%		4%	$ 70			0%	$ -	1%	$ 70	$ 40	$ -	2,842	55
Markdale Rec & Daycare				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	30,516	0

Table 125: Savings Potential for 14 Low Savings Potential Indoor Recreational Facilities

Savings potential is considered high if 30% or more, moderate if between 11 and 29%, and low if 10% or less.

Average % savings for each energy component are calculated as (Actual Energy Use – Target Energy Use)/Actual Energy Use and $/year savings for each component are calculated as (Actual Energy Use - Target Energy Use) * utility company rates $0.14 per kWh of electricity and $0.26 per m^3 of gas.

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company CDM Incentives are calculated based on $0.08/kWh of electricity and $0.10/$m^3$ of natural gas saved.

Indoor Sports Arenas

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1 Benchmarking and Conservation Potential

1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 27 indoor sports arenas in the Energy Conservation Demand Management (ECDM) Plan. The names, addresses and building areas are provided in Appendix B.

The total area for all of the buildings is 862,996 ft^2. Indoor sports arenas range in size from just over 22,300 ft^2 to over 65,400 ft^2.

The facilities equipped with a renewable energy system are presented in the table below:

Building Name	Building Address	Renewable Installation	System Size	Unit
Agincourt Arena	31 Glen Watford Dr	Solar Photovoltaic	48	kW
Mimico Arena	31 Drummond St	Solar Photovoltaic	50	kW
York Mills CC Arena	2539 Bayview Ave	Solar Photovoltaic	75	kW
Victoria Village Arena	190 Bermondsey Rd	Solar Photovoltaic	84	kW

Table 126: Current Renewable Energy Systems on Indoor Sports Arena

The facilities range from 0% to 100% air-conditioned. There are a number of other facilities using between 5 and 20% electric heat. No facilities are served by water source heat pumps. There are food services at the majority of the facilities, all with approximately 5% of the building served. The majority of the arenas have 1 ice pad, with the exception of Etobicoke Centennial Arena which has 2 ice pads. The ice pads range in size from 14,400 to 17,000 ft^2. The time period of ice-in ranges from 6 to 8 months.

1.1.2 Summary of Energy Use and Costs

This Energy Conservation Demand Management (ECDM) Plan is based on energy use taken from monthly bills for the 2012 calendar year. Energy costs are presented throughout using $0.14 per kWh of electricity and $0.26 per m^3 of gas. Refer to Appendix A (section 'Selection of 2012 utility bills for calculation of actual energy use intensities') for the methodology used to calculate the energy use intensities from the utility bills. Total energy use and costs for the 27 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	19,946,566	$2,792,519
Natural Gas (m^3)	1,490,132	$387,434
Total		**$3,179,954**

Table 127: 2012 Energy Use and Costs for 27 City of Toronto Indoor Sports Arenas

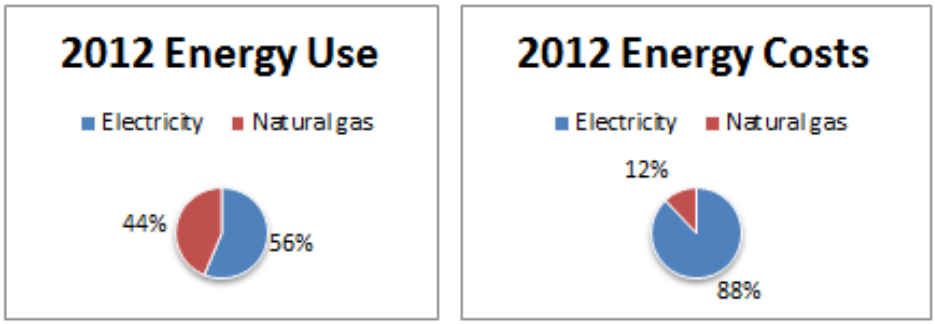

Figure 75: 2012 Energy Use and Cost Breakdown for 27 City of Toronto Indoor Sports Arenas

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 27 buildings. Total energy use ranges from approximately 21.6 to 93.6 ekWh/ft^2. There are also wide ranges for electricity and gas use per ft^2. The red line represents the top quartile. The corresponding data for total energy, total electricity and total gas for each building is located in Appendix B.

