	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	3	7	Year 1	Annual Review	Building Occupants
B2	Enable ENERGY STAR power settings, turn off computers when not in use	4	3	7	Year 1	Annual Review	Building Occupants
B3	Turn off lights when areas not in use	4	3	7	Year 1	Annual Review	Building Occupants
B4	Make use of natural light instead of turning on lights where possible	4	3	7	Year 1	Annual Review	Building Occupants
P1	Upgrade control of under-pad heating	4	3	7	Year 2	Seasonal Review	
P2	Lower water use for ice resurfacing	4	3	7	Year 2	Seasonal Review	
P3	Upgrade/adjust ice temperature control	4	3	7	Year 2	Seasonal Review	
P4	Implement ice temperature reset based on types of use	4	3	7	Year 2	Seasonal Review	
P5	Reduce ice thickness	4	3	7	Year 2	Seasonal Review	
P7	Reduce brine pump operation	4	3	7	Year 2	Seasonal Review	
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	
P8	Reduce rink lighting operation	4	3	7	Year 2	Seasonal Review	
P6	Repair low-emissivity ceiling	4	3	7	Year 1	Seasonal Review	
P10	Install compressor head pressure control	4	3	7	Year 1	Seasonal Review	
P11	Insulate brine headers	3	3	6	Year 2	5 to 10	
P9	Install/make better use of multi-level rink lighting control	2	3	5	Year 3	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	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	
EN1	Install low-emissivity ceiling	1	3	4	Year 4	10 to 12	
M3	Replace/right-size pumps	1	3	4	Year 4	10 to 20	
M4	Install variable speed drive on brine pump	1	3	4	Year 4	10 to 15	
M5	Install multi-pass refrigerant pipe configuration	1	3	4	Year 4	20 to 30	
M6	Install de-ionized water system	1	3	4	Year 4	5 to 10	
M7	Replace ice resurfacer with high efficiency unit	1	3	4	Year 4	10 to 15	
M8	Replace ice plant with high efficiency unit	1	3	4	Year 4	15 to 20	
M9	Install variable frequency drives (VFDs) on suitable fans and pumps	1	3	4	Year 4	10 to 20	
M10	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						
B5	Adjust blinds (to retain heat in winter)	4	1	5	Year 1	annual review	Building Occupants
B6	Avoid use of electric heaters	4	1	5	Year 1	annual review	Building Occupants
B7	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	1	5	Year 1	annual review	Building Occupants
M11	Control fan coil and entrance heaters to optimize run-times	3	1	4	Year 2	seasonal review	
P12	Control car plug-in outlets	3	1	4	Year 2	seasonal review	
M12	Evaluate conversion from electric heating to natural gas	2	1	3	Year 2	n/a	
M13	Convert electric to gas dehumidifiers	1	1	2	Year 5	15 to 20	
M14	Install snow sensors to control the snow-melting system	1	1	2	Year 5	seasonal review	
M15	Upgrade base building heating system to avoid use of electric heaters	1	1	2	Year 5	seasonal review	
M16	Upgrade electric heating controls to optimize space temperatures and operating periods	1	1	2	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						
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
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	
P13	Upgrade/adjust dehumidifier controls	3	4	7	Year 2	seasonal review	
M20	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						
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 2	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	
P14	Optimize DHW temperature control	2	4	6	Year 2	annual review	
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 3	10 to 15	
M22	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M23	Install ice plant heat recovery	1	4	5	Year 3	10 to 15	
M24	Install solar hot water heating	1	4	5	Year 3	10 to 15	
M25	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						
B14	Check and clear baseboard heaters of obstructions	4	2	6	Year 1	annual review	Building Occupants
B15	Adjust blinds (to retain heat in winter)	4	2	6	Year 1	annual review	Building Occupants
B16	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	2	6	Year 1	annual review	Building Occupants
M26	Optimize operating periods of ventilation systems supplying heated spaces	2	2	4	Year 2	seasonal review	
M30	Optimize fan-coil unit and entrance heater controls	3	2	5	Year 2	seasonal review	
P19	Control loading dock heating	4	2	6	Year 2	annual review	
P21	Reduce circulating pump operation in mild weather	4	2	6	Year 2	seasonal review	
M27	Test and adjust ventilation systems to optimize outside air volumes	3	2	5	Year 2	seasonal review	
M28	Test and tune boiler efficiency	3	2	5	Year 2	seasonal review	
M29	Check heating system for flow balancing and air venting	3	2	5	Year 2	seasonal review	
EN2	Check and seal exterior walls and openings	3	2	5	Year 2	10 to 15	
EN3	Seal window and door frames	3	2	5	Year 2	5	
EN4	Insulate and seal dividing walls between arena and heated areas	3	2	5	Year 2	5	
P20	Isolate idle boilers	4	2	6	Year 2	seasonal review	
M32	Test, repair, replace and right-size heating control valves and outside air dampers	2	2	4	Year 4	10 to 15	
M31	Replace spectator heating system with radiant heat	1	2	3	Year 5	10 to 15	
M33	Upgrade heating system control to optimize space temperatures and operating periods	1	2	3	Year 5	10 to 15	
EN5	Replace single-pane windows with double-pane windows	1	2	3	Year 5	20 to 25	
EN6	If replacing the roof, ensure R-value at least 22	1	2	3	Year 5	n/a	
M34	Install high efficiency burners	1	2	3	Year 5	15 to 20	
M35	Replace boilers with more efficient models	1	2	3	Year 5	15 to 20	
M36	Replace old rooftop units with energy efficient units	1	2	3	Year 5	15 to 20	
M37	Install heat recovery or solar heating units	1	2	3	Year 5	10 to 15	
	Other:_____						

Behavioural Measures

Operational Measures

Retrofit/Capital Measures

Table 132: Energy Saving Measures for Indoor Sports Arenas

The specific measures and implementation timeline for each individual indoor sports arena 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
Albion Arena	1501 Albion Rd	Geothermal	280	kW
Albion Arena	1501 Albion Rd	Solar PV	112	kW
Amesbury Sport Complex	155 Culford	Solar PV	130	kW
East York Memorial Arena	888 Cosburn Ave	Solar PV	138	kW
H. Carnegie Centennial Arena	580 Finch Ave W	Solar PV	199	kW
Lambton Park Arena	4100 Dundas St W	Solar PV	140	kW
Long Branch Arena	75 Arcadian Circle	Solar PV	200	kW

Table 133: Proposed Renewable Energy Systems on Indoor Sports Arenas

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 at $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 sports arenas are summarized in Table 134 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	2	49,907	11.25	$ 1,122,904	$ 326,348	27.0%	3.44
$5,000 - $100,000	20	30,302	9.38	$ 5,681,624	$ 877,330	72.5%	6.48
< $5,000	5	31,428	0.75	$ 117,857	$ 7,210	0.6%	16.35
	27			**$ 6,922,384**	**$ 1,210,887**		**5.72**

Table 134: 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)	2	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	20	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	5	$ 150	< $5,000	Division Champion and staff
		27			

Table 135: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There are 2 indoor sports arenas with over $100,000 in annual energy saving potential. Over 27% of the total energy savings for all indoor sports arenas can be found at these 2 facilities.

These 2 indoor sports arenas can save an average of 56% of their total energy use. The total annual energy savings are estimated to be over $326,300 and the annual GHG savings are estimated to be approximately 472,500 kg.

These 2 indoor sports arenas can save an average of 59% of their total electricity use (all in Electric Baseload). The total annual electricity savings are estimated to be approximately $292,800.

These 2 indoor sports arenas can save an average of 53% of their total gas use (81% Gas Baseload and 32% Gas Heating). The total annual gas savings are estimated to be approximately $33,500.

These 2 indoor sports arenas 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 Baseload. After the implementation of the proposed measures, these facilities are eligible to receive over $180,200 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 20 indoor sports arenas with between $5,000 and $100,000 in annual energy saving potential. Approximately 73% of the total energy savings for all 27 indoor sports arenas can be found in these 20 facilities.

These 20 indoor sports arenas can save an average of 35% of their total energy use. The total annual energy savings are estimated to be over $877,300 and individual building annual savings range from approximately $8,150 to almost $74,000. The annual GHG savings are approximately 1,188,000 kg.

These 20 indoor sports arenas can save an average of 41% of their total electricity use (31% Electric Baseload, 0% Electric Cooling and 25% Electric Heating). The total annual electricity savings are estimated to be almost $800,000 and individual building annual savings range from approximately $6,680 to over $66,700.

These 20 indoor sports arenas can save an average of 27% of their total gas use (61% Gas Baseload and 20% Gas Heating). The total annual gas savings are estimated to be approximately $77,400 and individual building annual savings range from $0 to over $23,000.

These 20 facilities will undergo an Energy Assessment with highest potential indoor sports arenas focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 20 indoor sports arenas and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 20 indoor sports arenas can be found in 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 indoor sports arenas are eligible to receive almost $487,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 5 indoor sports arenas with less than $5,000 in savings potential. Less than 1% of the total energy savings for all 27 indoor sports arenas can be found in these 5 facilities.

These 5 indoor sports arenas can save an average of 2% of their total energy use. The total annual energy savings are estimated to be approximately $7,200 and individual building annual savings range from $0 to over $3,900. The annual GHG savings are approximately 11,800 kg.

These 5 indoor sports arenas can save an average of 2% of their total electricity use (all in Electric Baseload). The total annual electricity savings are estimated to be approximately $6,260 and individual building annual savings range from $0 to over $3,900.

Only one of these 5 indoor sports arenas has potential gas savings, which can average of 2% of its total gas use (all in Gas Heating). The total annual gas savings are estimated to be approximately $950.

These 5 facilities will undergo a checklist approach with highest potential indoor sports arenas focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 5 indoor sports arenas and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 5 indoor sports arenas can be found in Electric Baseload and Gas Heating.

The energy savings checklist will be used by the Division Champion for the indoor sports arenas in conjunction with the building operator and/or service contractor for each indoor sports arena. 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 27 facilities. The total costs to implement the energy management and retrofit plan for indoor sports arenas are estimated to be $6,953,134. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	15,000
Energy Assessment	$	15,000
Checklist	$	750
Implementation	$	6,922,384
Total	**$**	**6,953,134**

Table 136: 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 both Building Performance Audits completed by the end of Year 2. The implementation of these measures will begin

in Year 2 and will be completed by the end of Year 3. Identification of measures from Energy Assessments will begin in Year 1, with all 20 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 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 $1,820,510. The cumulative net cash flow becomes positive in Year 9.

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	1	0	0	0	0	0	0	0	0	2
Mid Potential - Energy Assessment	5	5	5	3	2	0	0	0	0	0	20
Low Potential - Checklist	0	1	1	1	1	1	0	0	0	0	5
Assessment Costs	$ 11,250	$ 11,406	$ 3,909	$ 2,412	$ 1,666	$ 169	$ -	$ -	$ -	$ -	$ 30,812
Implementation Costs	$ -	$ 2,061,925	$ 2,128,177	$ 1,563,007	$ 966,970	$ 666,388	$ 27,076	$ -	$ -	$ -	$ 7,413,544
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 1,125	$ 207,333	$ 213,209	$ 156,542	$ 96,864	$ 66,656	$ 2,708	$ -	$ -	$ -	$ 744,436
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 103,096	$ 209,505	$ 287,655	$ 336,004	$ 369,323	$ 370,677	$ 370,677	$ 370,677	$ 370,677.21	
Annual Costs	$ 12,375	$ 2,383,760	$ 2,554,800	$ 2,009,617	$ 1,401,504	$ 1,102,536	$ 400,461	$ 370,677	$ 370,677	$ 370,677	$ 10,977,085
Estimated Achieved Annual Savings		$ 143,925	$ 559,033	$ 1,088,013	$ 1,411,871	$ 1,585,864	$ 1,697,940	$ 1,789,032	$ 1,878,484	$ 1,972,408	$ 12,126,568
Estimated Incentives	$ -	$ 288,285	$ 243,510	$ 97,140	$ 33,045	$ 9,048	$ -	$ -	$ -	$ -	$ 671,027
Annual Savings and Incentives	$ -	$ 432,209	$ 802,542	$ 1,185,153	$ 1,444,915	$ 1,594,912	$ 1,697,940	$ 1,789,032	$ 1,878,484	$ 1,972,408	$ 12,797,595
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 495	-$ 78,557	-$ 148,647	-$ 181,626	-$ 179,889	-$ 160,194	-$ 108,295	-$ 51,561	$ -	-$ 909,265
Net Cash Flow incl borrowing costs	-$ 12,375	-$ 1,952,046	-$ 1,830,815	-$ 973,111	-$ 138,214	$ 312,486	$ 1,137,284	$ 1,310,060	$ 1,456,245	$ 1,601,731	$ 911,245
Cumulative Net Cash Flow	-$ 12,375	-$ 1,963,926	-$ 3,716,184	-$ 4,540,648	-$ 4,497,236	-$ 4,004,860	-$ 2,707,382	-$ 1,289,027	$ 218,780	$ 1,820,510	

Table 137: Cash Flow for 10-Year Implementation Plan

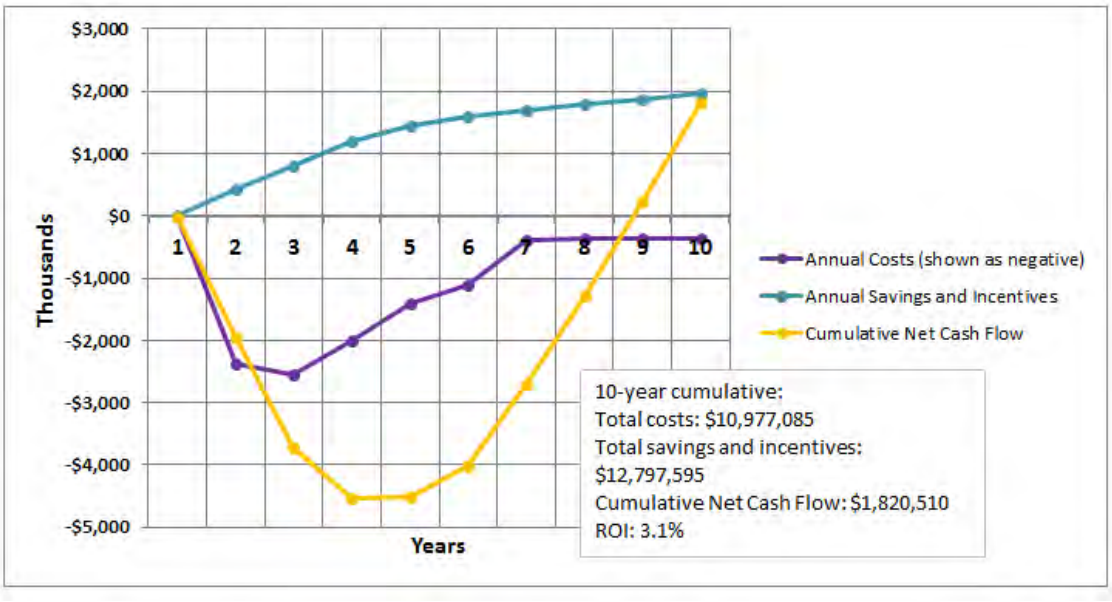

Figure 79: Cash Flow for 10-Year Implementation Plan

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 sports arenas 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:

- 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 138: Implementation Costs by Measure Type

Implementation costs for lighting include measures such as re-lamping and re-ballasting with about 40% 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 draft-proofing, re-insulation and roof/wall air sealing.

Costs for process measures include cost effective retrofits to ice plant, related equipment and controls.

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 Sports Arenas

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 27 indoor sports arena buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Albion Arena	1501 Albion Rd	32,658
Amesbury Arena	155 Culford Rd	26,942
Baycrest Arena	160 Neptune Dr	27,060
Bayview Arena	3230 Bayview Ave	28,417
Chris Tonks Arena	2801 Eglinton Ave	23,638
Cummer Arena	6000 Leslie St	34,348
Don Mills Arena	1030 Don Mills Rd	27,857
Downsview Arena	1633 Wilson Ave	34,218
East York Arena	888 Cosburn Ave	30,257
Etobicoke Centennial Arena	56 Centennial Park Rd	65,466
Fenside Arena	30 Slidell Cres	26,307
Flemingdon Arena	165 Grenoble Dr	25,640
Forest Hill Memorial Arena	340 Chaplin Cres	40,666
George Bell Arena	215 Ryding Ave	41,785
Habitant Arena	3383 Weston Rd	26,307
Herbert Carnegie Centennial Arena	580 Finch Ave W	42,270
Lambton Park Arena	4100 Dundas St W	24,854
Long Branch Arena	75 Arcadian Crcl	25,629
McCormick Arena	66 Sheridan Ave	37,082
Mimico Arena	31 Drummond St	35,607
Mitchell Field Arena	89 Church Ave	30,182
Moss Park Arena	140 Sherbourne St	22,335
Phil White Arena	443 Arlington Ave	25,941
Pine Point Arena	15 Grierson Rd	32,001
Scarborough Arena Gardens	75 Birchmount Rd	38,319
Victoria Village Arena	190 Bermondsey Rd	33,637
York Mills Arena	190 Bermondsey Rd	23,573

Table 139: Indoor Sports Arena Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 27 indoor sports arena 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)
Albion Arena	12.22	9.38	21.60
George Bell Arena	13.11	9.65	22.76
Chris Tonks Arena	14.38	9.37	23.75
Mimico Arena	16.65	10.05	26.70
Pine Point Arena	17.55	9.87	27.42
Fenside Arena	14.31	16.04	30.35
Baycrest Arena	15.25	15.78	31.03
Phil White Arena	23.69	7.52	31.20
Bayview Arena	14.71	17.11	31.82
Scarborough Arena Gardens	18.78	14.05	32.84
York Mills Arena	20.94	11.91	32.85
Long Branch Arena	19.43	13.59	33.02
Don Mills Arena	16.55	17.26	33.81
Flemingdon Arena	19.78	15.21	34.99
Lambton Park Arena	24.43	12.74	37.17
Habitant Arena	17.67	21.12	38.80
Victoria Village Arena	25.42	15.87	41.29
Downsview Arena	20.75	21.40	42.15
Etob Centennial Arena	32.73	11.23	43.97
McCormick Arena	27.23	17.47	44.70
East York Arena	27.83	19.81	47.63
Forest Hill Memorial Arena	29.68	19.22	48.90
Mitchell Field Arena	30.70	21.58	52.28
Moss Park Arena	38.85	18.27	57.12
Herbert Carnegie Centennial Arena	21.48	37.53	59.01
Amesbury Arena	24.89	34.46	59.35
Cummer Arena	41.14	51.92	93.05

Table 140: Indoor Sports Arena 2012 Energy Intensity

5.3 Target-setting Method and Metrics

2 indoor sports arenas 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
Albion Arena	331	Electricity
Forest Hill Memorial Arena	34	Electricity

Table 141: Excluded Facilities

After excluding these 2 facilities, 25 City of Toronto facilities and 12 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.

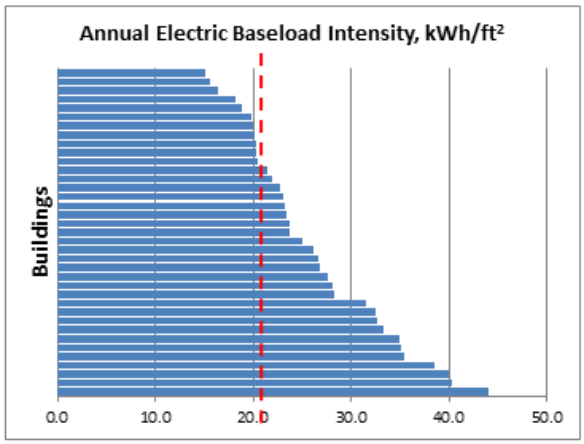

Figure 80: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to electricity use under normal facility operations for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for indoor sports arenas is seen during the months when the ice is in, and ranges from 15.1 to 44.0 ekWh/ft^2 with the top-quartile at 20.38 ekWh/ft^2.

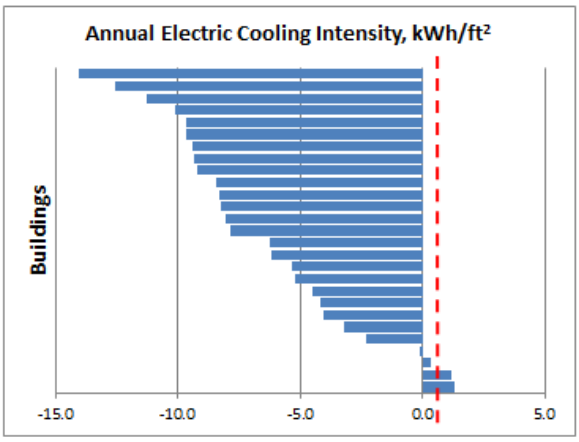

Figure 81: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Since many arena facilities take the ice out during the summer, electricity use is actually below the Electricity Baseload, and Electric Cooling is negative (see the Electric Cooling chart). For indoor sports arenas Electric Cooling ranges from minus 14.1 to plus 1.3 ekWh/ft^2 and the top-quartile is 0.76 ekWh/ft^2.

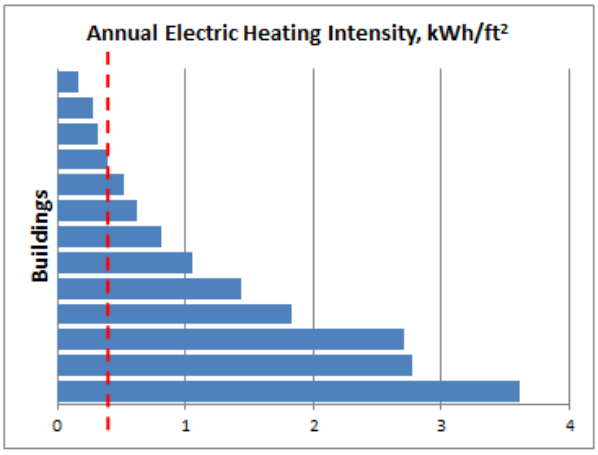

Figure 82: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months typically associated with heating**.** Electric Heating for indoor sports arenas ranges from 0.2 to 3.6 ekWh/ft^2 and the top-quartile is 0.39 ekWh/ft^2.

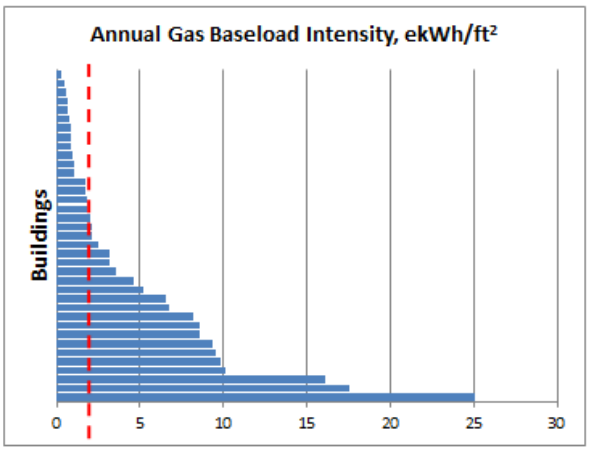

Figure 83: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for indoor sports arenas ranges from 0.96 to 25.1 ekWh/ft^2 and the top-quartile is 1.97 ekWh/ft^2.

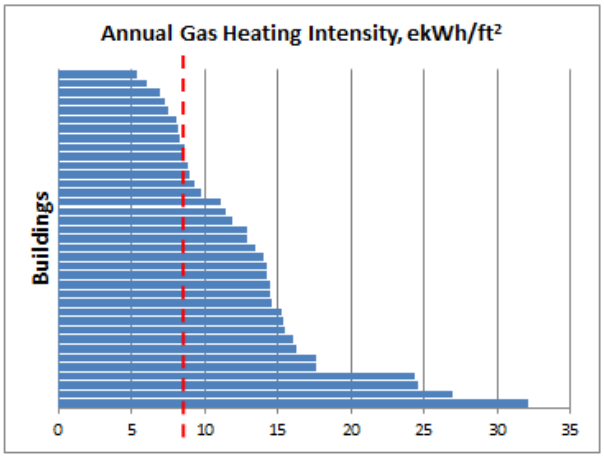

Figure 84: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for indoor sports arenas ranges from 5.4 to 32.1 ekWh/ft^2 and the top-quartile is 8.68 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 sports arenas, 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, area of the ice surface and months of ice-in.

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 2 High Savings Potential Indoor Sports Arenas

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

There are 2 indoor sports arenas 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				
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total				Electricity	Gas	ft²	kg/yr
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
Etob Centennial Arena	49%			60%	$ 179,484	35%		10%	$ 1,873	47%	$ 181,357	$ 102,563	$ 720	65,466	154,559
Cummer Arena	54%			57%	$ 113,316	92%	51%	71%	$ 31,675	65%	$ 144,990	$ 64,752	$12,183	34,348	317,943

Table 142: Savings Potential for 2 High Savings Potential Indoor Sports Arenas

Savings Potential by Energy Use Component for the 20 Mid Savings Potential Indoor Sports Arenas

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

There are 20 indoor sports arenas 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 (20)	31%	00%	25%	41%	$ 799,904	61%	20%	27%	$ 77,426	35%	$ 877,330	$457,088	$29,779	606,040	1,188,046
Downsview Arena	43%			67%	$ 66,792	78%	19%	38%	$ 6,974	52%	$ 73,766	$ 38,167	$ 2,682	34,218	102,880
Herbert Carnegie Centennial Arena	30%			38%	$ 48,649	68%	56%	58%	$ 23,084	51%	$ 71,733	$ 27,800	$ 8,878	42,270	205,050
East York Arena	42%			54%	$ 63,547	21%	25%	24%	$ 3,681	42%	$ 67,228	$ 36,313	$ 1,416	30,257	76,535
Amesbury Arena	41%			55%	$ 51,907	82%	52%	60%	$ 14,010	58%	$ 65,917	$ 29,661	$ 5,388	26,942	142,032
Mitchell Field Arena	39%			45%	$ 57,723	72%		27%	$ 4,450	37%	$ 62,173	$ 32,985	$ 1,712	30,182	77,516
Lambton Park Arena	45%			71%	$ 60,457			0%	$ -	47%	$ 60,457	$ 34,547	$ -	24,854	47,502
Forest Hill Memorial Arena				34%	$ 56,843			15%	$ 2,978	26%	$ 59,821	$ 32,482	$ 1,145	40,666	66,182
Habitant Arena	43%			86%	$ 55,721	43%	16%	20%	$ 2,809	50%	$ 58,531	$ 31,841	$ 1,081	26,307	64,084
Victoria Village Arena	37%			47%	$ 55,972		7%	7%	$ 882	31%	$ 56,854	$ 31,984	$ 339	33,637	50,350
Moss Park Arena	42%			43%	$ 51,935	66%		31%	$ 3,203	39%	$ 55,138	$ 29,677	$ 1,232	22,335	63,951
McCormick Arena	27%	100%		28%	$ 39,491	81%		43%	$ 7,050	34%	$ 46,540	$ 22,566	$ 2,711	37,082	81,976
Flemingdon Arena	32%			50%	$ 35,709		9%	8%	$ 823	32%	$ 36,532	$ 20,405	$ 317	25,640	34,007
Phil White Arena	24%		54%	36%	$ 31,113			0%	$ -	27%	$ 31,113	$ 17,779	$ -	25,941	24,446
Mimico Arena	23%			35%	$ 29,059			0%	$ -	22%	$ 29,059	$ 16,605	$ -	35,607	22,832
Long Branch Arena	27%			39%	$ 26,997			0%	$ -	23%	$ 26,997	$ 15,427	$ -	25,629	21,212
Scarborough Arena Gardens	19%			23%	$ 23,243			0%	$ -	13%	$ 23,243	$ 13,282	$ -	38,319	18,262
York Mills Arena	18%		40%	28%	$ 19,074	65%		35%	$ 2,486	30%	$ 21,560	$ 10,900	$ 956	23,573	32,955
Bayview Arena	12%			20%	$ 11,770		18%	17%	$ 2,123	19%	$ 13,893	$ 6,726	$ 816	28,417	24,588
Don Mills Arena	8%			11%	$ 7,218		13%	12%	$ 1,399	11%	$ 8,617	$ 4,125	$ 538	27,857	15,784
Fenside Arena	8%			13%	$ 6,682		14%	14%	$ 1,474	13%	$ 8,156	$ 3,818	$ 567	26,307	15,903

Table 143: Savings Potential for 20 Medium Savings Potential Indoor Sports Arenas

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 Indoor Sports Arenas

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

There are 5 indoor sports arenas 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%	00%	00%	02%	$ 6,261	00%	03%	02%	$ 949	02%	$ 7,210	$ 3,578	$ 365	157,142	11,777
Chris Tonks Arena	5%			8%	$ 3,934			0%	$ -	5%	$ 3,934	$ 2,248	$ -	23,638	3,091
Pine Point Arena	3%			3%	$ 2,327			0%	$ -	2%	$ 2,327	$ 1,330	$ -	32,001	1,828
Baycrest Arena				0%	$ -		9%	9%	$ 949	4%	$ 949	$ -	$ 365	27,060	6,858
George Bell Arena				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	41,785	0
Albion Arena				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	32,658	0

Table 144: Savings Potential for 5 Low-Savings Potential Indoor Sports Arenas

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 Swimming Pools

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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 7 indoor swimming pool buildings 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 214,077 ft^2. The indoor swimming pools range in size from less than 14,000 ft^2 to over 52,000 ft^2.

None of the indoor swimming pools are equipped with renewable energy systems.

The indoor swimming pools have air conditioning serving between 0 and 80% of the building. There are a number of other facilities using between 5 and 20% electric heat. None of the indoor swimming pools 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 7 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	**4,212,737**	**$589,783**
Natural Gas (m^3)	**995,591**	**$258,854**
Total		**$848,637**

Table 145: 2012 Energy Use and Costs for 7 City of Toronto Indoor Swimming Pools

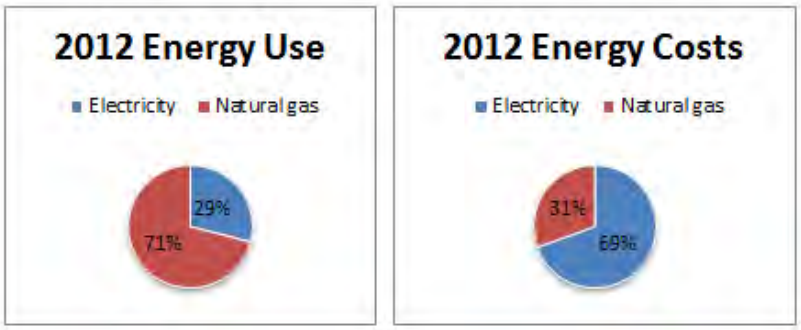

Figure 85: 2012 Energy Use and Cost Breakdown for 7 City of Toronto Indoor Swimming Pools

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 7 buildings. Total energy use ranges from 26.1 to 130.3 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.

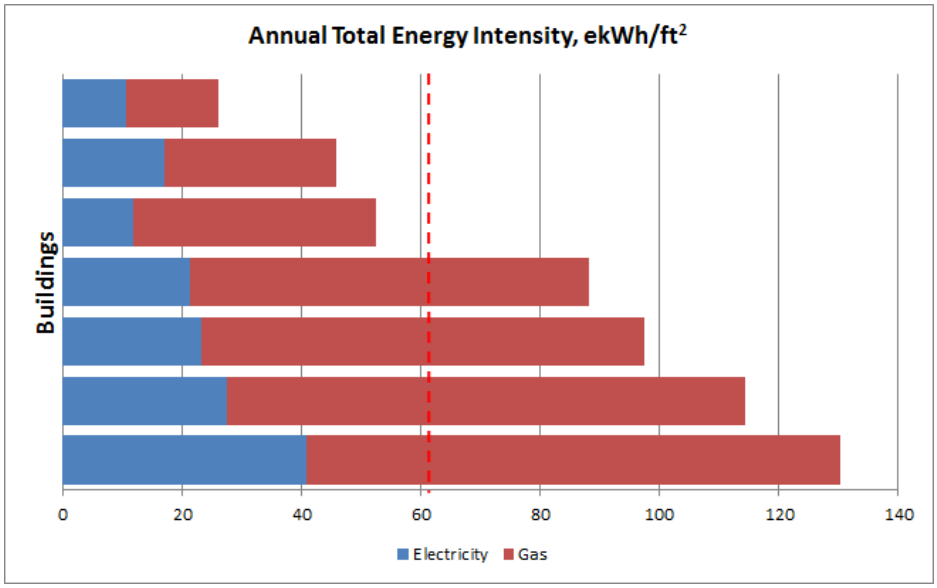

Figure 86: 2012 Total Energy Intensity Benchmark

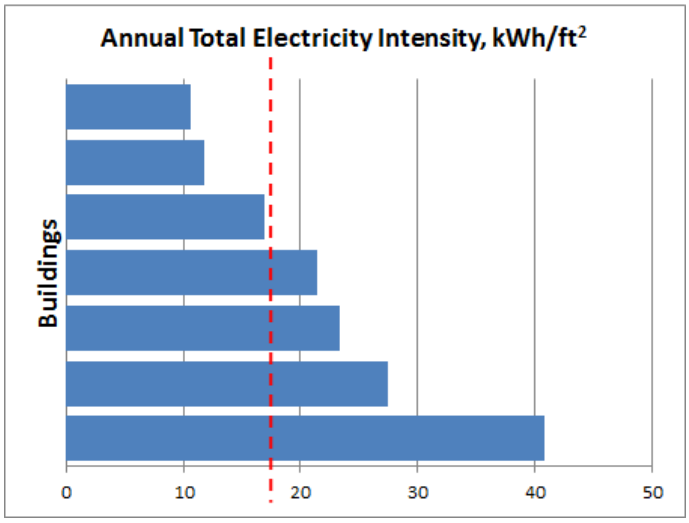

Figure 87: 2012 Total Electricity Intensity Benchmark

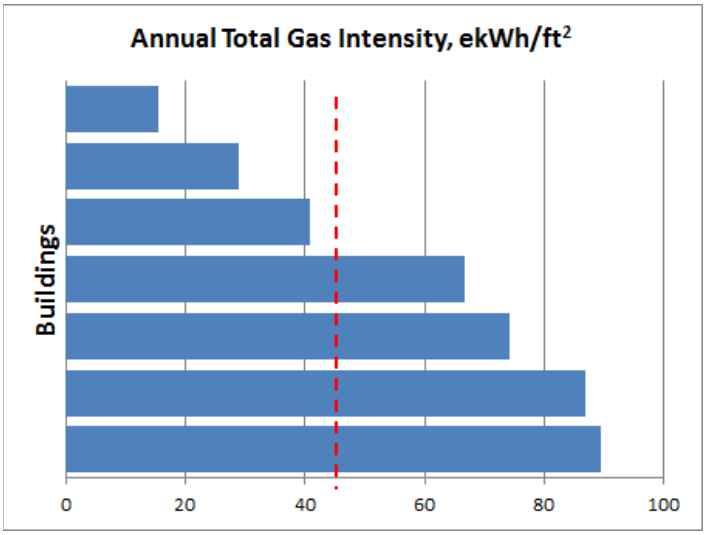

Figure 88: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for indoor swimming pools 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 swimming pool to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	15.9	kWh/ft²/year
	Cooling	0.6	kWh/ft²/year
	Heating	0.7	kWh/ft²/year
	Total	17.2	kWh/ft²/year
Gas	Base	21.5	ekWh/ft²/year
	Heating	22.9	ekWh/ft²/year
	Total	44.3	ekWh/ft²/year
Total energy	Total	61.5	ekWh/ft²/year

Table 146: Top Quartile Targets

11 indoor swimming pools made up the data set for target-setting, 7 of which are City of Toronto buildings with complete and reliable data, with 4 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 indoor swimming pool. The total savings potential for each indoor swimming pool 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 7 indoor swimming pools 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 indoor swimming pools with annual savings potential greater than $100,000. 6 indoor swimming pools have annual savings potential between $5,000 and $100,000 and 1 indoor swimming pool has annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 7 buildings is $264,892 ($167,343 for electricity and $97,549 for gas) with an average total energy savings of 35%.

For the 6 mid-potential savings facilities, the total annual savings potential is $261,857 ($164,307 for electricity and $97,549 for gas) with an average total energy savings of 38%.

For the 1 low-potential savings facility, the total annual savings potential is $3,036 ($3,036 for electricity and $0 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: 7 facilities	**25%**	**63%**	**52%**	**28%**	**$167,343**	**55%**	**17%**	**38%**	**$97,549**	**35%**	**$264,892**	**$95,625**	**$37,519**	**214,077**	**836,465**
Mid-potential savings facilities (6)	29%	59%	55%	32%	$164,307	56%	20%	41%	$97,549	38%	$261,857	$93,890	$37,519	161,846	834,079
Low potential savings facilities (1)	00%	100%	00%	04%	$ 3,036	00%	00%	00%	$ -	02%	$ 3,036	$ 1,735	$ -	52,231	2,385

Table 147: 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 7 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	17.4	13.1	25%	$ 128,737
Electric Cooling (kWh/ft²)	1.0	0.4	63%	$ 19,300
Electric Heating (kWh/ft²)	1.4	0.7	52%	$ 19,306
Total Electricity (kWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Gas Baseload (ekWh/ft²)	28.3	12.8	55%	$ 77,120
Gas Heating (ekWh/ft²)	21.9	18.1	17%	$ 20,430
Total Gas (ekWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Total Energy (ekWh/ft²)	**67.8**	**44.1**	**35%**	**$ 264,892**

High savings | Moderate | Low savings

Table 148: Savings Potential Based on Energy Use Component for 7 Indoor Swimming Pools

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) 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 indoor swimming pools. 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 7 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	2	6	Year 1	Annual Review	Building Occupants
B2	Enable ENERGY STAR power settings, turn off computers when not in use	4	2	6	Year 1	Annual Review	Building Occupants
B3	Turn off lights when areas not in use	4	2	6	Year 1	Annual Review	Building Occupants
B4	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	
L1	Replace incandescent and halogen light bulbs with high efficiency lighting	1	2	3	Year 4	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	2	3	Year 4	10 to 15	
L3	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	2	3	Year 4	10 to 15	
L4	Replace HID lighting with high efficiency fluorescent	1	2	3	Year 4	10 to 15	
L5	Replace outdoor lights and signage with high efficiency fixtures	1	2	3	Year 4	10 to 15	
L6	Replace festive lighting with LED	1	2	3	Year 4	10 to 15	
L7	Install sufficient manual switching to allow occupants to effectively control lighting operation	1	2	3	Year 4	15+	
EL1	Replace refrigerators, dishwasher, microwaves with ENERGY STAR rated appliances	1	2	3	Year 4	8 to 12	
EL2	Replace computers with ENERGY STAR rated units	1	2	3	Year 4	4 to 6	
EL3	Install controls on vending machines	1	2	3	Year 4	10 to 15	
EL4	Install power factor correction	3	2	5	Year 4	15+	
M3	Test and replace/right-size circulating pumps	1	2	3	Year 4	10 to 20	
M4	Install VFD on circulating pump	1	2	3	Year 4	10 to 20	
M5	Install variable frequency drives (VFDs) on HVAC fans and pumps	1	2	3	Year 4	10 to 20	
M6	Convert electric hot water heaters to natural gas	1	2	3	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
M7	Control fan coil and entrance heaters to optimize run-times	3	4	7	Year 2	seasonal review	
P1	Control car plug-in outlets	3	4	7	Year 2	seasonal review	
M8	Evaluate conversion from electric heating to natural gas	2	4	6	Year 2	n/a	
M9	Convert electric to gas dehumidifiers	1	4	5	Year 2	15 to 20	
M10	Install snow sensors to control the snow-melting system	1	4	5	Year 3	seasonal review	
M11	Upgrade base building heating system to avoid use of electric heaters	1	4	5	Year 3	seasonal review	
M12	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 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
P2	Upgrade/adjust dehumidifier controls	3	4	7	Year 2	seasonal review	
M13	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	4	6	Year 2	seasonal review	
M14	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	4	7	Year 2	seasonal review	
M15	Test and tune the air conditioning units	3	4	7	Year 2	3	
M16	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						
B13	Optimize dishwasher operation (only run when full)	4	4	8	Year 1	annual review	Building Occupants
P6	Identify and repair hot water leaks	4	4	8	Year 1	seasonal review	
P3	Optimize pool water temperature control, reset based on use	4	4	8	Year 2	seasonal review	
P4	Optimize DHW temperature control	2	4	6	Year 2	annual review	
P5	Test and tune DHW boiler efficiency	3	4	7	Year 2	annual review	
M18	Investigate and repair possible gas leaks	3	4	7	Year 2	annual review	
P7	Implement DHW circulation pump control	1	4	5	Year 2	annual review	
M17	Install heat recovery dehumidification system	1	4	5	Year 3	10 to 15	
P8	Install low flow showerheads and faucet aerators	1	4	5	Year 3	10 to 15	
M19	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
M20	Recover heat from nearby ice plant	1	4	5	Year 3	10 to 15	
M21	Install solar hot water heating	1	4	5	Year 3	10 to 15	
M22	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						
B14	Check and clear baseboard heaters of obstructions	4	1	5	Year 1	annual review	Building Occupants
B15	Adjust blinds (to retain heat in winter)	4	1	5	Year 1	annual review	Building Occupants
B16	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	1	5	Year 1	annual review	Building Occupants
M23	Optimize operating periods of ventilation systems	2	1	3	Year 2	seasonal review	
M24	Test and adjust ventilation systems to optimize outside air volumes	3	1	4	Year 2	seasonal review	
M25	Test and tune boiler efficiency	3	1	4	Year 2	seasonal review	
M26	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	
EN2	Seal window and door frames	3	1	4	Year 2	5	
M27	Optimize fan-coil unit and entrance heater controls	3	1	4	Year 2	seasonal review	
P9	Control loading dock heating	4	1	5	Year 2	seasonal review	
P10	Isolate idle boilers	4	1	5	Year 2	seasonal review	
M28	Test, repair, replace and right-size heating control valves and outside air dampers	2	1	3	Year 4	10 to 15	
M29	Upgrade heating system control to optimize space temperatures and operating periods	1	1	2	Year 5	10 to 15	
EN3	Replace single-pane windows with double-pane windows	1	1	2	Year 5	20 to 24	
EN4	If replacing the roof, ensure R-value at least 22	1	1	2	Year 5	n/a	
M30	Install high efficiency burners	1	1	2	Year 5	15 to 20	
M31	Replace boilers with more efficient models	1	1	2	Year 5	15 to 20	
M32	Replace old rooftop units with energy efficient units	1	1	2	Year 5	15 to 20	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 149: Energy Saving Measures for Indoor swimming pools

The specific measures and implementation timeline for each individual indoor swimming pool 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
Wallace Emerson	1260 Dufferin St	Solar PV	10	kW

Table 150: Proposed Renewable Energy Systems on Indoor Swimming Pools

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 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 $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 swimming pools are summarized in Table 140 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	-	11.25	$ -	$ -	0.0%	
$5,000 - $100,000	6	26,974	9.38	$ 1,517,311	$ 261,857	98.9%	5.79
< $5,000	1	52,231	0.75	$ 39,173	$ 3,036	1.1%	12.90
	7			**$ 1,556,484**	**$ 264,892**		**5.88**

Table 151: 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 141 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	6	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	1	$ 150	< $5,000	Division Champion and staff
		7			

Table 152: Assessment Tools used to determine specific energy-saving measures

3.2.1 Energy Assessment

There are 6 indoor swimming pools with between $5,000 and $100,000 in annual energy saving potential. Approximately 99% of the total energy savings for all 7 indoor swimming pools can be found in these 6 facilities.

These 6 indoor swimming pools can save an average of 38% of their total energy use. The total annual energy savings are estimated to be over $261,850 and individual building annual savings range from approximately $7,100 to over $93,000. The annual GHG savings are approximately 834,000 kg.

These 6 indoor swimming pools can save an average of 32% of their total electricity use (29% Electric Baseload, 59% Electric Cooling and 55% Electric Heating). The total annual electricity savings are estimated to be approximately $164,300 and individual building annual savings range from just over $7,800 to over $69,300.

These 6 indoor swimming pools can save an average of 41% of their total gas use (56% Gas Baseload and 20% Gas Heating). The total annual gas savings are estimated to be approximately $97,549 and individual building annual savings range from approximately $0 to approximately $40,500.