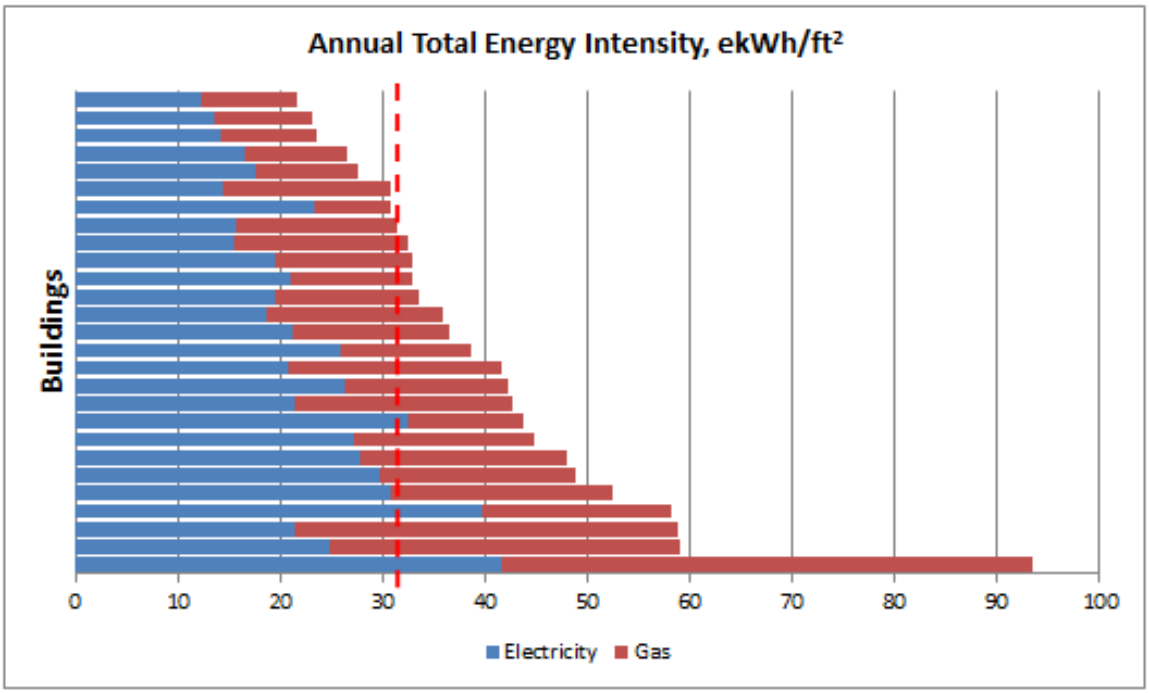

Figure 76: 2012 Total Energy Intensity Benchmark

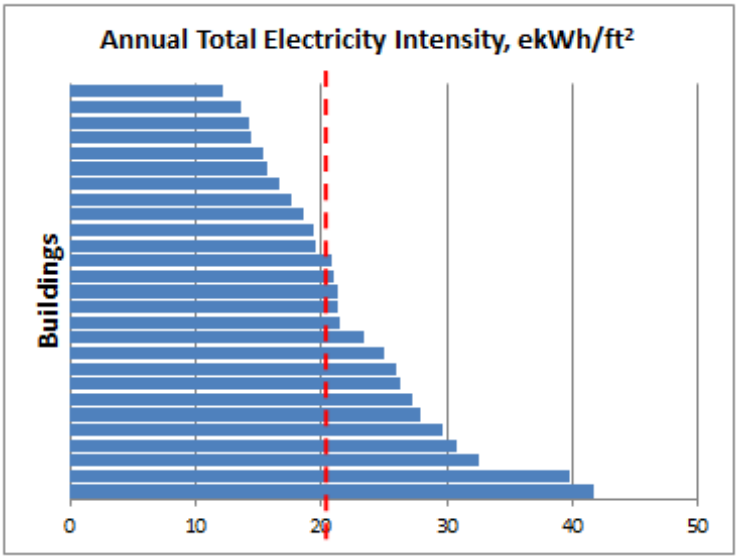

Figure 77: 2012 Total Electricity Intensity Benchmark

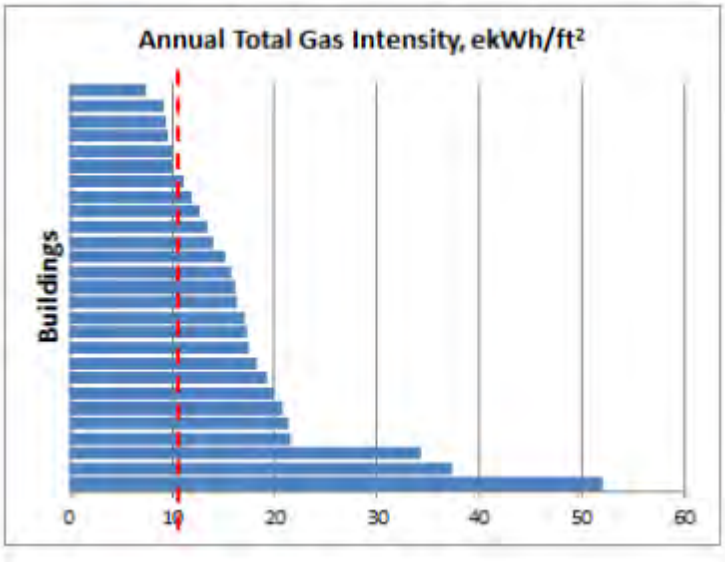

Figure 78: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for indoor sports arenas are presented in the table below. The target-setting methodology is based upon all buildings improving to the top quartile intensity for each component of energy use, and is described in Appendix B. The goal is for each indoor sports arena to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	20.4	kWh/ft²/year
	Cooling	0.8	kWh/ft²/year
	Heating	0.4	kWh/ft²/year
	Total	21.5	kWh/ft²/year
Gas	Base	2.0	ekWh/ft²/year
	Heating	8.7	ekWh/ft²/year
	Total	10.6	ekWh/ft²/year
Total energy	Total	32.2	ekWh/ft²/year

Table 128: Top Quartile Targets

The data set for target-setting is made up of 37 indoor sports arenas with complete and reliable data, 25 of which are City of Toronto buildings and 12 are from other municipalities. Before calculation of potential savings for each building, the energy use component targets were adjusted for site specific factors including electric heat (% building served and % for Domestic Hot Water (DHW)), % of the area

which is air conditioned, % of the area served by food services, area of the ice surface and months of ice-in. The specific target adjustments are found in Appendix A.

1.3 Savings Potential

The difference between the actual 2012 energy use and the adjusted target represents the potential annual savings for each energy component in each indoor sports arena. The total savings potential for each indoor sports arena is then determined as the sum of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 27 indoor sports arenas are categorized as high potential (annual savings of over $100,000), medium (mid) potential (annual savings between $5,000 and $100,000) and low potential (annual savings of less than $5,000). The savings potential for each individual building is summarized in Appendix B.

There are 2 indoor sports arenas with annual savings potential greater than $100,000. 20 indoor sports arenas have annual savings potential between $5,000 and $100,000, and 5 indoor sports arenas have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 27 buildings is $1,210,887 ($1,098,965 for electricity and $111,922 for gas) with an average total energy savings of 35%.

For the 2 high-potential savings facilities, the total annual savings potential is $326,348 ($292,800 for electricity and $33,547 for gas) with an average total energy savings of 56%.

For the 20 mid-potential savings facilities, the total annual savings potential is $877,330 ($799,904 for electricity and $77,426 for gas) with an average total energy savings of 35%.

For the 5 low-potential savings facilities, the total annual savings potential is $7,210 ($6,261 for electricity and $949 for gas) with an average total energy savings of 2%.

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 27 facilities	**31%**	**00%**	**16%**	**39%**	**$1,098,965**	**65%**	**20%**	**29%**	**$111,922**	**35%**	**$1,210,887**	**$627,980**	**$43,047**	**862,996**	**1,672,325**
High potential savings facilities (2)	50%	00%	00%	59%	$ 292,800	81%	32%	53%	$ 33,547	56%	$ 326,348	$167,315	$12,903	99,814	472,502
Mid-potential savings facilities (20)	31%	00%	25%	41%	$ 799,904	61%	20%	27%	$ 77,426	35%	$ 877,330	$457,088	$29,779	606,040	1,188,046
Low potential savings facilities (5)	02%	00%	00%	02%	$ 6,261	00%	03%	02%	$ 949	02%	$ 7,210	$ 3,578	$ 365	157,142	11,777

Table 129: Savings Potential Summary

GHG emissions reduction is based on 110g GHG/kWh of electricity and 1879g GHG/m^3 of natural gas. Utility company incentives are calculated based on $0.08/kWh of electricity (a composite of $0.05/kWh for lighting retrofits and $0.10 for non-lighting measures) and $0.10/$m^3$ of natural gas saved.

The savings potential for each individual energy component points to where the biggest savings are to be found and guides the priorities for implementation. Table 4 below shows the total potential savings for all 27 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	29.7	20.3	31%	$ 1,029,692
Electric Cooling (kWh/ft²)	0.3	0.0	100%	$ 1,756
Electric Heating (kWh/ft²)	0.5	0.4	16%	$ 10,675
Total Electricity (kWh/ft²) for facilities w/o component intensities	21.9	16.4	25%	$ 56,843
Gas Baseload (ekWh/ft²)	4.2	1.4	65%	$ 53,907
Gas Heating (ekWh/ft²)	14.0	11.2	20%	$ 55,037
Total Gas (ekWh/ft²) for facilities w/o component intensities	14.8	13.2	11%	$ 2,978
Total Energy (ekWh/ft²)	**41.0**	**26.7**	**35%**	**$ 1,210,887**

High savings | Moderate savings | Low savings

Table 130: Savings Potential Based on Energy Use Component for 27 Indoor Sports Arenas

Savings potential is considered high if it is 30% and above, moderate if between 10 and 29% and low if less than 10%.