These 6 facilities will undergo an Energy Assessment with highest potential indoor swimming pools focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 6 Indoor swimming pools and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 6 indoor swimming pools can be found in Electric Heating, 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 swimming pools are eligible to receive over $131,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Savings Checklist

There is 1 indoor swimming pool (John Innes Park) with less than $5,000 in savings potential. Approximately 1% of the total energy savings for all 7indoor swimming pools can be found at this facility.

John Innes Park indoor swimming pool can save an average of 2% of its total energy use. The total annual energy savings are estimated to be approximately $3,000 and the annual GHG savings are approximately 2,385 kg.

John Innes Park indoor swimming pool can save an average of 4% of its total electricity use (0% Electric Baseload, 100% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $3,000.

There is no gas savings potential at this facility.

John Innes Park indoor swimming pool will undergo a checklist approach (see the Implementation Plan for further details).

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

All of the savings for this building can be found in Electric Cooling.

The energy savings checklist will be used by the Division Champion for the Indoor swimming pools in conjunction with the building operator and/or service contractor for each Indoor swimming pool. 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 7 facilities. The total cost to implement the energy management and retrofit plan for indoor swimming pools is estimated to be $1,561,134. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	4,500
Checklist	$	150
Implementation	$	1,556,484
Total	**$**	**1,561,134**

Table 153: 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 6 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 occur in Year 2 and the implementation of these measures will occur 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 $391,608. The cumulative net cash flow becomes positive in Year 9.

The implementation plan includes the following assumptions:

- Approximately 70% of the project budget will be spent in the first 5 years, and the other 30% 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. 70% of medium and low potential savings facilities will be retrofitted in the first 5 years and 30% in the following 5 years.
- 25% of energy savings potential of retrofitted facilities are 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).

o 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	2	1	1	1	1	0	0	0	0	0	6
Low Potential - Checklist	0	1	0	0	0	0	0	0	0	0	1
Assessment Costs	$ 1,500	$ 906	$ 750	$ 750	$ 750	$ -	$ -	$ -	$ -	$ -	$ 4,656
Implementation Costs	$ -	$ 526,203	$ 309,934	$ 273,731	$ 279,206	$ 284,790	$ -	$ -	$ -	$ -	$ 1,673,864
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 150	$ 52,711	$ 31,068	$ 27,448	$ 27,996	$ 28,479	$ -	$ -	$ -	$ -	$ 167,852
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 26,310	$ 41,807	$ 55,493	$ 69,454	$ 83,693	$ 83,693	$ 83,693	$ 83,693	$ 83,693.21	
Annual Costs	$ 1,650	$ 606,131	$ 383,560	$ 357,423	$ 377,405	$ 396,962	$ 83,693	$ 83,693	$ 83,693	$ 83,693	$ 2,457,903
Estimated Achieved Annual Savings		$ 50,652	$ 160,953	$ 258,292	$ 301,733	$ 340,719	$ 370,236	$ 391,366	$ 410,935	$ 431,481	$ 2,716,367
Estimated Incentives	$ -	$ 93,024	$ 15,371	$ 12,367	$ 9,655	$ 2,727	$ -	$ -	$ -	$ -	$ 133,143
Annual Savings and Incentives	$ -	$ 143,676	$ 176,324	$ 270,659	$ 311,388	$ 343,445	$ 370,236	$ 391,366	$ 410,935	$ 431,481	$ 2,849,511
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 66	-$ 18,564	-$ 26,854	-$ 30,324	-$ 32,965	-$ 35,106	-$ 23,644	-$ 11,337	$ -	-$ 178,859
Net Cash Flow incl borrowing costs	-$ 1,650	-$ 462,520	-$ 225,800	-$ 113,617	-$ 96,341	-$ 86,481	$ 251,437	$ 284,029	$ 315,905	$ 347,788	$ 212,749
Cumulative Net Cash Flow	-$ 1,650	-$ 464,104	-$ 671,340	-$ 758,104	-$ 824,121	-$ 877,638	-$ 591,095	-$ 283,422	$ 43,820	$ 391,608	

Table 154: Cash Flow for 10-Year Implementation Plan

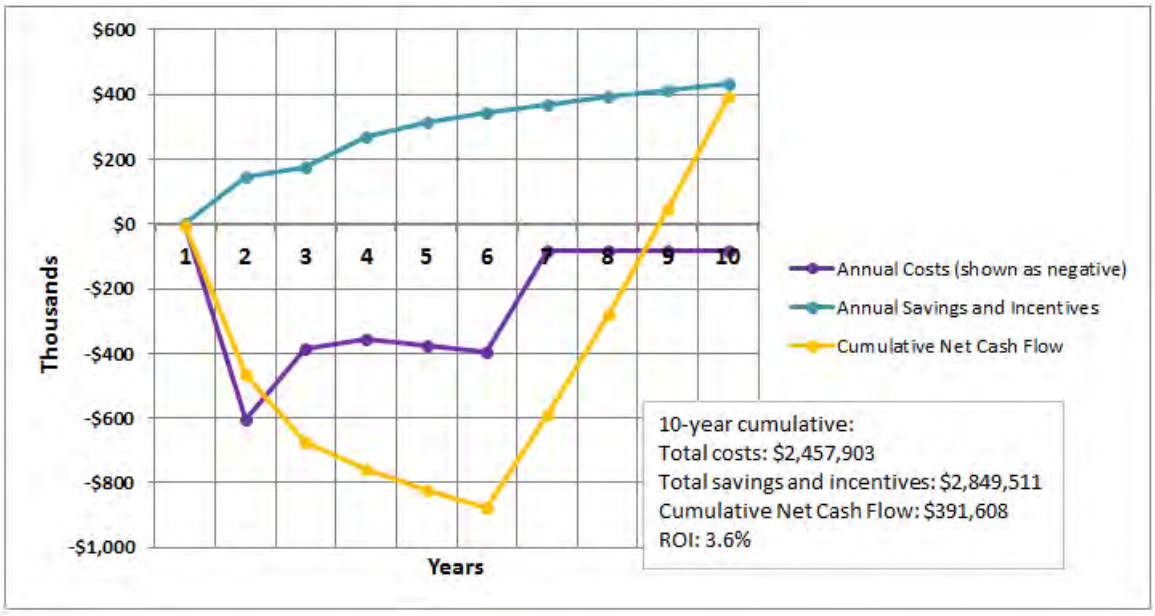

Figure 89: Cash Flow for 10-Year Implementation Plan

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 indoor swimming pools 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:

- 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 155: 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 measures include cost effective retrofits to the pool circulation pump, dehumidification, heat recovery, related equipment and controls.

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 Swimming Pools

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 7 indoor swimming pool buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Douglas Snow Aquatic Center	5100 Yonge Street	40,666
Gus Ryder Pool (indoor)	302 Birmingham St	21,097
Harrison Pool	15 Stephanie St	15,263
John Innes Park	150 Sherbourne St	52,231
Norseman Pool (indoor)	105 Norseman St	19,052
The Elms Pool (indoor)	45 Golfdown Dr	13,885
Wallace-Emerson C.C	1260 Dufferin St	51,882

Table 156: Indoor Swimming Pool Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 7 indoor swimming pool 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 ($ekWh/ft^2$)
John Innes Park	10.67	15.40	26.07
Wallace-Emerson C.C	16.97	28.79	45.76
Harrison Pool	11.75	40.95	52.70
Norseman Pool (indoor)	20.81	66.97	87.79
Douglas Snow Aquatic Center	23.30	67.83	91.14
The Elms Pool (indoor)	27.39	86.98	114.38
Gus Ryder Pool (indoor)	40.78	89.61	130.39

Table 157: Indoor Swimming Pool 2012 Energy Intensity

5.3 Target-setting Method and Metrics

No indoor swimming pools were determined to be ineligible for determination of energy components or target-setting. See Appendix A.

7 City of Toronto facilities and 4 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.

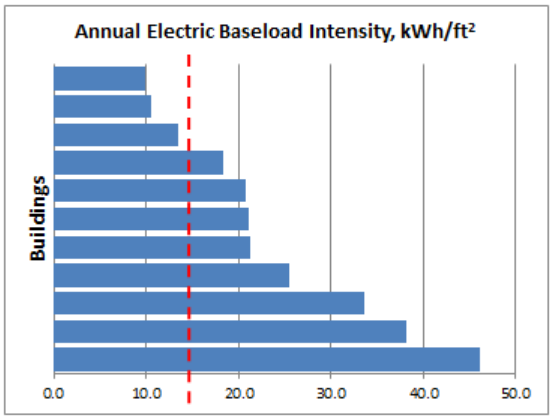

Figure 90: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for indoor swimming pools ranges from 9.9 to 46.2 ekWh/ft^2 and the top-quartile is 15.87 ekWh/ft^2.

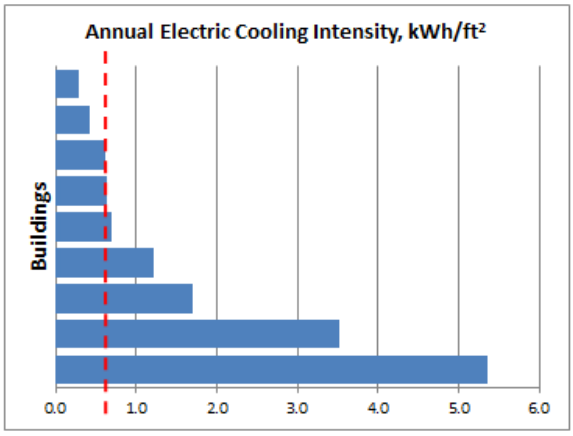

Figure 91: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for indoor swimming pools ranges from 0.3 to 5.4 ekWh/ft^2 and the top-quartile is 0.61 ekWh/ft^2.

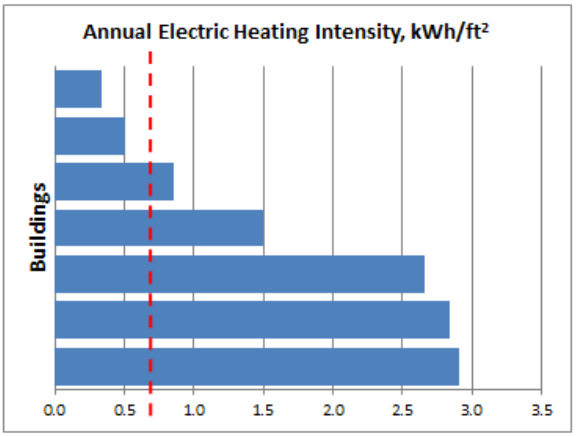

Figure 92: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for indoor swimming pools ranges from 0.3 to 2.9 ekWh/ft^2 and the top-quartile is 0.68 ekWh/ft^2.

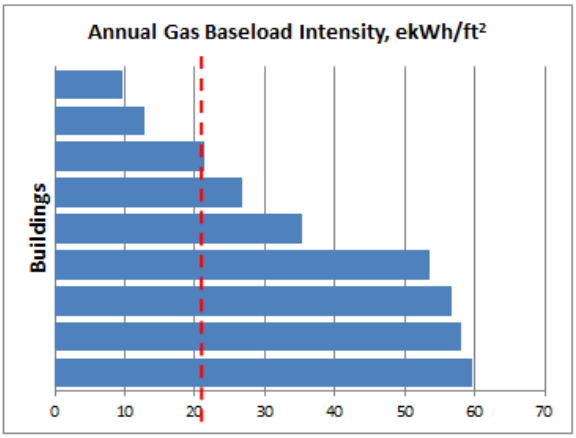

Figure 9: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for indoor swimming pools ranges from 9.6 to 59.7 ekWh/ft^2 and the top-quartile is 21.46 ekWh/ft^2.

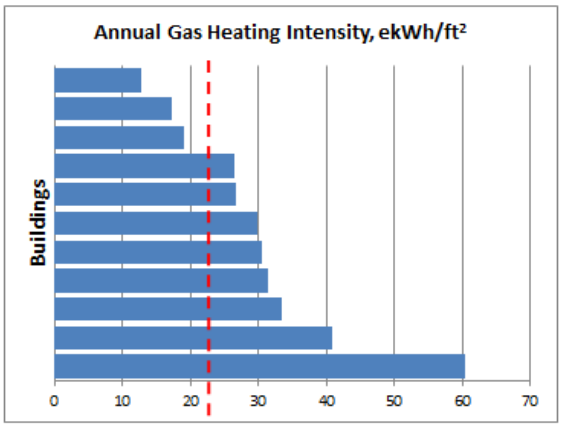

Figure 10: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for indoor swimming pools ranges from 12.9 to 60.5 ekWh/ft^2 and the top-quartile is 22.88 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 swimming pools, 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 6 Mid Savings Potential Indoor Swimming Pools

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

There are 6indoor swimming pools 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 (6)	29%	59%	55%	32%	$164,307	56%	20%	41%	$97,549	38%	$261,857	$93,890	$37,519	161,846	834,079
Gus Ryder Pool (indoor)	58%	40%	62%	58%	$ 69,363	64%	23%	50%	$23,683	52%	$ 93,047	$39,636	$ 9,109	21,097	225,658
Douglas Snow Aquatic Center	37%	63%		38%	$ 50,234	70%		58%	$40,491	53%	$ 90,725	$28,705	$15,573	40,666	332,096
Norseman Pool (indoor)	28%			27%	$ 15,241	43%	37%	40%	$12,809	37%	$ 28,050	$ 8,709	$ 4,927	19,052	104,545
Wallace-Emerson C.C		100%	80%	18%	$ 21,642			0%	$ -	7%	$ 21,642	$12,367	$ -	51,882	17,005
The Elms Pool (indoor)	10%	53%		15%	$ 7,826	49%	36%	44%	$13,476	37%	$ 21,302	$ 4,472	$ 5,183	13,885	103,541
Harrison Pool				0%	$ -		45%	45%	$ 7,090	35%	$ 7,090	$ -	$ 2,727	15,263	51,235

Table 158: Savings Potential for 6 Medium Savings Potential Indoor Swimming Pools

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 1 Low Savings Potential Indoor Swimming Pool

There is 1 indoor swimming pool with less than $5,000 in 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							
Low potential savings facilities (1)	00%	100%	00%	04%	$ 3,036	00%	00%	00%	$ -	02%	$ 3,036	$ 1,735	$ -	52,231	2,385
John Innes Park		100%		4%	$ 3,036			0%	$ -	2%	$ 3,036	$ 1,735	$ -	52,231	2,385

Table 159: Savings Potential for 1 Low-Savings Potential Indoor Swimming Pool

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.

Long-Term Care Homes and 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 10 long-term care homes and services 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 1,622,285 ft^2. The long-term care homes and services range in size from approximately 67,000 ft^2 to over 294,000 ft^2.

True Davidson Acres is the only Long Term Care facility equipped with a 100 kW solar hot water system.

All of the long-term care homes and services are 100% air-conditioned. One facility (Castleview Wychwood Towers) is partially served by electric heat. None of the facilities are served by ground or water source heat pumps. Approximately 20% of each of the facilities is related to food services.

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 10 buildings are summarized below.

	2012 Energy Use	
	Unit	$
Electricity (kWh)	**29,095,073**	**$4,073,310**
Natural Gas (m^3)	**3,452,073**	**$897,539**
Total		**$4,970,849**

Table 160: 2012 Energy Use and Costs for 10 City of Toronto Long-term Care Homes and Services

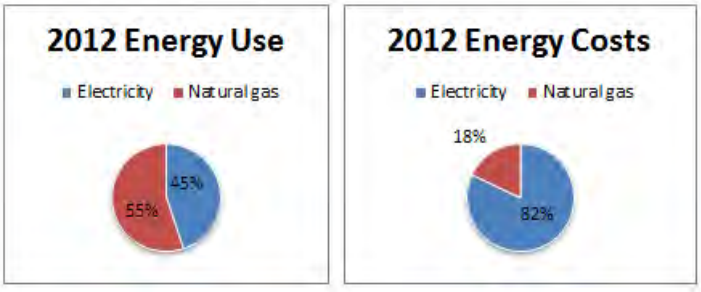

Figure 93: 2012 Energy Use and Cost Breakdown for City of Toronto Long-Term Care Facilities

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 10 buildings. Total energy use ranges from approximatley 27 to over 50 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.

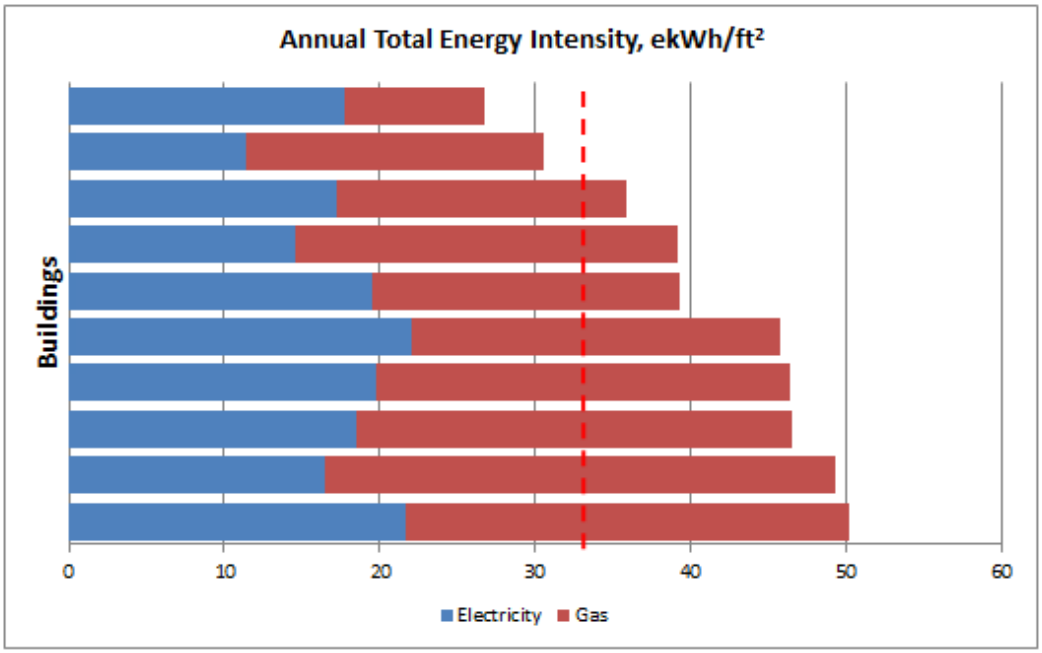

Figure 94: 2012 Total Energy Intensity Benchmark

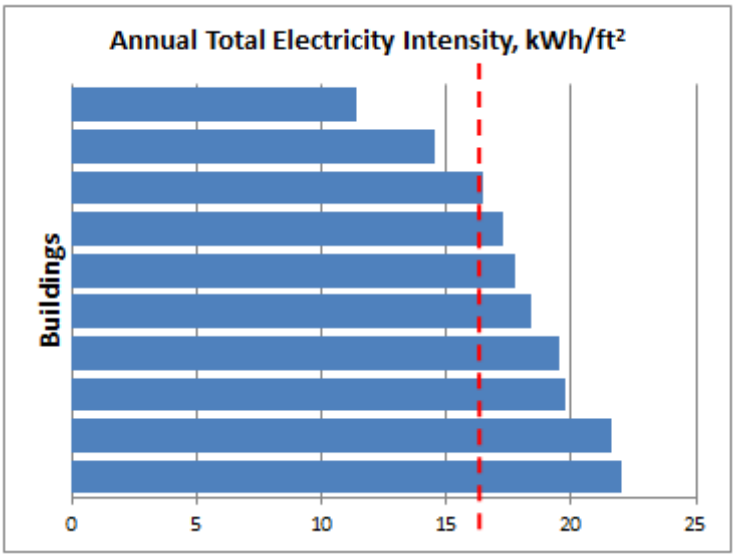

Figure 95: 2012 Total Electricity Intensity Benchmark

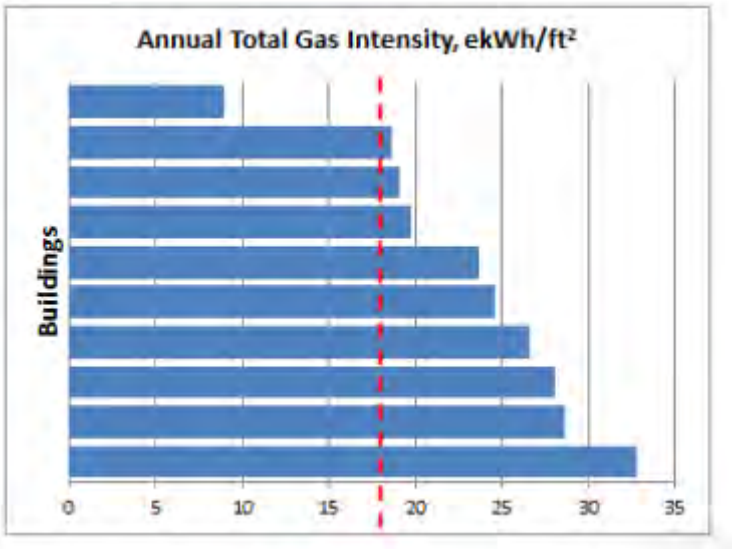

Figure 96: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for long-term care homes and services 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 long-term care home to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	14.7	kWh/ft²/year
	Cooling	0.7	kWh/ft²/year
	Heating	1.1	kWh/ft²/year
	Total	16.5	kWh/ft²/year
Gas	Base	4.3	ekWh/ft²/year
	Heating	13.7	ekWh/ft²/year
	Total	17.9	ekWh/ft²/year
Total energy	Total	34.4	ekWh/ft²/year

Table 161: Top Quartile Targets

The data set for target-setting is made up of the 10 long-term care homes and services 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)), % of the area which is air conditioned and % of the area which is food services. 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 long-term care home. The total savings potential for each long-term care home 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 10 long-term care homes and services 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 long-term care homes and services with annual savings potential greater than $100,000. 10 long-term care homes and services have annual savings potential between $5,000 and $100,000 and no long-term care homes and services have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 10 buildings is $335,242 ($84,781 for electricity and $250,460 for gas) with an average total energy savings of 16%.

	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 10 facilities	**00%**	**36%**	**11%**	**02%**	**$ 84,781**	**36%**	**25%**	**28%**	**$250,460**	**16%**	**$335,242**	**$ 48,447**	**$ 96,331**	**1,622,285**	**1,876,671**
Mid-potential savings facilities (10)	00%	36%	11%	02%	$ 84,781	36%	25%	28%	$250,460	16%	$335,242	$ 48,447	$ 96,331	1,622,285	1,876,671

Table 162: 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 10 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	16.5	16.5	0%	$ -
Electric Cooling (kWh/ft²)	0.9	0.6	36%	$ 72,708
Electric Heating (kWh/ft²)	1.1	1.0	11%	$ 12,073
Total Electricity (kWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Gas Baseload (ekWh/ft²)	6.4	4.1	36%	$ 94,128
Gas Heating (ekWh/ft²)	15.6	11.8	25%	$ 156,332
Total Gas (ekWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Total Energy (ekWh/ft²)	**40.0**	**33.4**	**16%**	**$ 335,242**

High savings | Moderate | Low savings

Table 163: Savings Potential based on Energy Use Component for 10 Long-term Care Homes and Services

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 long-term care homes and services. 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 10 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).

	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	1	5	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	1	5	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	1	5	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	1	4	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	1	3	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	1	2	Year 5	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	1	2	Year 5	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	1	2	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	3	7	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	3	7	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	3	7	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	3	7	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	3	7	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	3	7	Year 1		Building Occupants
M10	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	3	5	Year 2	seasonal review	
M12	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	3	6	Year 2	seasonal review	
M13	Test and tune the air conditioning units	3	3	6	Year 2	3	
M11	Replace and right-size air conditioning units with ENERGY STAR rated units	1	3	4	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						
B17	Optimize dishwasher operation (only run when full)	4	3	7	Year 1		Building Occupants
P1	Optimize DHW temperature control	2	3	5	Year 2	annual review	
P3	Test and tune DHW boiler efficiency	3	3	6	Year 2	annual review	
M16	Investigate and repair possible gas leaks	3	3	6	Year 2	annual review	
P2	Implement DHW circulation pump control	1	3	4	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	3	4	Year 4	10 to 15	
M14	Insulate DHW tanks and distribution piping	2	3	5	Year 3	10 to 15	
M15	Replace DHW boilers with more efficient models	1	3	4	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						
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 164: Energy Saving Measures for Long-term Care Homes and Services

The specific measures and implementation timeline for each individual long-term care home will be determined from the results of the Energy Assessments (explained in the Implementation section of this plan).

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
Kipling Acres I	2233 Kipling Ave	Solar PV	150	kW
Kipling Acres II	2233 Kipling Ave	Solar PV	75	kW

Table 165: Proposed Renewable Energy Systems on Indoor Swimming Pools

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.

In the case of long-term care facilities, the range of energy performance between high and low users is substantially less than for the other facility types, implying a fairly consistent level of energy efficiency. As a result, the targeted % savings are relatively low, so that the required level of investment in energy efficiency improvements is lower. In order to achieve a rational ROI, an implementation cost of $1.00/ft^2 has been applied. See Table 6.

The total implementation costs, payback and cash flows for the portfolios of high medium and low-potential long-term care homes and services are summarized in Table 166 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	10	162,229	1.00	$ 1,622,285	$ 335,242	100.0%	4.84
< $5,000	0	-	1.68	$ -	$ -	0.0%	
	10			**$ 1,622,285**	**$ 335,242**		**4.84**

Table 166: 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 167 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	10	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	0	$ 150	< $5,000	Division Champion and staff
		10			

Table 167: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Energy Assessment

There are 10 long-term care homes and services with between $5,000 and $100,000 in annual energy saving potential. These 10 long-term care homes and services can save an average of 16% of their total energy use.

The total annual energy savings are estimated to be over $335,000 and individual building annual savings range from approximately $6,200 to over $66,000. The annual GHG savings are approximately 1,876,000 kg.

These 10 long-term care homes and services can save an average of 2% of their total electricity use (0% Electric Baseload, 36% Electric Cooling and 11% Electric Heating). The total annual electricity savings are estimated to be approximately $84,780 and individual building annual savings range from approximately $300 to over $28,000.

These 10 long-term care homes and services can save an average of 28% of their total gas use (36% Gas Baseload and 25% Gas Heating). The total annual gas savings are estimated to be approximately $250,000 and individual building annual savings range from approximately $4,000 to over $53,000.

These 10 facilities will undergo an Energy Assessment with highest potential long-term care homes and services focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 10 long-term care homes and services and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 10 long-term care homes and services 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 long-term care homes and services are eligible to receive over $144,000 in incentives based on current incentives available from the Ontario Power Authority.

3.3 Implementation Budget

Table 168 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 10 facilities. The total costs to implement the energy management and retrofit plan for long-term care homes is estimated to be $1,629,785. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	7,500
Checklist	$	-
Implementation	$	1,622,285
Total	**$**	**1,629,785**

Table 168: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 169 and Figure 97 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 10 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.

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 $969,087. The cumulative net cash flow becomes positive in Year 10.

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
High Potential - Building Performance Audit	0	0	0	0	0	0	0	0	0	0	0
Mid Potential - Energy Assessment	3	2	2	2	1	0	0	0	0	0	10
Low Potential - Checklist	0	0	0	0	0	0	0	0	0	0	0
Assessment Costs	$ 2,250	$ 1,500	$ 1,500	$ 1,500	$ 750	$ -	$ -	$ -	$ -	$ -	$ 7,500
Implementation Costs	$ -	$ 506,348	$ 344,316	$ 351,203	$ 358,227	$ 182,696	$ -	$ -	$ -	$ -	$ 1,742,790
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 225	$ 50,785	$ 34,582	$ 35,270	$ 35,898	$ 18,270	$ -	$ -	$ -	$ -	$ 175,029
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 25,317	$ 42,533	$ 60,093	$ 78,005	$ 87,139	$ 87,139	$ 87,139	$ 87,139	$ 87,139	
Annual Costs	$ 2,475	$ 583,950	$ 422,931	$ 448,066	$ 472,879	$ 288,105	$ 87,139	$ 87,139	$ 87,139	$ 87,139	$ 2,566,965
Estimated Achieved Annual Savings		$ 50,848	$ 175,240	$ 310,230	$ 387,095	$ 436,866	$ 469,546	$ 495,305	$ 520,070	$ 546,073	$ 3,391,274
Estimated Incentives	$ -	$ 79,973	$ 32,734	$ 21,099	$ 8,538	$ 2,433	$ -	$ -	$ -	$ -	$ 144,777
Annual Savings and Incentives	$ -	$ 130,821	$ 207,974	$ 331,330	$ 395,634	$ 439,299	$ 469,546	$ 495,305	$ 520,070	$ 546,073	$ 3,536,051
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 99	-$ 18,224	-$ 26,822	-$ 31,492	-$ 34,582	-$ 28,534	-$ 13,238	$ -	$ -	-$ 152,991
Net Cash Flow incl borrowing costs	-$ 2,475	-$ 453,228	-$ 233,182	-$ 143,559	-$ 108,737	$ 116,612	$ 353,872	$ 394,927	$ 432,930	$ 458,934	$ 816,096
Cumulative Net Cash Flow	-$ 2,475	-$ 455,604	-$ 670,561	-$ 787,298	-$ 864,543	-$ 713,349	-$ 330,943	$ 77,222	$ 510,153	$ 969,087	

Table 169: Cash Flow for 10-Year Implementation Plan

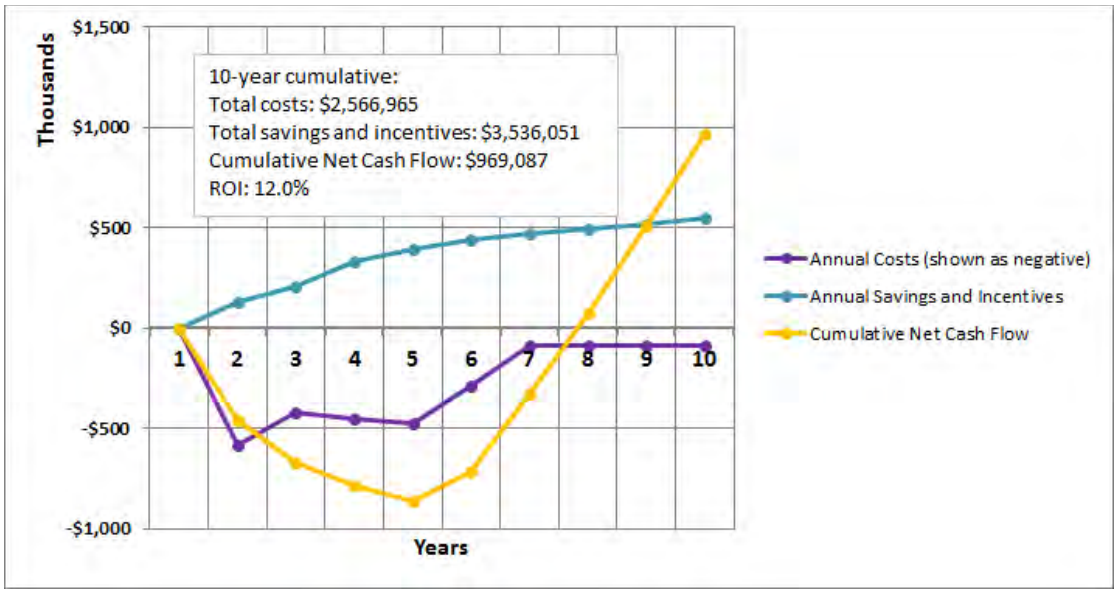

Figure 97: Cash Flow for 10-Year Implementation Plan

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 long-term care homes 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 170: 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 - Long-term Care Homes and Services

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 10 long-term care home buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Bendale Acres	2920 Lawrence Ave. E.	210,329
Carefree Lodge	306 Finch Ave. E.	67,490
Cummer Lodge	205 Cummer Ave.	243,202
Castleview Wychwood Towers	351 Christie St.	294,449
Fudger House	439 Sherbourne St.	118,996
Kipling Acres	2233 Kipling Ave.	184,592
Lakeshore Lodge	3197 Lakeshore Blvd.	88,964
Seven Oaks	9 Neilson Rd.	133,312
True Davidson Acres	200 Dawes Rd.	130,083
Wesburn Manor	400 The West Mall	150,868

Table 171: Long-term Care Home Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 10 long-term care home 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 ($ekWh/ft^2$)
Castleview Wychwood Towers	17.75	8.92	26.68
Kipling Acres	10.93	19.28	30.20
Carefree Lodge	17.25	18.65	35.91
Wesburn Manor	14.05	24.19	38.25
Lakeshore Lodge	18.86	19.76	38.63
Cummer Lodge	21.25	23.48	44.73
True Davidson Acres	19.63	26.51	46.13
Bendale Acres	18.44	28.83	47.28
Fudger House	16.18	32.87	49.05
Seven Oaks	20.93	28.54	49.47

Table 172: Long-term Care Home 2012 Energy Intensity

5.3 Target-setting Method and Metrics

No long-term care homes and services were determined to be ineligible for determination of energy components or target-setting. See Appendix A.

All 10 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.

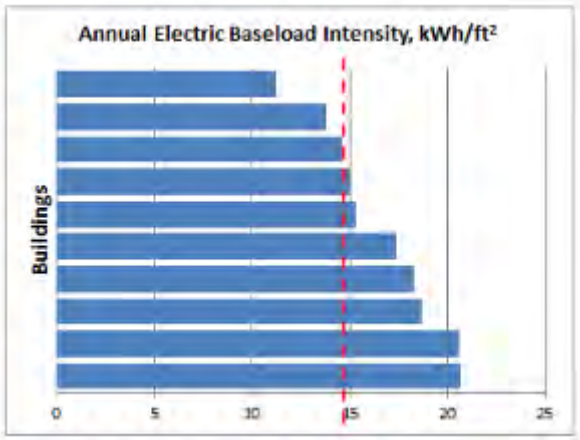

Figure 98: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for long-term care homes and services ranges from 11.2 to 20.6 ekWh/ft^2 and the top-quartile is 14.7 ekWh/ft^2.

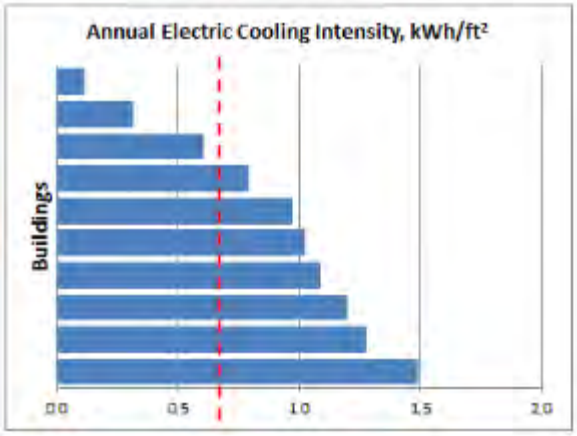

Figure 99: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for long-term care homes and services ranges from 0.1 to 1.5 ekWh/ft^2 and the top-quartile is 0.65 ekWh/ft^2.

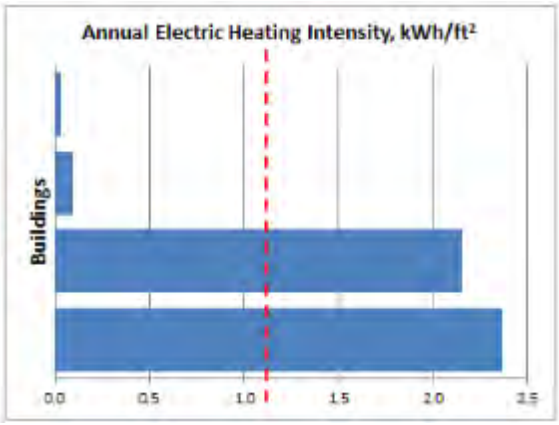

Figure 100: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for long-term care homes and services ranges from 0.1 to 2.4 ekWh/ft^2 and the top-quartile is 1.1 ekWh/ft^2.

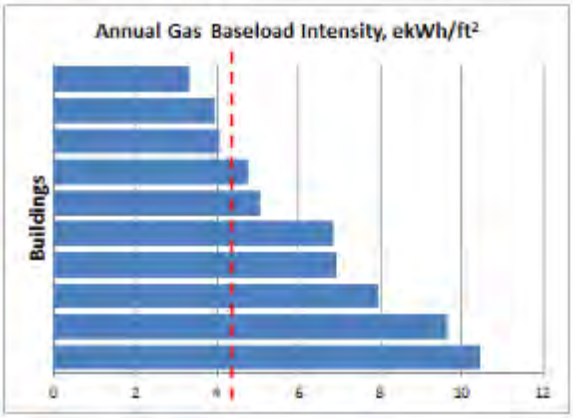

Figure 101: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for long-term care homes and services ranges from 3.4 to 10.5 ekWh/ft^2 and the top-quartile is 4.3 ekWh/ft^2.

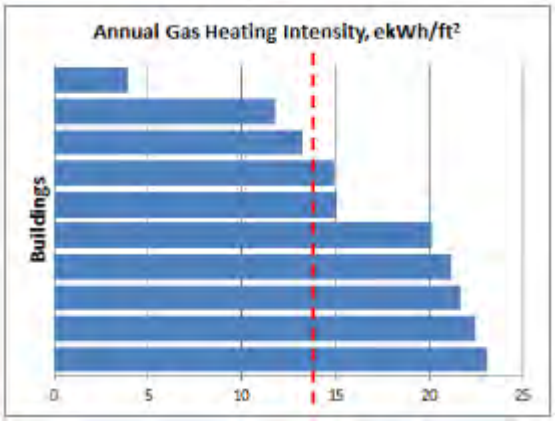

Figure 102: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for long-term care homes and services ranges from 3.9 to 23.1 ekWh/ft^2 and the top-quartile is 13.7 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 long-term care homes and services, 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 and % of area served by food services.

5.4 Savings Potential by Energy Use Component

Savings Potential by Energy Use Component for the 10 Mid Savings Potential Long-term Care Homes and Services

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

There are 10 long-term care homes and services 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 %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 10 facilities	**00%**	**36%**	**11%**	**02%**	**$ 84,781**	**36%**	**25%**	**28%**	**$250,460**	**16%**	**$335,242**	**$ 48,447**	**$ 96,331**	**1,622,285**	**1,876,671**
High potential savings facilities (0)	00%	00%	00%	00%	$ -	00%	00%	00%	$ -	00%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (10)	00%	36%	11%	02%	$ 84,781	36%	25%	28%	$250,460	16%	$335,242	$ 48,447	$ 96,331	1,622,285	1,876,671
Low potential savings facilities (0)	00%	00%	00%	00%	$ -	00%	00%	00%	$ -	00%	$ -	$ -	$ -	0	0
Cummer Lodge		56%		4%	$ 28,362	59%		26%	$ 37,956	16%	$ 66,318	$ 16,207	$ 14,599	243,202	296,591
Bendale Acres		36%		2%	$ 10,853	47%	32%	35%	$ 53,750	22%	$ 64,603	$ 6,202	$ 20,673	210,329	396,974
Fudger House		45%		3%	$ 9,061	56%	41%	45%	$ 44,500	31%	$ 53,561	$ 5,178	$ 17,115	118,996	328,715
Seven Oaks		33%		2%	$ 5,907	39%	37%	37%	$ 35,831	22%	$ 41,738	$ 3,376	$ 13,781	133,312	263,588
True Davidson Acres		40%		2%	$ 7,850		39%	33%	$ 28,837	20%	$ 36,687	$ 4,486	$ 11,091	130,083	214,569
Wesburn Manor		18%		1%	$ 2,959		36%	31%	$ 28,568	20%	$ 31,527	$ 1,691	$ 10,988	150,868	208,783
Carefree Lodge			53%	7%	$ 11,767	38%		14%	$ 4,412	11%	$ 16,179	$ 6,724	$ 1,697	67,490	41,129
Lakeshore Lodge		49%		3%	$ 7,715	11%	9%	9%	$ 4,005	6%	$ 11,721	$ 4,409	$ 1,540	88,964	35,007
Kipling Acres				0%	$ -		10%	8%	$ 6,732	5%	$ 6,732	$ -	$ 2,589	184,592	48,650
Castleview Wychwood Towers			0%	0%	$ 306	16%		9%	$ 5,870	3%	$ 6,177	$ 175	$ 2,258	294,449	42,665

Table 173: Savings Potential for 10 Medium Savings Potential Long-term Care Homes and Services

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

Performing Arts 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 3 performing arts 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 430,370 ft^2. The performing arts facilities range in size from approximately 80,700 ft^2 to almost 178,000 ft^2.

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

The facilities are all 100% air-conditioned and are served by approximately 5% electric heat. None of the 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)	**6,061,100**	**$848,554**
Natural Gas (m^3)	**271,413**	**$70,567**
Total		**$919,121**

Table 174: 2012 Energy Use and Costs for 3 City of Toronto Performing Arts Facilities

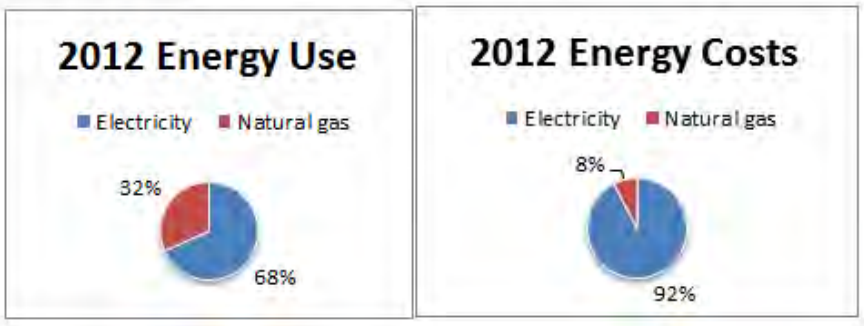

Figure 103: 2012 Energy Use and Cost Breakdown for 3 City of Toronto Performing Arts Facilities

In the case of performing arts facilities, the range of energy performance between high and low users is substantially less than for the other facility types, implying a fairly consistent level of energy efficiency. Total energy use ranges from approximately 15.2 to 34.0 ekWh/ft^2 and electricity use ranges from 12.3 to 20.1 ekWh/ft^2 . Gas use has a wider range, and ranges from 2.2 to 13.9 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.