Components with the highest percentage savings potential (i.e. Electric Cooling and Gas Baseload) will be given higher priority in terms of recommended measures for implementation. In many cases, Electric Baseload measures can provide a significant portion of dollar savings. However, they generally require significant capital investment and will therefore be implemented in later years.

2 Conservation Measures and Budget

2.1 Previous Energy Efficiency Initiatives

In 2004, the City of Toronto undertook a study to identify building improvement measures that would improve energy and water efficiency and reduce the operating cost and environmental impact of arenas located throughout the City of Toronto.

Table 131 below summarizes the estimated overall project costs, savings and estimated energy reduction for 89 arenas as a result of the 2004 project.

			Project Cost & Annual Savings (estimated)					Estimated Energy Reduction			
Project Name & Year	Num. of Bldgs	Total Floor Area (m2)	Retrofit Cost	Total $Savings	Total ekWh Savings	Total CO2 Savings (tonnes)	Payback	Electrcity Savings kWh	Electrcity Savings kW	Natural Gas Savings m3	Water Savings m3
Arena 2004	89	206,485	$9,932,267	$1,217,181	19,815,506	4,298	8.2	9,051,822	3,649	1,040,804	1,469

Table 131: 2004 Arenas Project Estimated Project Costs and Savings

The design and construction of the measures took place from January 2005 to June 2007. Various Energy Conservation Measures (ECMs) were installed in 89 ice arenas, outdoor rinks and community centres. The majority of the indoor arenas in this ECDM Plan were part of this 2004 project. These measures included design and retrofit of energy efficient lighting, lighting controls, improved temperature controls, ventilation controls, insulation, building envelope and refrigeration controls. Training and energy awareness was also provided as part of this project.

2.2 Proposed Energy Efficiency Measures

Table 123 below shows the full range of possible energy efficiency measures for the entire portfolio of indoor sports arenas. The measures are grouped based on the component of energy use they relate to and have been sorted based on chronology of implementation.

The measures are categorized by system type - lighting (L), mechanical (M), electrical (EL), envelope (EN), process (P) (i.e. domestic hot water) and behavioural (B) measures. The profiles of energy use and conservation potential for the 27 facilities indicate that the largest percentage will come from measures associated with electric cooling and gas baseload, the majority of which are low/no cost measures.

The measures have been prioritized in order to help make an informed decision on which to implement first. Priorities are set using the criteria of 'Energy Savings Potential' and 'Ease of Implementation'. Each measure was assigned a score from 1 to 4 for both energy savings potential and ease of implementation.

For Energy Savings Potential, a score of 4 was assigned to measures with the greatest percentage energy savings potential and a score of 1 was assigned to measures with the smallest percentage energy savings potential. For Ease of Implementation, a score of 4 was assigned to measures that are the easiest to implement and a score of 1 to measures that are the most difficult to implement.

The Energy Savings Potential scoring was determined using the following criteria:

4 – Savings potential is greater than 40%

3 – Savings potential is 30-40%

2 – Savings potential is 20-30%

1 – Savings potential is less than 20%

The Ease of Implementation scoring was determined using the following criteria:

4 – Measure can be done immediately by building occupants or service contractors (little/no cost)

3 – Measure involves testing, tuning, measuring (low cost)

2 – Measure involves significant investigation/optimization (more significant costs)

1 – Measure involves replacement/installation involving capital costs

The measures with the highest combined Energy Savings Potential and Ease of Implementation scores (out of 8) are deemed the highest priority.

Accordingly the Overall score associated to the proposed measures can be summarized as follows:

1 - Least energy savings potential; Most difficult to implement

8 - Greatest energy savings potential; Easiest to implement

Timelines

Measures recommended to be implemented in Year 1 (the year of the initial assessment) are behavioural measures that can be done immediately without capital budgets. Measures recommended for Year 2 will generally result in high percentage savings, are mainly operational and do not require significant capital costs. Year 3 measures will provide high percentage savings (i.e. measures related to electric cooling and gas baseload) but have associated capital costs (i.e. installation and replacement measures). Measures to be implemented in Year 4 and Year 5 are those that have significant associated capital costs and may result in high dollar savings but less significant percentage energy savings (i.e. measures related to all other energy components).