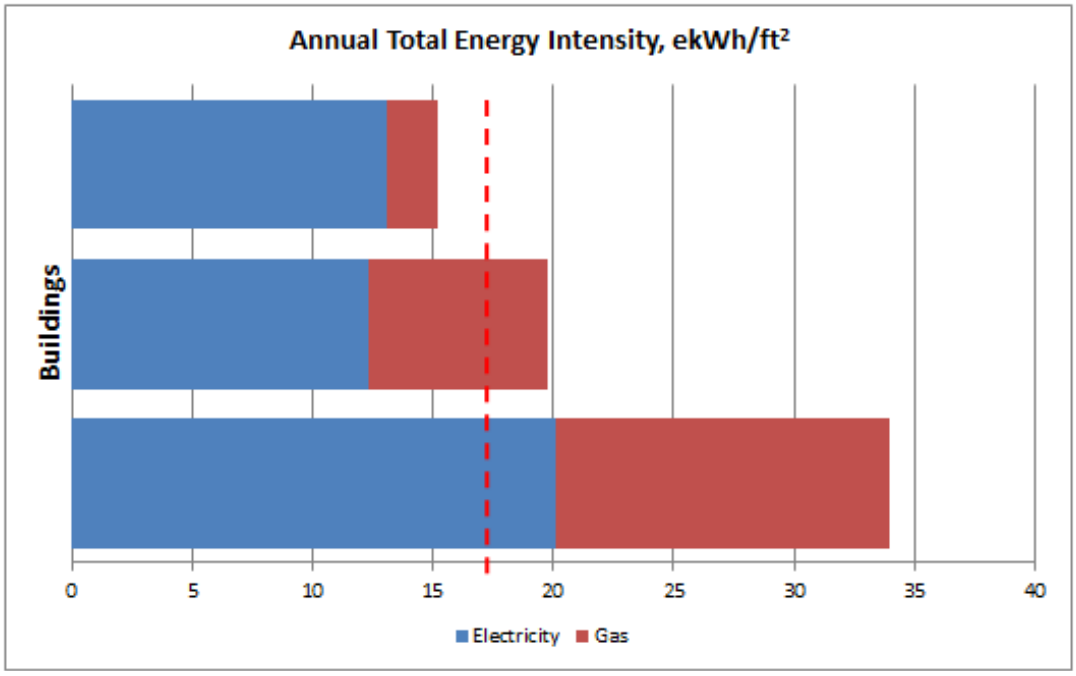

Figure 104: 2012 Total Energy Intensity Benchmark

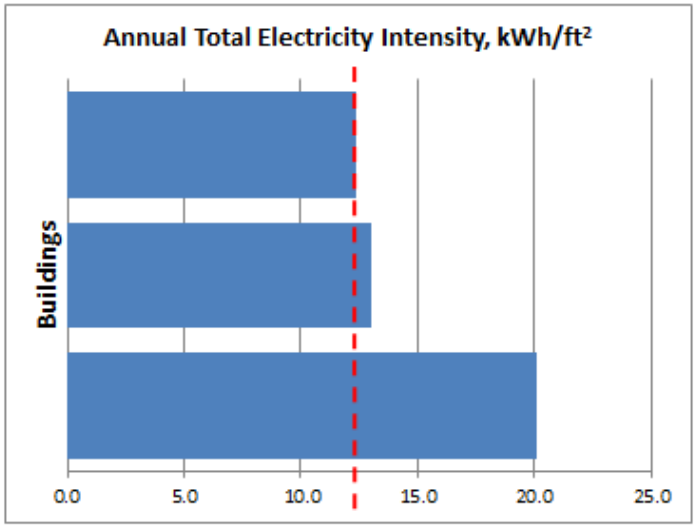

Figure 105: 2012 Total Electricity Intensity Benchmark

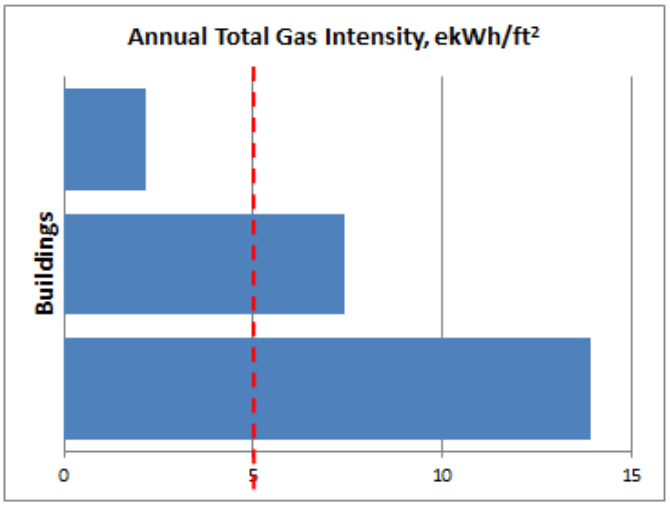

Figure 106: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for performing arts 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 performing arts facility to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Base	11.4	kWh/ft²/year
	Cooling	0.9	kWh/ft²/year
	Heating	0.0	kWh/ft²/year
	Total	12.3	kWh/ft²/year
Gas	Base	0.4	ekWh/ft²/year
	Heating	4.6	ekWh/ft²/year
	Total	5.0	ekWh/ft²/year
Total energy	Total	17.3	ekWh/ft²/year

Table 175: Top Quartile Targets

The data set for target-setting is made up of 3 performing arts 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 performing arts facility. The total savings potential for each performing arts 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 3 performing arts 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 performing arts facility with annual savings potential greater than $100,000. 2 performing arts facilities have annual savings potential between $5,000 and $100,000, and no performing arts facilities have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 3 buildings is $155,618 ($124,444 for electricity and $31,174 for gas) with an average total energy savings of 24%.

For the 1 high-potential savings facility, the total annual savings potential is $109,046 ($89,665 for electricity and $19,380 for gas) with an average total energy savings of 51%.

For the 2 mid-potential savings facilities, the total annual savings potential is $19,873 ($34,779 for electricity and $11,794 for gas) with an average total energy savings of 12%.

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: 3 facilities	**14%**	**27%**	**00%**	**15%**	**$124,444**	**00%**	**45%**	**44%**	**$31,174**	**24%**	**$155,618**	**$71,111**	**$11,990**	**430,370**	**323,068**
High potential savings facilities (1)	41%	00%	00%	39%	$ 89,665	00%	69%	69%	$19,380	51%	$109,046	$51,237	$ 7,454	80,729	210,510
Mid-potential savings facilities (2)	03%	31%	00%	06%	$ 34,779	00%	29%	28%	$11,794	12%	$ 46,572	$19,873	$ 4,536	349,640	112,558
Low potential savings facilities (0)	00%	00%	00%	00%	$ -	00%	00%	00%	$ -	00%	$ -	$ -	$ -	0	0

Table 176: 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 3 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	11.1	14%	$ 104,882
Electric Cooling (kWh/ft²)	1.2	0.9	27%	$ 19,562
Electric Heating (kWh/ft²)	0.0	0.0	0%	$ -
Total Electricity (kWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Gas Baseload (ekWh/ft²)	0.4	0.4	0%	$ -
Gas Heating (ekWh/ft²)	6.3	3.5	45%	$ 31,174
Total Gas (ekWh/ft²) for facilities w/o component intensities	0.0	0.0	0%	$ -
Total Energy (ekWh/ft²)	**20.6**	**15.7**	**24%**	**$ 155,618**

High savings | Moderate | Low savings

Table 177: Savings Potential based on Energy Use Component for 3 Performing Arts 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 Heating) 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 performing arts 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 3 facilities indicate that the highest percentage reductions will come from measures associated with gas heating and electric cooling.

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	
L1	Conduct audit of stage and audience lighting to identify possible improvements	3	1	4	Year 4	4 to 6	
L2	Replace incandescent and halogen light bulbs with high efficiency lighting	1	1	2	Year 5	10 to 15	
L3	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	1	1	2	Year 5	10 to 15	
L4	Install photo-sensors and/or a timer on outdoor and daylit interior area lighting	1	1	2	Year 5	10 to 15	
L5	Replace HID lighting with high efficiency fluorescent	1	1	2	Year 5	10 to 15	
L6	Replace outdoor lights and signage with high efficiency fixtures	1	1	2	Year 5	10 to 15	
L7	Replace festive lighting with LED	1	1	2	Year 5	10 to 15	
L8	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	
EL4	Install power factor correction	3	1	4	Year 5	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	1	5	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	1	5	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	1	5	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	1	4	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	1	3	Year 2	n/a	
M5	Install snow sensors to control the snow-melting system	1	1	2	Year 5	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	1	2	Year 5	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	1	2	Year 5	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	2	6	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	2	6	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	2	6	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	2	6	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	2	6	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	2	6	Year 1		Building Occupants
M10	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	2	4	Year 2	seasonal review	
M12	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	2	5	Year 2	seasonal review	
M13	Test and tune the air conditioning units	3	2	5	Year 2	3	
M11	Replace and right-size air conditioning units with ENERGY STAR rated units	1	2	3	Year 5	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	1	5	Year 1		Building Occupants
P1	Optimize DHW temperature control	2	1	3	Year 2	annual review	
P3	Test and tune DHW boiler efficiency	3	1	4	Year 2	annual review	
M16	Investigate and repair possible gas leaks	3	1	4	Year 2	annual review	
P2	Implement DHW circulation pump control	1	1	2	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	1	2	Year 5	10 to 15	
M14	Insulate DHW tanks and distribution piping	2	1	3	Year 5	10 to 15	
M15	Replace DHW boilers with more efficient models	1	1	2	Year 5	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 178: Energy Saving Measures for Performing Arts Facilities

The specific measures and implementation timeline for each individual performing arts 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.

In the case of performing arts facilities, the range of energy performance between high and low users is less than for the other facility types, implying a fairly consistent level of energy efficiency. As a result, the targeted % savings are relatively low, so that the required level of investment in energy efficiency improvements is lower. In order to achieve a rational ROI, an implementation cost of $1.00/ft^2 has been applied to the facilities with savings potential between $5,000 and $100,000. See Table 6.

The total implementation costs, payback and cash flows for the portfolios of high medium and low-potential performing arts facilities 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	1	80,729	5.58	$ 450,469	$ 109,046	70.1%	4.13
$5,000 - $100,000	2	174,820	1.00	$ 349,640	$ 46,572	29.9%	7.51
< $5,000	0	-	1.86	$ -	$ -	0.0%	
	3			**$ 800,110**	**$ 155,618**		**5.14**

Table 179: 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)	1	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	2	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	0	$ 150	< $5,000	Division Champion and staff
		3			

Table 180: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There is 1 performing arts facility (St Lawrence Centre) with over $100,000 in annual energy saving potential. Over 70% of the total energy savings for all performing arts facilities can be found at this facility.

St Lawrence Centre can save an average of 51% of its total energy use. The total annual energy savings are estimated to be over $109,000 and the annual GHG savings are approximately 210,500 kg.

St Lawrence Centre can save an average of 39% of its total electricity use (41% Electric Baseload, 0% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $89,660.

St Lawrence Centre can save an average of 69% of its total gas use, and all of the savings are in Gas Heating. The total annual gas savings are estimated to be approximately $19,400.

St Lawrence Centre 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.

All of the savings for this facility can be found in Gas Heating and Electric Baseload. After the implementation of the proposed measures, this facility is eligible to receive over $58,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 2 performing arts facilities with between $5,000 and $100,000 in annual energy saving potential. Approximately 30% of the total energy savings for all 3 performing arts facilities can be found in these 2 facilities.

These 2 performing arts facilities can save an average of 12% of their total energy use. The total annual energy savings are estimated to be over $46,500.The annual GHG savings are approximately 112,550 kg.

These 2 performing arts facilities can save an average of 6% of their total electricity use (3% Electric Baseload, 31% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $34,780.

These 2 performing arts facilities can save an average of 28% of their total gas use (all in gas heating). The total annual gas savings are estimated to be approximately $11,800.

These 2 facilities will undergo an Energy Assessment with highest potential performing arts facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 2 performing arts facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 2 performing arts 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 performing arts facilities are eligible to receive over $24,000 in incentives based on current incentives available from the Ontario Power Authority.

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 3 facilities. The total costs to implement the energy management and retrofit plan for performing arts facilities is estimated to be $809,110. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	7,500
Energy Assessment	$	1,500
Checklist	$	-
Implementation	$	800,110
Total	$	**809,110**

Table 181: 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 both Energy Assessments completed by the end of Year 2. The implementation of these measures will begin in Year 2, and will be completed by the end of 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 $478,037. 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	1	1	0	0	0	0	0	0	0	0	2
Assessment Costs	$ 8,250	$ 750	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,000
Implementation Costs	$ -	$ 650,551	$ 185,521	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 836,072
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 825	$ 65,130	$ 18,552	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 84,507
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 32,528	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	
Annual Costs	$ 9,075	$ 748,959	$ 245,876	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 41,804	$ 1,296,535
Estimated Achieved Annual Savings		$ 37,910	$ 118,960	$ 183,661	$ 198,612	$ 208,543	$ 218,970	$ 229,918	$ 241,414	$ 253,485	$ 1,691,472
Estimated Incentives	$ -	$ 72,771	$ 10,330	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 83,101
Annual Savings and Incentives	$ -	$ 110,680	$ 129,290	$ 183,661	$ 198,612	$ 208,543	$ 218,970	$ 229,918	$ 241,414	$ 253,485	$ 1,774,573
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 363	-$ 25,894	-$ 30,558	-$ 24,883	-$ 18,611	-$ 11,941	-$ 4,855	$ -	$ -	-$ 117,105
Net Cash Flow incl borrowing costs	-$ 9,075	-$ 638,642	-$ 142,480	$ 111,300	$ 131,925	$ 148,128	$ 165,225	$ 183,260	$ 199,610	$ 211,681	$ 360,932
Cumulative Net Cash Flow	-$ 9,075	-$ 647,354	-$ 763,940	-$ 622,082	-$ 465,274	-$ 298,535	-$ 121,369	$ 66,746	$ 266,356	$ 478,037	

Table 182: Cash Flow for 10-Year Implementation Plan

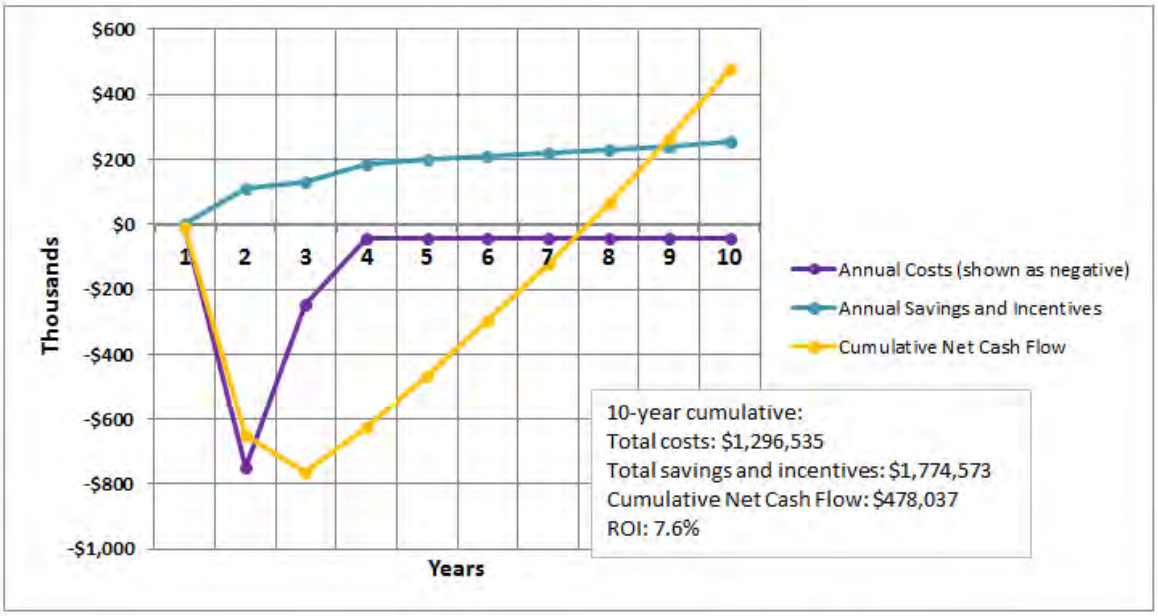

Figure 107: Cash Flow for 10-Year Implementation Plan

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 performing arts 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:

- Performing arts facilities
- Cultural 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 183: 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 - Performing Arts Facilities

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 3 performing arts facility buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Sony Centre for the Performing Arts	1 Front St E	171,649
St Lawrence Centre	27 Front St E	80,729
Toronto Centre for the Arts	5040 Yonge St	177,992

Table 184: Performing Arts Facility Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 3 performing arts 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 ($ekWh/ft^2$)
Sony Centre for the Performing Arts	12.66	2.15	14.82
Toronto Centre for the Arts	12.16	7.44	19.60
St Lawrence Centre	19.28	13.90	33.19

Table 185: Performing Arts Facility 2012 Energy Intensity

5.3 Target-setting Method and Metrics

No performing arts facilities were determined to be ineligible for determination of energy components or target-setting. See Appendix A.

3 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.

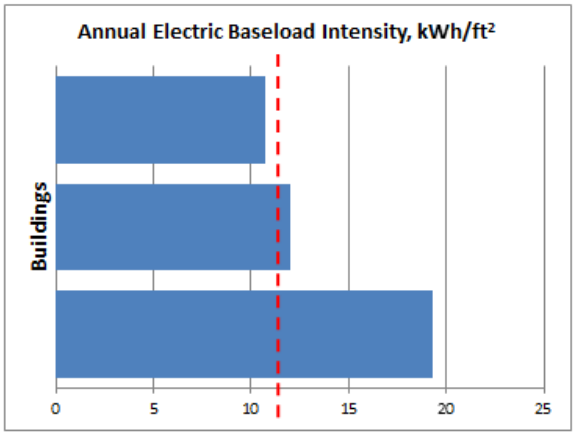

Figure 108: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for performing arts facilities ranges from 10.8 to 19.3 ekWh/ft^2 and the top-quartile is 11.4 ekWh/ft^2.

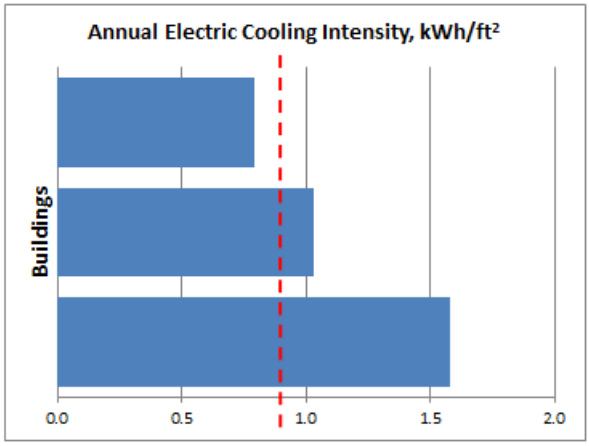

Figure 109: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for performing arts facilities ranges from 0.8 to 1.6 ekWh/ft^2 and the top-quartile is 0.9 ekWh/ft^2.

Electric Heating refers to additional electricity use in winter months for heating purposes**.** There is no Electric Heating for performing arts facilities.

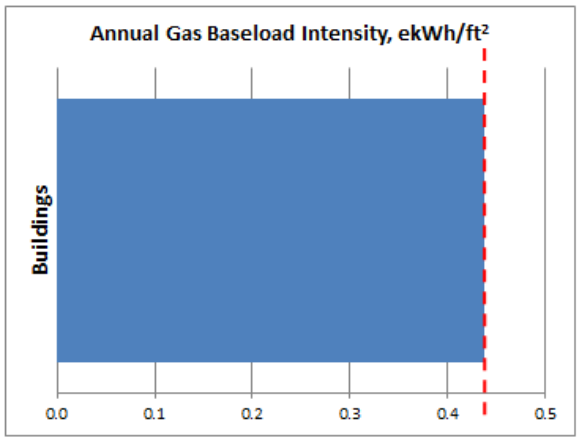

Figure 110: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. There is Gas Baseload only at Toronto Centre for the Arts and it is 0.44 ekWh/ft^2.

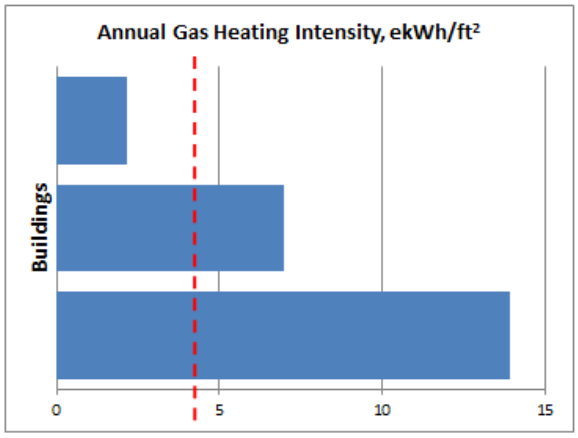

Figure 111: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for performing arts facilities ranges from 2.2 to 13.9 ekWh/ft^2 and the top-quartile is 4.8 ekWh/ft^2.

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 performing arts 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 Performing Arts Facility

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

There is one performing arts 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)	41%	00%	00%	39%	$ 89,665	00%	69%	69%	$19,380	51%	$109,046	$51,237	$ 7,454	80,729	210,510
St Lawrence Centre	41%			39%	$ 89,665		69%	69%	$19,380	51%	$109,046	$51,237	$ 7,454	80,729	210,510

Table 186: Savings Potential for 1 High Savings Potential Performing Arts Facility

Savings Potential by Energy Use Component for the 2 Mid-Savings Potential Performing arts Facilities

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

There are 2 performing arts 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 (2)	03%	31%	00%	06%	$ 34,779	00%	29%	28%	$11,794	12%	$ 46,572	$19,873	$ 4,536	349,640	112,558
Toronto Centre for the Arts		42%		6%	$ 16,701		38%	35%	$11,794	17%	$ 28,495	$ 9,543	$ 4,536	177,992	98,354
Sony Centre for the Performing Arts	5%	12%		6%	$ 18,077				$ -	5%	$ 18,077	$10,330	$ -	171,649	14,204

Table 187: Savings Potential for 2 Medium Savings Potential Performing Arts 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.

Police Services Facilities

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1.1 Energy Use and Building Characteristics

1.1.1 Building Characteristics

The City of Toronto is reporting on 39 police services 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 2,589,421 ft^2. The police services facilities range in size from less than 500 ft^2 (Leuty Beach) to almost 300,000 ft^2.

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

Building Name	Building Address	Renewable Installation	System Size	Unit
Police Garage (Forensic)	2050 Jane St	Solar Air	49	kW
Police Headquarters	40 College St	Deep Lake Water Cooling	450	kW
Police No.11 Division	2054 Davenport Rd	Geothermal	N/A	N/A
Police No.14 Divison	350 Dovercourt Rd	Geothermal	N/A	N/A
Police Traffic Services and Garage	9 Hanna Ave	Solar Photovoltaic	50	kW
Toronto Police Services Training College	70 Birmingham Street	Geothermal	N/A	N/A
Toronto Police Services Training College	70 Birmingham Street	Solar Photovoltaic	216	kW

Table 188: Current Renewable Energy Systems on Police Services Facilities

The facilities range from 0% to 100% air-conditioned. Two facilities (Centre Island Marine Unit and Centre Island Police Division) are 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 police 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).

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 39 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	38,388,047	$5,374,327
Natural Gas (m^3)	2,622,208	$681,774
Total		**$6,056,101**

Table 189: 2012 Energy Use and Costs for 39 City of Toronto Police Services Facilities

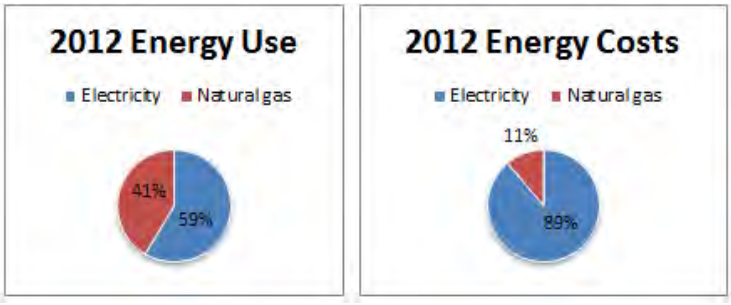

Figure 112: 2012 Energy Use and Cost Breakdown for 39 City of Toronto Police Services Facilities

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 39 buildings. Total energy use ranges from approximatley 2 to 138 ekWh/ft^2 (Leuty Beach). It should be noted that this could be a data error and should be investigated. 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.

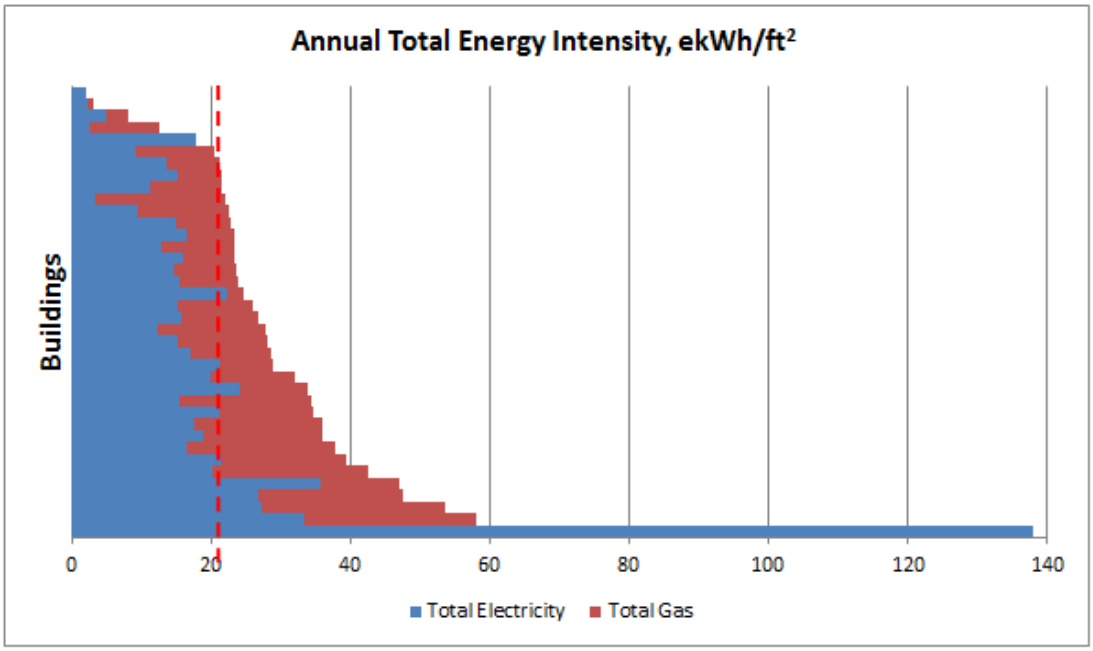

Figure 113: 2012 Total Energy Intensity Benchmark

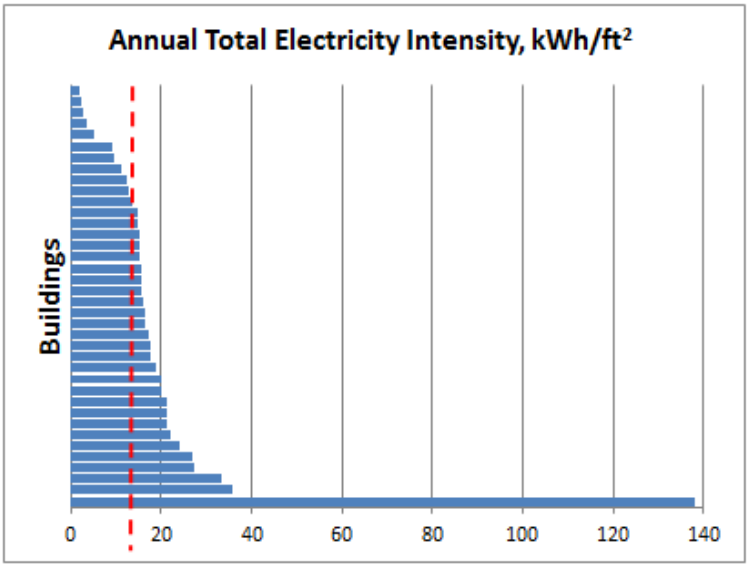

Figure 114: 2012 Total Electricity Intensity Benchmark

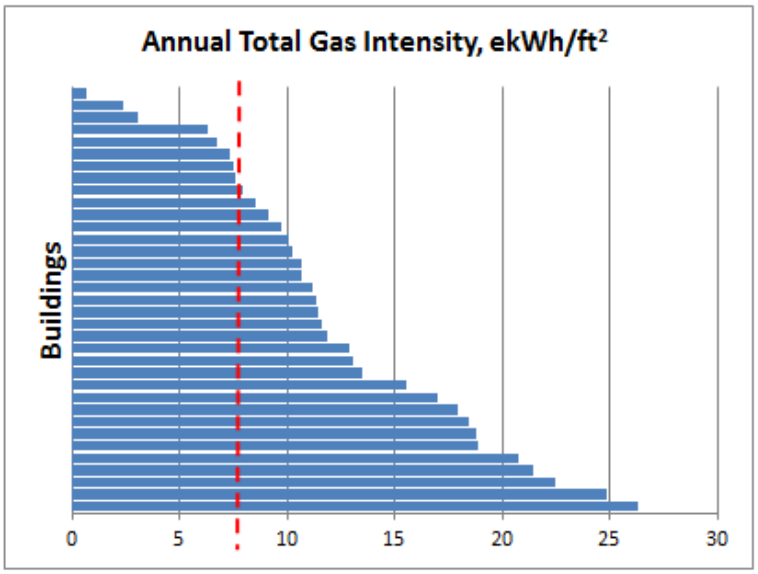

Figure 115: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for police services 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 police station to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Baseload	12.9	kWh/ft²/year
	Cooling	1.2	kWh/ft²/year
	Heating	0.3	kWh/ft²/year
	Total	14.4	kWh/ft²/year
Gas	Baseload	1.0	ekWh/ft²/year
	Heating	7.7	ekWh/ft²/year
	Total	8.7	ekWh/ft²/year
Total energy	Total	23.1	ekWh/ft²/year

Table 190: Top Quartile Targets

The data set for target-setting is made up of 33 police services 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)), % of the area which is air conditioned and % of the area served by a data centre. 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 police station. The total savings potential for each police services 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 39 police services 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 3 police services facilities with annual savings potential greater than $100,000. 19 police services facilities have annual savings potential between $5,000 and $100,000 and 17 police services facilities have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 39 buildings is $1,200,163 ($1,118,748 for electricity and $81,415 for gas) with an average total energy savings of 17%.

For the 3 high-potential savings facilities, the total annual savings potential is $796,242 ($747,820 for electricity and $48,422 for gas) with an average total energy savings of 36%.

For the 19 mid-potential savings facilities, the total annual savings potential is $380,761 ($350,730 for electricity and $30,031 for gas) with an average total energy savings of 19%.

For the 17 low-potential savings facilities, the total annual savings potential is $23,160 ($20,198 for electricity and $2,962 for gas) with an average total energy savings of 1%.

	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: 39 facilities	**22%**	**27%**	**27%**	**21%**	**$1,118,748**	**56%**	**06%**	**12%**	**$81,415**	**17%**	**$1,200,163**	**$639,284**	**$31,313**	**2,589,421**	**1,467,396**
High potential savings facilities (3)	37%	49%	64%	38%	$ 747,820	70%	20%	31%	$48,422	36%	$ 796,242	$427,326	$18,624	410,374	937,516
Mid-potential savings facilities (19)	21%	18%	09%	21%	$ 350,730	57%	05%	15%	$30,031	19%	$ 380,761	$200,417	$11,550	646,598	492,603
Low potential savings facilities (17)	00%	15%	17%	01%	$ 20,198	09%	00%	01%	$ 2,962	01%	$ 23,160	$ 11,542	$ 1,139	1,532,449	37,277

Table 191: 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 39 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	14.0	10.9	22%	$ 998,223
Electric Cooling (kWh/ft²)	1.1	0.8	27%	$ 77,811
Electric Heating (kWh/ft²)	0.5	0.3	27%	$ 14,615
Total Electricity (kWh/ft²) for facilities w/o component intensities	13.0	12.1	7%	$ 28,098
Gas Baseload (ekWh/ft²)	1.4	0.6	56%	$ 43,076
Gas Heating (ekWh/ft²)	9.1	8.6	6%	$ 32,727
Total Gas (ekWh/ft²) for facilities w/o component intensities	11.4	10.4	9%	$ 5,612
Total Energy (ekWh/ft²)	**25.3**	**21.0**	**17%**	**$ 1,200,163**

High savings | Moderate savings | Low savings

Table 192: Savings Potential based on Energy Use Component for 39 Police Services 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, 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 Previous Energy Efficiency Initiatives

In 2007, 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 police services facilities located throughout the City of Toronto.

Table 5 below summarizes the estimated overall project costs, savings and estimated energy reduction for 21 police services facilities as a result of the 2007 project.

			Project Cost & Savings (estimated)					Estimated Energy Reduction			
Project Name & Year	# 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
Police Station 2007	21	73,283	$2,280,021	$285,003	3,459,456	792	8.0	2,417,933	2,257	100,711	17,759

Table 193: 2007 Police Station Project Estimated Project Costs and Savings

Table 6 below lists the specific buildings where projects occurred, and what the specific measures were.

Building #	Building Name	Measure Name
1	#12 Police Division	Advance Lighting Control System
1	#12 Police Division	Building Envelope Sealing
1	#12 Police Division	Domestic Water Retrofits
2	#13 Police Division	HVAC Modifications
2	#13 Police Division	Demand Control Ventilation
2	#13 Police Division	Building Envelope Sealing
2	#13 Police Division	Domestic Water Retrofits
3	#22 Police Division	Lighting Retrofits and Redesign
3	#22 Police Division	Lighting Controls
3	#22 Police Division	HVAC Modifications
3	#22 Police Division	Building Envelope Sealing
3	#22 Police Division	Domestic Water Retrofits
4	#31 Police Division	Building Envelope Sealing
4	#31 Police Division	Domestic Water Retrofits
5	#32 Police Division	Lighting Retrofits and Redesign
5	#32 Police Division	Lighting Controls
5	#32 Police Division	Building Envelope Sealing
5	#32 Police Division	Domestic Water Retrofits
6	#33 Police Division	Lighting Retrofits and Redesign
6	#33 Police Division	Lighting Controls
6	#33 Police Division	Building Envelope Sealing
6	#33 Police Division	Domestic Water Retrofits
7	#41 Police Division	Lighting Retrofits and Redesign
7	#41 Police Division	Lighting Controls
7	#41 Police Division	Building Envelope Sealing

7	#41 Police Division	Domestic Water Retrofits
8	#42 Police Division	Building Envelope Sealing
8	#42 Police Division	Domestic Water Retrofits
9	#51 Police Division	Lighting Retrofits and Redesign
9	#51 Police Division	Lighting Controls
9	#51 Police Division	Building Envelope Sealing
9	#51 Police Division	Domestic Water Retrofits
10	#52 Police Division	Lighting Retrofits and Redesign
10	#52 Police Division	Lighting Controls
10	#52 Police Division	HVAC Modifications
10	#52 Police Division	BAS Upgrade
10	#52 Police Division	Demand Control Ventilation
10	#52 Police Division	Building Envelope Sealing
10	#52 Police Division	Domestic Water Retrofits
11	#53 Police Division	Lighting Retrofits and Redesign
11	#53 Police Division	Lighting Controls
11	#53 Police Division	HVAC Modifications
11	#53 Police Division	Demand Control Ventilation
11	#53 Police Division	Building Envelope Sealing
11	#53 Police Division	Domestic Water Retrofits
12	#54 Police Division	Lighting Retrofits and Redesign
12	#54 Police Division	Lighting Controls
12	#54 Police Division	Building Envelope Sealing
12	#54 Police Division	Domestic Water Retrofits
13	#55 Police Division	Lighting Retrofits and Redesign
13	#55 Police Division	Lighting Controls
13	#55 Police Division	HVAC Modifications
13	#55 Police Division	BAS Upgrade
13	#55 Police Division	Building Envelope Sealing
13	#55 Police Division	Domestic Water Retrofits
14	Emergency Task Force	Building Envelope Sealing
14	Emergency Task Force	Domestic Water Retrofits
15	Forensic Service	Building Envelope Sealing
15	Forensic Service	Domestic Water Retrofits
16	Intelligence Bureau	Building Envelope Sealing
16	Intelligence Bureau	Domestic Water Retrofits
17	Police Dog Service	Building Envelope Sealing
17	Police Dog Service	Domestic Water Retrofits
18	Police Garage	Lighting Retrofits and Redesign
18	Police Garage	Lighting Controls
18	Police Garage	Building Envelope Sealing

18	Police Garage	Domestic Water Retrofits
19	Police Marine HQ	Lighting Retrofits and Redesign
19	Police Marine HQ	Lighting Controls
19	Police Marine HQ	Building Envelope Sealing
19	Police Marine HQ	Domestic Water Retrofits
20	Property Bureau	Lighting Retrofits and Redesign
20	Property Bureau	Lighting Controls
20	Property Bureau	Building Envelope Sealing
20	Property Bureau	Domestic Water Retrofits
21	Public Order	Lighting Retrofits and Redesign
21	Public Order	Lighting Controls
21	Public Order	Building Envelope Sealing
21	Public Order	Domestic Water Retrofits

Table 194: Measures from 2007 Police Station Project

2.2 Proposed Energy Efficiency Measures

Table 7 below shows the full range of possible energy efficiency measures for the entire portfolio of police services 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 39 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	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	
M10	Install controls on vehicle plug-in heaters	1	2	3	Year 5	10 to 15	
	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	2	6	Year 1		Building Occupants
B12	Use recommended thermostat set points (during the summer, set to 78 degrees or more)	4	2	6	Year 1		Building Occupants
B13	Only cool rooms that are being used	4	2	6	Year 1		Building Occupants
B14	Install and use energy efficient ceiling fans	4	2	6	Year 1		Building Occupants
B15	Close blinds (to shade space from direct sunlight)	4	2	6	Year 1		Building Occupants
B16	Install window film, solar screens or awnings on south and west facing windows	4	2	6	Year 1		Building Occupants
M11	Optimize operating periods of ventilation systems supplying air conditioned spaces	2	2	4	Year 2	seasonal review	
M13	Upgrade control of air conditioning units to optimize space temperatures & operating periods	3	2	5	Year 2	seasonal review	
M14	Test and tune the air conditioning units	3	2	5	Year 2	3	
M12	Replace and right-size air conditioning units with ENERGY STAR rated units	1	2	3	Year 5	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 195: Energy Saving Measures for Police Services Facilities

The specific measures and implementation timeline for each individual police services 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
Police Div. 42	242 Milner Ave	Geothermal	350	kW
Police Div. 55	101 Coxwell Ave	Geothermal	140	kW
Police Cranfield Garage	18 Cranfield Road	Solar PV	100	kW
Police Div. 13	1435 Eglinton Ave W	Solar PV	37	kW
Police Div. 33	50 Upjohn Rd	Solar PV	45	kW
Police Property & Evidence	799 Islington Ave	Solar PV	150	kW

Table 196: Proposed Renewable Energy Systems on Police Services 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 police services facilities are summarized in Table 8 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	3	136,791	5.04	$ 2,068,283	$ 796,242	66.3%	2.60
$5,000 - $100,000	19	34,031	4.20	$ 2,715,713	$ 380,761	31.7%	7.13
< $5,000	17	90,144	1.68	$ 2,574,514	$ 23,160	1.9%	111.16
	39			**$ 7,358,510**	**$ 1,200,163**		**6.13**

Table 197: 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)	3	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	19	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	17	$ 150	< $5,000	Division Champion and staff
		39			

Table 198: Assessment Tools used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There are 3 police services facilities (Police Headquarters, #51 Police Division New, and Forensic Service, Store & Garage) with over $100,000 in annual energy saving potential. Over 65% of the total energy savings for all police services facilities can be found at these 3 facilities.

These 3 police services facilities can save an average of 36% of their total energy use. The total annual energy savings are estimated to be over $796,000 and individual building annual savings range from approximately $123,000 to over $536,000. The annual GHG savings are estimated to be approximately 937,500 kg.

These 3 police services facilities can save an average of 38% of their total electricity use (37% Electric Baseload, 49% Electric Cooling and 64% Electric Heating). The total annual electricity savings are estimated to be approximately $747,820 and individual building annual savings range from just over $106,000 to over $747,800.

These 3 police services facilities can save an average of 31% of their total gas use (70% Gas Baseload and 20% Gas Heating). The total annual gas savings are estimated to be approximately $48,400 and individual building annual savings range from approximately $17,000 to over $20,000.

These 3 police services 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 Heating. After the implementation of the proposed measures, these facilities are eligible to receive over $445,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 19 police services facilities with between $5,000 and $100,000 in annual energy saving potential. Approximately 33% of the total energy savings for all 39 police services facilities can be found in these 19 facilities.

These 19 police services facilities can save an average of 19% of their total energy use. The total annual energy savings are estimated to be over $380,700 and individual building annual savings range from approximately $5,500 to almost $94,000. The annual GHG savings are approximately 492,600 kg.

These 19 police services facilities can save an average of 21% of their total electricity use (21% Electric Baseload, 18% Electric Cooling and 9% Electric Heating). The total annual electricity savings are estimated to be approximately $350,700 and individual building annual savings range from just over $4,300 to over $93,700.

These 19 police services facilities can save an average of 15% of their total gas use (57% Gas Baseload and 5% Gas Heating). The total annual gas savings are estimated to be approximately $30,000 and individual building annual savings range from $0 to over $4,600.

These 19 facilities will undergo an Energy Assessment with highest potential police services facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 19 police services facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 19 police services facilities can be found in 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 police services facilities are eligible to receive almost $212,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 17 police services facilities with less than $5,000 in savings potential. Approximately 2% of the total energy savings for all 39 police services facilities can be found in these 17 facilities.

These 17 police services facilities can save an average of 1% of their total energy use. The total annual energy savings are estimated to be approximately $23,000 and individual building annual savings range from $0 to almost $5,000. The annual GHG savings are approximately 37,300 kg.

These 17 police services facilities can save an average of 1% of their total electricity use (0% Electric Baseload, 15% Electric Cooling and 17% Electric Heating). The total annual electricity savings are estimated to be approximately $20,200 and individual building annual savings range from $0 to almost $5,000.

These 17 police services facilities can save an average of 1% of their total gas use (9% Gas Baseload and 0% Gas Heating). The total annual gas savings are estimated to be approximately $3,000 and individual building annual savings range from $0 to over $1,600.

These 17 facilities will undergo a checklist approach with highest potential police services facilities focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 17 police services facilities and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 17 police services facilities can be found in Electric Heating and Electric Cooling.

The energy savings checklist will be used by the Division Champion for the police services facilities in conjunction with the building operator and/or service contractor for each police services 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 10 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 39 facilities. The total costs to implement the energy management and retrofit plan for police services facilities are estimated to be $7,397,810. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	22,500
Energy Assessment	$	14,250
Checklist	$	2,550
Implementation	$	7,358,510
Total	**$**	**7,397,810**

Table 199: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 11 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 3 Building Performance Audits completed by the end of Year 3. The implementation of these measures will begin in Year 2. Identification of measures from Energy Assessments will begin in Year 1, with all 19 Energy Assessments 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 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 (M&V), and maintenance costs.

Over a 10 year period, the cumulative net cash flow for this plan is estimated to be $1,470,746. The cumulative net cash flow becomes positive in Year 10.

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 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
High Potential - Building Performance Audit	1	1	1	0	0	0	0	0	0	0	3
Mid Potential - Energy Assessment	5	5	5	4	0	0	0	0	0	0	19
Low Potential - Checklist	0	4	4	4	4	1	0	0	0	0	17
Assessment Costs	$ 11,250	$ 11,874	$ 11,887	$ 3,649	$ 662	$ 169	$ -	$ -	$ -	$ -	$ 39,492
Implementation Costs	$ -	$ 1,460,814	$ 2,132,876	$ 2,175,534	$ 1,300,052	$ 682,193	$ 173,959	$ -	$ -	$ -	$ 7,925,429
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 1,125	$ 147,269	$ 214,476	$ 217,918	$ 130,071	$ 68,236	$ 17,396	$ -	$ -	$ -	$ 796,492
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 73,041	$ 179,685	$ 288,461	$ 353,464	$ 387,573	$ 396,271	$ 396,271	$ 396,271	$ 396,271	
Annual Costs	$ 12,375	$ 1,692,998	$ 2,538,924	$ 2,685,563	$ 1,784,250	$ 1,138,172	$ 587,627	$ 396,271	$ 396,271	$ 396,271	$ 11,628,722
Estimated Achieved Annual Savings		$ 208,634	$ 696,211	$ 1,194,487	$ 1,451,214	$ 1,599,602	$ 1,688,750	$ 1,773,187	$ 1,861,846	$ 1,954,939	$ 12,428,870
Estimated Incentives	$ -	$ 427,503	$ 134,086	$ 94,452	$ 14,557	$ -	$ -	$ -	$ -	$ -	$ 670,598
Annual Savings and Incentives	$ -	$ 636,137	$ 830,297	$ 1,288,939	$ 1,465,771	$ 1,599,602	$ 1,688,750	$ 1,773,187	$ 1,861,846	$ 1,954,939	$ 13,099,468
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 495	-$ 42,769	-$ 111,115	-$ 166,979	-$ 179,719	-$ 161,261	-$ 117,216	-$ 62,140	-$ 3,517	-$ 845,212
Net Cash Flow incl borrowing costs	-$ 12,375	-$ 1,057,356	-$ 1,751,396	-$ 1,507,738	-$ 485,458	$ 281,711	$ 939,862	$ 1,259,699	$ 1,403,435	$ 1,555,150	$ 625,534
Cumulative Net Cash Flow	-$ 12,375	-$ 1,069,236	-$ 2,777,863	-$ 4,174,486	-$ 4,492,965	-$ 4,031,535	-$ 2,930,412	-$ 1,553,496	-$ 87,921	$ 1,470,746	

Table 200: Cash Flow for 10-Year Implementation Plan

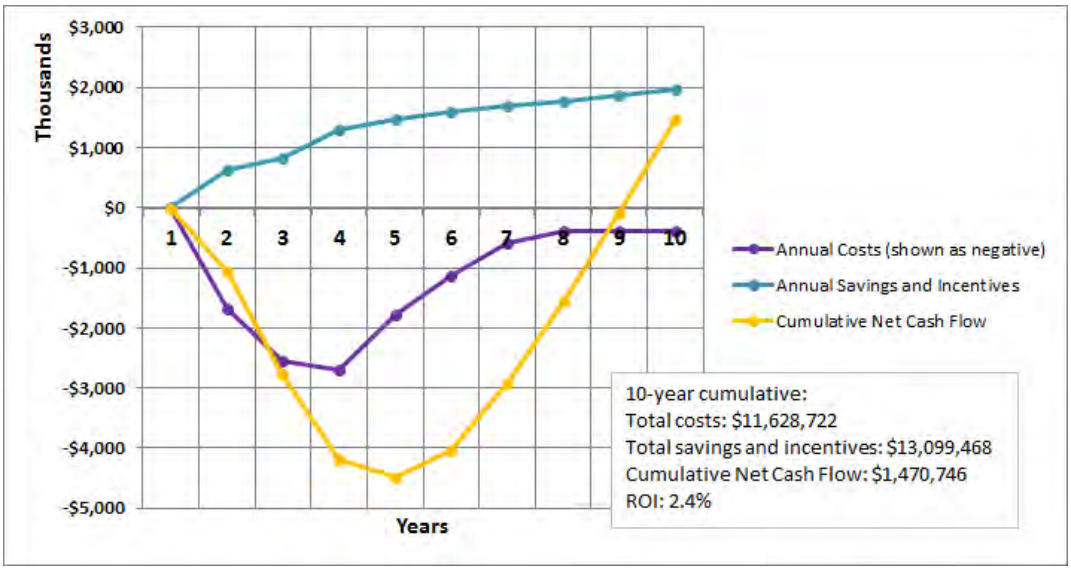

Figure 116: Cash Flow for 10-Year Implementation Plan

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 police services 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 201: 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 - Police Services Facilities

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 39 police services facilities included in this report and Plan.

Building	Address	Building Area (ft^2)
#11 Police Division	211 Mavety St	21,119
#11 Police Division - NEW	2054 Davenport Rd	89,610
#12 Police Division	200 Trethewey Dr	25,780
#13 Police Division	1435 Eglinton Ave W	20,344
#14 Police Division	150 Harrison St	24,197
#14 Police Division - NEW	11 St. Annes Rd.	84,896
#21 Police Division	791 Islington Ave	7,492
#22 Police Division	3699 Bloor St W	32,270
#23 Police Division	2126 Kipling Ave	13,616
#23 Police Division New	5230 Finch Ave W	55,972
#31 Police Division	40 Norfinch Dr	35,489
#32 Police Division	30 Ellerslie Ave	47,652
#33 Police Division	50 Upjohn Rd	27,889
#41 Police Division	2222 Eglington Ave E	52,183
#42 Police Division	242 Milner Ave	41,990
#43 Police Division	4331 Lawrence Ave E	51,990
#51 Police Division New	51 Parliament St	47,899
#52 Police Division	255 Dundas St W	71,677
#53 Police Division	75 Eglinton Ave W	52,183
#54 Police Division	41 Cranfield	23,358
#55 Police Division	101 Coxwell	23,519
C.O Bick College	4620 Finch Ave E	92,849
Centre Island Marine Unit	1 Centre Island Pk Unit M Yrd	1,001
Centre Island Police Division	0 Centre Isl	1,001
Detective Services Building	160-180 Duncan Mill Rd	172,192
Emergency Task Force	300 Lesmill Rd	35,994
Forensic Service, Store & Garage	2050 Jane St	62,484
Humber Bay Life Stn	2233 Lakeshore Blvd	1,475
Intelligence Bureau	30 Upjohn St	70,547
Leuty Beach	1 Leuty Ave	495
Police Academy	70 Birmingham Street	296,987
Police Dog Service	44 Beechwood Dr	9,203
Police Garage	18 Cranfield Rd	33,024

Police Headquarters	40 College St	299,990
Police Marine Hq	259 Queens Quay W	22,992
Property Bureau	799 Islington Ave	43,992
Property Evident Unit	330 Progress Ave	287,741
Public Order	4610 Finch Ave E	8,342
Traffic Services and Garage	9 Hanna Ave	297,988

Table 202: Police Services Facilities Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 39 police services facilities 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)
Humber Bay Life Stn	-33.79	0.00	-33.79
Centre Island Marine Unit	1.99	0.00	1.99
Detective Services Building	2.36	0.69	3.05
Property Evident Unit	4.83	3.04	7.87
C.O Bick College	2.37	10.02	12.40
Centre Island Police Division	17.03	0.00	17.03
Traffic Services and Garage	9.22	11.10	20.32
#14 Police Division - NEW	13.75	7.49	21.24
Property Bureau	11.27	10.18	21.46
#53 Police Division	15.15	6.35	21.50
#11 Police Division	3.34	18.76	22.10
Police Academy	9.46	13.12	22.58
#52 Police Division	14.90	7.95	22.84
#23 Police Division New	16.38	6.80	23.18
#11 Police Division - NEW	12.72	10.66	23.38
#14 Police Division	16.12	7.33	23.45
#32 Police Division	14.66	9.13	23.79
#33 Police Division	15.52	8.49	24.00
#12 Police Division	22.26	2.39	24.66
#42 Police Division	15.24	10.73	25.97
Police Garage	10.57	15.56	26.13
Police Dog Service	15.70	11.23	26.93
Police Marine Hq	15.36	12.77	28.13
#43 Police Division	16.76	11.47	28.23

#55 Police Division	21.13	7.67	28.79
Public Order	20.15	11.93	32.08
Intelligence Bureau	23.85	9.57	33.42
#41 Police Division	15.32	18.76	34.07
#31 Police Division	21.25	13.50	34.75
#23 Police Division	18.82	16.93	35.75
Emergency Task Force	17.79	18.53	36.31
#22 Police Division	16.33	21.38	37.70
#21 Police Division	21.48	17.99	39.47
#54 Police Division	20.20	22.46	42.65
#13 Police Division	26.58	20.78	47.36
Forensic Service, Store & Garage	27.25	26.45	53.70
#51 Police Division New	33.06	23.99	57.05
Police Headquarters	35.72	11.43	68.43
Leuty Beach	137.99	0.00	137.99

Table 203: Police Services Facilities 2012 Energy Intensity

5.3 Target-setting Method and Metrics

6 police services 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
Leuty Beach	huge adjustment bill in Feb 2012	Electricity
Humber Bay Life Stn	huge negative consumption in March 2012	Electricity
#14 Police Division - NEW	huge negative consumption in September 2012	Electricity
#54 Police Division	333	Electricity
#11 Police Division	significant negative consumption in March 2012	Electricity
#11 Police Division - NEW	incomplete gas data	Gas

Table 204: Excluded Facilities

After excluding these 6 facilities, 33 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.

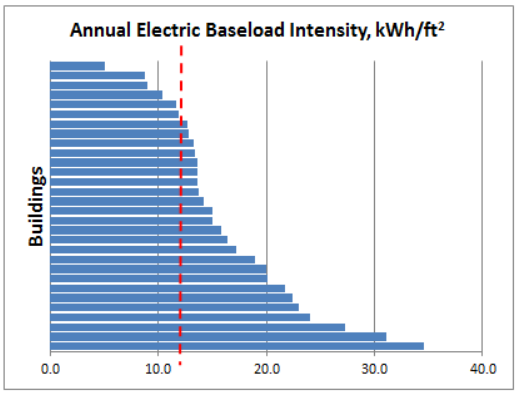

Figure 117: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for police services facilities ranges from 5.0 to 34.5 ekWh/ft^2 and the top-quartile is 12.95 ekWh/ft^2.

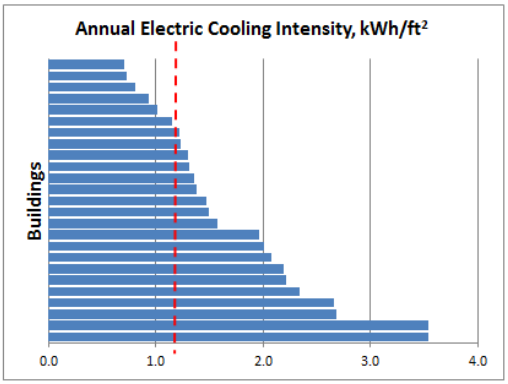

Figure 118: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for police services facilities ranges from 0.7 to 3.5 ekWh/ft^2 and the top-quartile is 1.2 ekWh/ft^2.

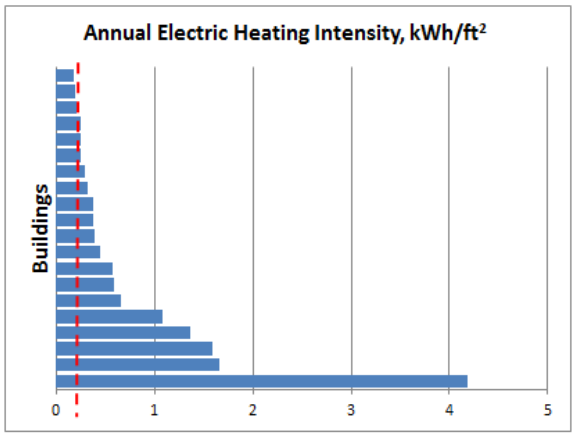

Figure 119: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for police services facilities ranges from 0.2 to 4.2 ekWh/ft^2 and the top-quartile is 0.25 ekWh/ft^2.

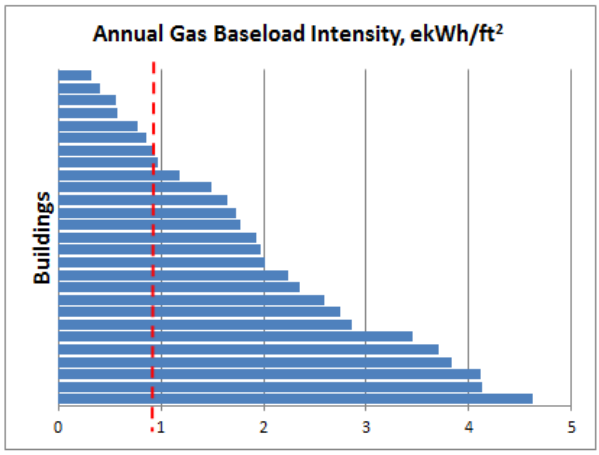

Figure 120: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for police services facilities ranges from 0.3 to 4.6 ekWh/ft^2 and the top-quartile is 0.95 ekWh/ft^2.

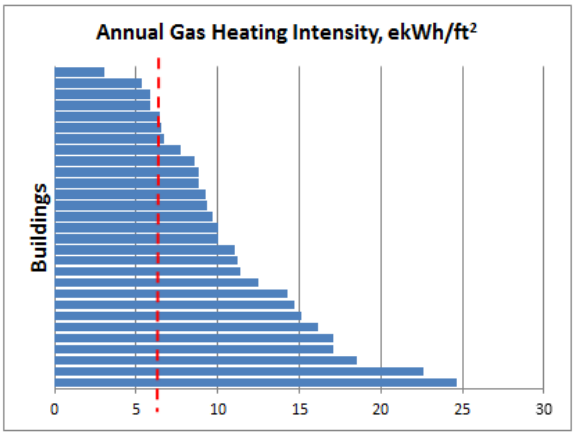

Figure 121: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for police services facilities ranges from 3.1 to 24.7 ekWh/ft^2 and the top-quartile is 7.7 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 police services 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 and % of the area served by a data centre.

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 3 High Savings Potential Police Services Facilities

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

There are 3 police services 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 (3)	37%	49%	64%	38%	$ 747,820	70%	20%	31%	$48,422	36%	$ 796,242	$427,326	$18,624	410,374	937,516
Police Headquarters	34%	60%		36%	$ 515,605	74%		24%	$20,700	32%	$ 536,305	$294,631	$ 7,961	299,990	554,714
#51 Police Division New	58%	29%		57%	$ 125,822	58%	35%	38%	$11,023	49%	$ 136,845	$ 71,898	$ 4,240	47,899	178,523
Forensic Service, Store & Garage	44%	41%	64%	45%	$ 106,393	42%	40%	40%	$16,699	42%	$ 123,092	$ 60,796	$ 6,423	62,484	204,278

Table 205: Savings Potential for 3 High Savings Potential Police Services Facilities

Savings Potential by Energy Use Component for the 19 Mid Savings Potential Police Services Facilities

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

There are 19 police services 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 (19)	21%	18%	09%	21%	$ 350,730	57%	05%	15%	$30,031	19%	$ 380,761	$200,417	$11,550	646,598	492,603
Intelligence Bureau	42%			40%	$ 93,791			0%	$ -	28%	$ 93,791	$ 53,595	$ -	70,547	73,693
#13 Police Division	46%	24%	14%	44%	$ 33,267	79%	9%	24%	$ 2,583	35%	$ 35,850	$ 19,010	$ 994	20,344	44,806
#31 Police Division	32%	21%		30%	$ 32,038	75%		21%	$ 2,569	27%	$ 34,607	$ 18,307	$ 988	35,489	43,740
#12 Police Division	40%			39%	$ 31,698	52%		43%	$ 664	40%	$ 32,361	$ 18,113	$ 255	25,780	29,702
#55 Police Division	36%			34%	$ 23,571	45%		10%	$ 465	28%	$ 24,036	$ 13,469	$ 179	23,519	21,878
#43 Police Division	18%			17%	$ 20,749	65%		16%	$ 2,350	16%	$ 23,098	$ 11,856	$ 904	51,990	33,282
#54 Police Division				25%	$ 16,668			30%	$ 3,977	28%	$ 20,645	$ 9,524	$ 1,530	23,358	41,840
#23 Police Division New	14%			13%	$ 16,463			0%	$ -	9%	$ 16,463	$ 9,407	$ -	55,972	12,935
Emergency Task Force	5%	55%		15%	$ 13,557	77%		17%	$ 2,869	16%	$ 16,426	$ 7,747	$ 1,103	35,994	31,386
#22 Police Division	14%			13%	$ 9,407	67%	21%	27%	$ 4,648	21%	$ 14,055	$ 5,376	$ 1,788	32,270	40,983
#41 Police Division	2%	28%		6%	$ 6,684	46%	14%	17%	$ 4,156	12%	$ 10,840	$ 3,820	$ 1,598	52,183	35,286
#23 Police Division	25%			23%	$ 8,222	60%		8%	$ 479	16%	$ 8,701	$ 4,698	$ 184	13,616	9,921
Leuty Beach				90%	$ 8,628				$ -	90%	$ 8,628	$ 4,930	$ -	495	6,779
#21 Police Division	35%			33%	$ 7,377		14%	13%	$ 450	24%	$ 7,827	$ 4,215	$ 173	7,492	9,050
#42 Police Division	5%			5%	$ 4,341	77%		29%	$ 3,333	15%	$ 7,674	$ 2,481	$ 1,282	41,990	27,495
#32 Police Division		41%		8%	$ 7,376			0%	$ -	5%	$ 7,376	$ 4,215	$ -	47,652	5,796
#52 Police Division	5%			4%	$ 6,242	19%		3%	$ 406	4%	$ 6,648	$ 3,567	$ 156	71,677	7,837
Public Order	21%	20%	66%	25%	$ 5,810	63%		14%	$ 343	21%	$ 6,153	$ 3,320	$ 132	8,342	7,046
#33 Police Division	9%			8%	$ 4,841	53%		12%	$ 739	10%	$ 5,580	$ 2,766	$ 284	27,889	9,145

Table 206: Savings Potential for 19 Medium Savings Potential Police Services 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 17 Low Savings Potential Police Services Facilities

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

There are 17 police services 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 (17)	00%	15%	17%	01%	$ 20,198	09%	00%	01%	$ 2,962	01%	$ 23,160	$ 11,542	$ 1,139	1,532,449	37,277
Property Bureau		100%		6%	$ 4,474			0%	$ -	3%	$ 4,474	$ 2,557	$ -	43,992	3,515
#14 Police Division	5%	11%	16%	6%	$ 3,372	45%		11%	$ 472	8%	$ 3,843	$ 1,927	$ 181	24,197	6,057
#53 Police Division			47%	3%	$ 3,749	1%		0%	$ 16	2%	$ 3,765	$ 2,142	$ 6	52,183	3,062
Detective Services Building		100%		6%	$ 3,324			0%	$ -	5%	$ 3,324	$ 1,900	$ -	172,192	2,612
#14 Police Division - NEW				2%	$ 2,802			0%	$ -	1%	$ 2,802	$ 1,601	$ -	84,896	2,202
Police Marine Hq	3%			3%	$ 1,476	36%		4%	$ 311	4%	$ 1,787	$ 843	$ 120	22,992	3,407
#11 Police Division				0%	$ -			16%	$ 1,634	14%	$ 1,634	$ -	$ 629	21,119	11,810
Police Dog Service		32%	3%	5%	$ 1,001	51%		9%	$ 226	7%	$ 1,226	$ 572	$ 87	9,203	2,416
Police Garage				0%	$ -		2%	2%	$ 304	1%	$ 304	$ -	$ 117	33,024	2,195
Centre Island Police Division				0%	$ -				$ -	0%	$ -	$ -	$ -	1,001	0
Humber Bay Life Stn				0%	$ -				$ -	0%	$ -	$ -	$ -	1,475	0
Centre Island Marine Unit				0%	$ -				$ -	0%	$ -	$ -	$ -	1,001	0
Property Evident Unit				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	287,741	0
C.O Bick College				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	92,849	0
#11 Police Division - NEW				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	89,610	0
Traffic Services and Garage				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	297,988	0
Police Academy				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	296,987	0

Table 207: Savings Potential for 17 Low-Savings Potential Police Services 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

Public Libraries

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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 73 public libraries 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 1,548,904 ft^2. The public libraries range in size from approximately 2,400 ft^2 to over 400,000 ft^2. There are 2 facilities over 100,000 ft^2.

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

The majority of the public libraries are 100% air-conditioned. One facility (Palmerston) is fully served by electric heat. The majority of the other public libraries are using some electric heat, ranging from 5% to 60%. One public library (Agincourt) is served by a water source heat pump.

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 73 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	28,794,910	$4,031,287
Natural Gas (m^3)	1,822,936	$473,963
Total		**$4,505,251**

Table 208: 2012 Energy Use and Costs for 73 City of Toronto Public Libraries

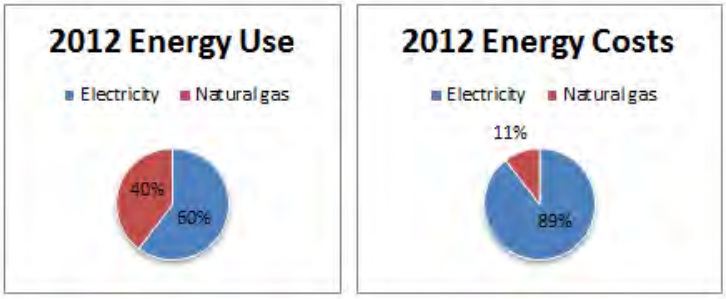

Figure 122: 2012 Energy Use and Cost Breakdown for 73 City of Toronto Public Libraries

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 73 buildings. Total energy use ranges from approximatley 10 to over 88 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.

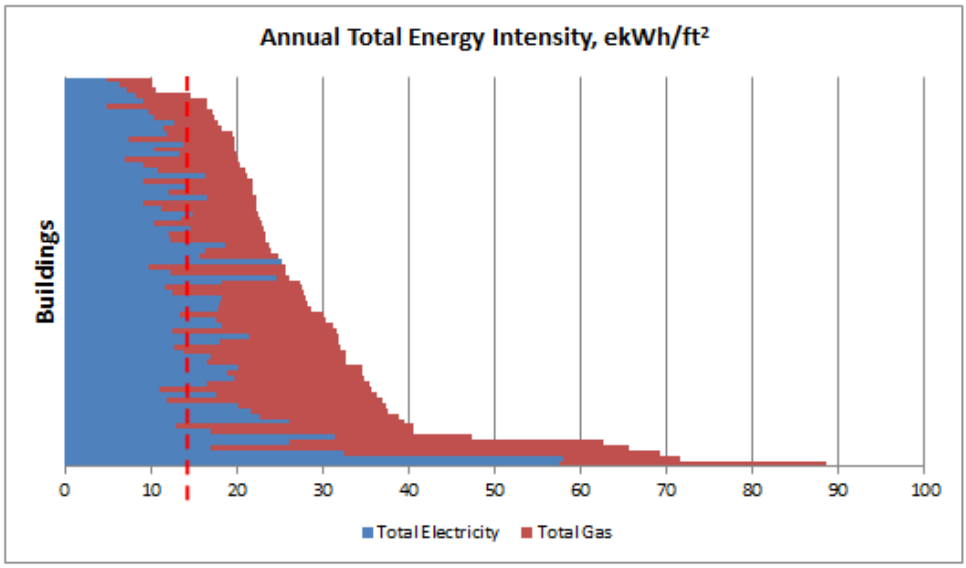

Figure 123: 2012 Total Energy Intensity Benchmark

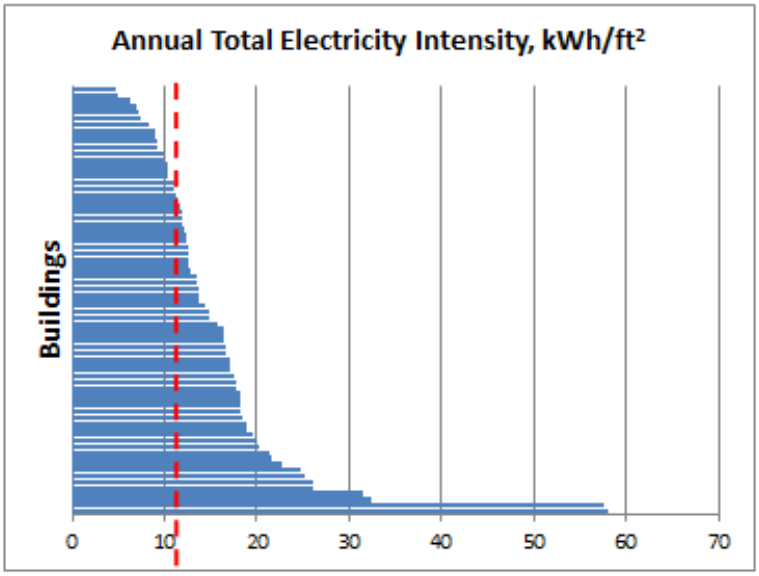

Figure 124: 2012 Total Electricity Intensity Benchmark

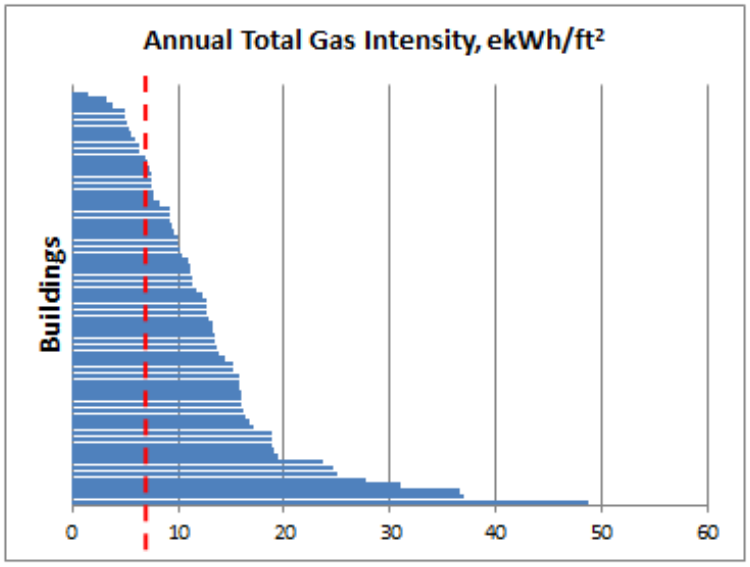

Figure 125: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for public libraries 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 public library to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Baseload	9.97	kWh/ft²/year
	Cooling	1.02	kWh/ft²/year
	Heating	0.51	kWh/ft²/year
	Total	11.50	kWh/ft²/year
Gas	Baseload	0.15	ekWh/ft²/year
	Heating	7.14	ekWh/ft²/year
	Total	7.29	ekWh/ft²/year
Total energy	Total	18.78	ekWh/ft²/year

Table 209: Top Quartile Targets

The data set for target-setting is made up of the 56 public libraries with complete and reliable data, 52 of which are City of Toronto buildings and 4 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)) 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 public library. The total savings potential for each public library 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 73 public libraries 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 4 public libraries with annual savings potential greater than $100,000. 33 public libraries have annual savings potential between $5,000 and $100,000 and 36 public libraries have annual savings potential less than $5,000 (see Table 3).

The total annual savings potential for the 73 buildings is $1,879,499 ($1,660,543 for electricity and $218,956 for gas) with an average total energy savings of 43%.

For the 4 high-potential savings facilities, the total annual savings potential is $1,067,994 ($980,828 for electricity and $87,166 for gas) with an average total energy savings of 52%.

For the 33 mid-potential savings facilities, the total annual savings potential is $745,956 ($643,612 for electricity and $102,344 for gas) with an average total energy savings of 41%.

For the 36 low-potential savings facilities, the total annual savings potential is $65,548 ($36,103 for electricity and $29,445 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: 73 facilities	**40%**	**48%**	**35%**	**41%**	**$1,660,543**	**92%**	**43%**	**46%**	**$218,956**	**43%**	**$1,879,499**	**$948,882**	**$84,214**	**1,548,904**	**2,887,088**
High potential savings facilities (4)	50%	52%	63%	54%	$ 980,828	64%	48%	48%	$ 87,166	52%	$1,067,994	$560,473	$33,525	528,755	1,400,593
Mid-potential savings facilities (33)	36%	48%	11%	36%	$ 643,612	94%	40%	47%	$102,344	41%	$ 745,956	$367,778	$39,363	723,345	1,245,328
Low potential savings facilities (36)	05%	34%	14%	08%	$ 36,103	92%	37%	39%	$ 29,445	23%	$ 65,548	$ 20,630	$11,325	296,804	241,167

Table 210: 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 73 buildings and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	13.8	8.3	40%	$ 1,193,624
Electric Cooling (kWh/ft²)	1.4	0.7	48%	$ 148,664
Electric Heating (kWh/ft²)	0.4	0.2	35%	$ 27,182
Total Electricity (kWh/ft²) for facilities w/o component intensities	20.2	11.3	44%	$ 291,074
Gas Baseload (ekWh/ft²)	0.8	0.1	92%	$ 27,574
Gas Heating (ekWh/ft²)	9.8	5.6	43%	$ 163,757
Total Gas (ekWh/ft²) for facilities w/o component intensities	10.7	6.0	44%	$ 27,625
Total Energy (ekWh/ft²)	**31.4**	**17.6**	**44%**	**$ 1,879,499**

High savings | Moderate savings | Low savings

Table 211: Savings Potential based on Energy Use Component for 73 Public Libraries

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 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 public libraries. 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 73 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).

	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 4	10 to 15	
L2	Install motion sensors in washrooms/occasional use spaces to shut off lights when unoccupied	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	
M3	Install variable frequency drives (VFDs) on suitable fans and pumps	1	4	5	Year 4	10 to 20	
M4	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						
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 4	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	4	5	Year 4	seasonal review	
M7	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						
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 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						
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	
M14	Insulate DHW tanks and distribution piping	2	4	6	Year 3	10 to 15	
P4	Install low flow showerheads and faucet aerators	1	4	5	Year 4	10 to 15	
M15	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						
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 4	10 to 15	
EN2	Insulate the attic adequately	1	4	5	Year 4	10 to 15	
EN3	Reclad the building's exterior	1	4	5	Year 4	20 to 24	
EN4	Replace single-pane windows with double-pane windows	1	4	5	Year 4	20 to 24	
EN6	If replacing the roof, ensure R-value at least 22	1	4	5	Year 4	n/a	
M25	Install high efficiency burners	1	4	5	Year 4	15 to 20	
M26	Replace boilers with more efficient models	1	4	5	Year 4	15 to 20	
M27	Replace old rooftop units with energy efficient units	1	4	5	Year 4	15 to 20	
M28	Install heat recovery or solar heating units	1	4	5	Year 4	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 212: Energy Saving Measures for Public Libraries

The specific measures and implementation timeline for each individual public library 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 public libraries are summarized in Table 166 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	4	132,189	5.04	$ 2,664,926	$ 1,067,994	56.8%	2.50
$5,000 - $100,000	33	21,920	4.20	$ 3,038,049	$ 745,956	39.7%	4.07
< $5,000	36	8,245	1.68	$ 498,631	$ 65,548	3.5%	7.61
	73			**$ 6,201,605**	**$ 1,879,499**		**3.30**

Table 213: 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 167 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	4	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	33	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	36	$ 150	< $5,000	Division Champion
		73			

Table 214: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Building Performance Audit

There are 4 public libraries with over $100,000 in annual energy saving potential. Approximately 56% of the total energy savings for all public libraries can be found at these 4 facilities.

These 4 public libraries can save an average of 52% of their total energy use. The total annual energy savings are estimated to be over $1,067,000 and individual building annual savings range from approximately $110,000 to almost $450,000. The annual GHG savings are approximately 1,400,000 kg.

These 4 public libraries can save an average of 54% of their total electricity use (50% Electric Baseload, 52% Electric Cooling and 63% Electric Heating).The total annual electricity savings are estimated to be approximately $980,800.

These 4 public libraries can save an average of 48% of their total gas use (64% Gas Baseload and 48% Gas Heating). The total annual gas savings are estimated to be approximately $87,000.

These 4 public libraries 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 highest percentage reductions for these facilities can be found in Gas Baseload and Electric Heating. After the implementation of the proposed measures, these facilities are eligible to receive almost $600,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Assessment

There are 33 public libraries with between $5,000 and $100,000 in annual energy saving potential. Approximately 40% of the total energy savings for all 73 public libraries can be found in these 33 facilities.

These 33 public libraries can save an average of 41% of their total energy use. The total annual energy savings are estimated to be over $745,000 and individual building annual savings range from approximately $5,700 to over $95,000. The annual GHG savings are approximately 1,245,000 kg.

These 33 public libraries can save an average of 36% of their total electricity use (36% Electric Baseload, 48% Electric Cooling and 11% Electric Heating). The total annual electricity savings are estimated to be approximately $643,000 and individual building annual savings range from just over $2,200 to almost $83,000.

These 33 public libraries can save an average of 47% of their total gas use (94% Gas Baseload and 40% Gas Heating). The total annual gas savings are estimated to be approximately $102,000 and individual building annual savings range from under $100 to approximately $13,000.

These 33 facilities will undergo an Energy Assessment with highest potential public libraries focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 33 Public libraries and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 33 public libraries 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 public libraries are eligible to receive over $400,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.3 Energy Savings Checklist

There are 36 public libraries with less than $5,000 in savings potential. Approximately 4% of the total energy savings for all 73 public libraries can be found in these 36 facilities.

These 36 public libraries can save an average of 23% of their total energy use. The total annual energy savings are estimated to be approximately $65,500 and individual building annual savings range from under $100 to approximately $4,800. The annual GHG savings are approximately 241,000 kg.

These 36 public libraries can save an average of 8% of their total electricity use (5% Electric Baseload, 34% Electric Cooling and 14% Electric Heating). The total annual electricity savings are estimated to be approximately $36,000 and individual building annual savings range from under $100 to over $4,600.

These 36 public libraries can save an average of 39% of their total gas use (92% Gas Baseload and 37% Gas Heating). The total annual gas savings are estimated to be approximately $29,400 and individual building annual savings range from under $100 to over $2,400.

These 36 facilities will undergo a checklist approach with highest potential public libraries focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 36 public libraries and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 36 public libraries can be found in Gas Baseload and Gas Heating.

The energy savings checklist will be used by the Division Champion for the public libraries in conjunction with the building operator and/or service contractor for each public library. 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 168 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 73 facilities. The total costs to implement the energy management and retrofit plan for Fire Halls is estimated to be $6,261,755. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	30,000
Energy Assessment	$	24,750
Checklist	$	5,400
Implementation	$	6,201,605
Total	**$**	**6,261,755**

Table 215: Total Budget - Energy Management and Retrofit Plan

3.4 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 169 and Figure 97 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 begin in Year 1, with all 4 Building Performance Audits 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 Energy Assessments will begin in Year 1, with all 33 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 36 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 $9,810,031. The cumulative net cash flow becomes positive in Year 7.

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
High Potential - Building Performance Audit	1	1	1	1	0	0	0	0	0	0	4
Mid Potential - Energy Assessment	7	7	7	7	5	0	0	0	0	0	33
Low Potential - Checklist	0	8	7	7	7	7	0	0	0	0	36
Assessment Costs	$ 12,750	$ 13,998	$ 13,864	$ 13,887	$ 4,909	$ 1,182	$ -	$ -	$ -	$ -	$ 60,591
Implementation Costs	$ -	$ 1,363,617	$ 1,508,478	$ 1,523,655	$ 1,554,128	$ 627,573	$ 111,372	$ -	$ -	$ -	$ 6,688,824
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 1,275	$ 137,762	$ 152,234	$ 153,754	$ 155,904	$ 62,876	$ 11,137	$ -	$ -	$ -	$ 674,941
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 68,181	$ 143,605	$ 219,788	$ 297,494	$ 328,873	$ 334,441	$ 334,441	$ 334,441	$ 334,441.18	
Annual Costs	$ 14,025	$ 1,583,558	$ 1,818,182	$ 1,911,084	$ 2,012,435	$ 1,020,503	$ 456,950	$ 334,441	$ 334,441	$ 334,441	$ 9,820,061
Estimated Achieved Annual Savings		$ 237,832	$ 861,954	$ 1,604,449	$ 2,089,070	$ 2,420,455	$ 2,629,793	$ 2,776,220	$ 2,915,719	$ 3,061,505	$ 18,596,996
Estimated Incentives	$ -	$ 480,040	$ 281,376	$ 160,996	$ 91,895	$ 18,041	$ 747	$ -	$ -	$ -	$ 1,033,095
Annual Savings and Incentives	$ -	$ 717,872	$ 1,143,330	$ 1,765,445	$ 2,180,965	$ 2,438,496	$ 2,630,540	$ 2,776,220	$ 2,915,719	$ 3,061,505	$ 19,630,091
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 561	-$ 35,188	-$ 62,183	-$ 68,008	-$ 61,267	-$ 4,547	$ -	$ -	$ -	-$ 231,754
Net Cash Flow incl borrowing costs	-$ 14,025	-$ 866,247	-$ 710,040	-$ 207,821	$ 100,521	$ 1,356,726	$ 2,169,042	$ 2,441,779	$ 2,581,278	$ 2,727,064	$ 9,578,277
Cumulative Net Cash Flow	-$ 14,025	-$ 879,711	-$ 1,554,563	-$ 1,700,202	-$ 1,531,672	-$ 113,679	$ 2,059,910	$ 4,501,689	$ 7,082,967	$ 9,810,031	

Table 216: Cash Flow for 10-Year Implementation Plan

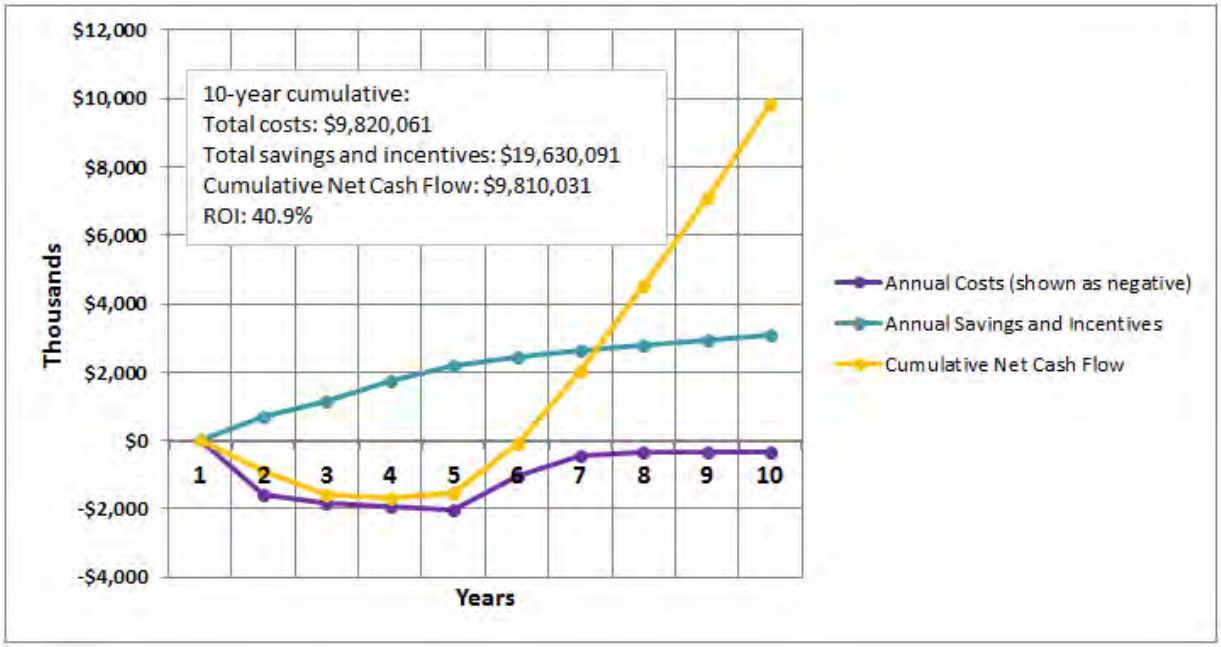

Figure 126: Cash Flow for 10-Year Implementation Plan

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 public libraries 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:

- 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 217: 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 - Public Libraries

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 73 public library buildings included in this report and Plan.

Building	Address	Building Area (ft^2)
Agincourt District	155 Bonis Ave	26,996
Albert Campbell District	496 Birchmount Rd	26,102
Albion	1515 Albion Rd	32,281
Amesbury Park	1565 Lawrence Ave W	6,318
Annette Street	145 Annette St	7,804
Barbara Frum	20 Covington Rd	39,224
Beaches	2161 Queen St E	7,804
Bendale	1515 Danforth Rd	8,503
Black Creek	1700 Wilson Ave	7,093
Bloor Gladstone	1101 Bloor St W	11,410
Brookbanks	210 Brookbanks Dr	7,933
Cedarbrae	545 Markham Rd	26,200
Centennial	578 Finch Ave W	6,867
Cliffcrest	3017 Kingston Rd	4,898
College Shaw	766 College St	7,685
Danforth Coxwell	1675 Danforth Ave	9,612
Deer Park	40 St Clair Ave E	16,576
Don Mills	888 Lawrence Ave E	21,560
Downsview	2793 Keele St	20,021
Dufferin St Clair	1625 Dufferin St	8,966
Eatonville	430 Burnhamthorpe Rd	12,217
Elmbrook Park	2 Elmbrook Crescent	3,595
Evelyn Gregory	120 Trowell Ave	6,200
Fairview Mall	35 Fairview Mall Dr	64,670
Gerrard Ashdale	1432 Gerrard St E	6,501
Goldhawk Park	295 Alton Towers Cir	7,998
Guildwood	123 Guildwood Pkwy	3,014
High Park	228 Roncesvalles Ave	9,494
Highland Creek	3550 Ellesmere Rd	6,997
Hillcrest	5801 Leslie St	7,470
Humber Bay	200 Parklawn Rd	2,400
Humber Summit	2990 Islington Ave	9,042
Jane & Dundas	620 Jane St	11,603
Jones	118 Jones Ave	3,638

Building	Address	Building Area (ft^2)
Leaside	165 McRae Dr	11,991
Lillian H Smith	239 College St	38,933
Locke	3083 Yonge St	11,647
Long Branch	3500 Lakeshore Blvd W	6,415
Main Street	137 Main St	8,665
Martin Ross Serv Bldg	120 Martin Ross Ave	27,997
Maryvale	85 Ellesmere Rd	4,424
Mimico	47 Station Rd	17,470
Morningside	4279 Lawrence Ave E	6,997
Mount Dennis	1123 Weston Rd	11,345
Mount Pleasant	599 Mt Pleasant Rd	5,834
New Toronto	110 Eleventh St	9,924
North York Central	5120 Yonge St	168,014
Northern District	40 Orchard View Blvd	45,800
Oakwood Village	341 Oakwood Ave	17,287
Palmerston	560 Palmerston Ave	8,493
Pape Danforth	701 Pape Ave	8,181
Parkdale	1305 Queen St W	24,079
Parliament	269 Gerrard St E	14,639
Perth Dupont	1589 Dupont St	3,627
Pleasant View	575 Van Horne Ave	6,997
Rexdale	2243 Kipling Ave	5,091
Richview	1806 Islington Ave	47,254
Riverdale	370 Broadview Ave	9,655
Runnymede	2178 Bloor St W	7,955
S Walter Stewart	170 Memorial Park Dr	24,133
Sanderson	327 Bathurst St	12,701
Spadina Road	10 Spadina Rd	3,950
St Clair Silverthorn	1748 St Clair Ave W	4,585
Steeles	375 Bamburgh Cir	5,005
Taylor Memorial	1440 Kingston Rd	5,005
Toronto Reference Library	789 Yonge St	416,025
Victoria Village	184 Sloane Ave	5,382
Weston	2 King St	11,948
Woodside Square	1571 Sandhurst Circle	9,795
Woodview Park	16-18 Bradstock Rd	5,360
Wychwood	1431 Bathurst St	6,383
York Woods	1785 Finch Ave W	42,173
Yorkville	22 Yorkville Ave	9,052

Table 218: Public Library Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 73 public library 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)
Mount Dennis	4.82	5.37	10.20
St Clair Silverthorn	6.29	3.92	10.21
Black Creek	7.29	3.35	10.63
Oakwood Village	8.16	6.42	14.58
Guildwood	9.11	7.37	16.48
Mimico	4.88	11.81	16.70
Main Street	10.06	7.52	17.58
Richview	12.69	5.19	17.88
Parkdale	11.53	6.89	18.42
Sanderson	11.34	7.15	18.49
Parliament	11.81	7.73	19.54
Perth Dupont	7.34	12.40	19.74
Elmbrook Park	13.82	5.93	19.74
Mount Pleasant	10.40	9.43	19.84
Danforth Coxwell	13.47	6.42	19.89
Rexdale	6.98	13.26	20.24
Gerrard Ashdale	9.03	11.28	20.31
Jane & Dundas	10.92	10.26	21.18
Morningside	16.30	4.95	21.26
College Shaw	9.20	12.66	21.86
Downsview	14.37	7.55	21.92
Bendale	12.01	9.96	21.97
Woodview Park	9.09	13.13	22.22
Steeles	16.69	5.54	22.24
Humber Summit	11.26	11.03	22.29
Highland Creek	14.98	7.55	22.52
New Toronto	13.62	9.24	22.86
Long Branch	10.40	12.62	23.02
North York Central	14.76	8.34	23.09
Weston	12.08	11.45	23.53
Albert Campbell District	18.75	4.89	23.64

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Albion	12.77	11.01	23.79
S Walter Stewart	16.33	7.73	24.05
Palmerston	24.27	0.00	24.27
Humber Bay	15.67	9.31	24.98
Maryvale	9.85	15.83	25.68
Agincourt District	24.79	1.47	26.26
Eatonville	13.05	14.16	27.21
Pape Danforth	18.22	9.21	27.44
Victoria Village	11.63	15.82	27.45
Dufferin St Clair	12.58	15.27	27.85
Toronto Reference Library	18.32	9.62	27.94
Don Mills	18.11	10.09	28.21
York Woods	17.92	11.01	28.93
Woodside Square	13.42	16.83	30.26
Centennial	17.73	12.78	30.51
Cedarbrae	18.41	12.99	31.40
Spadina Road	12.59	19.04	31.64
Annette Street	21.40	10.39	31.80
Evelyn Gregory	12.66	19.16	31.82
Beaches	18.11	13.81	31.92
High Park	13.72	18.96	32.68
Leaside	17.00	15.70	32.69
Wychwood	16.46	16.28	32.74
Riverdale	18.86	15.77	34.64
Fairview Mall	19.64	15.31	34.95
Runnymede	16.56	18.93	35.49
Taylor Memorial	10.91	24.92	35.83
Yorkville	21.53	14.66	36.19
Amesbury Park	17.41	18.88	36.29
Jones	11.96	25.01	36.97
Cliffcrest	20.21	17.13	37.34
Deer Park	21.65	15.93	37.58
Barbara Frum	22.73	16.26	39.00
Pleasant View	26.02	13.47	39.49
Brookbanks	12.91	27.22	40.13
Hillcrest	17.09	23.59	40.68
Goldhawk Park	31.58	16.03	47.61
Lillian H Smith	26.03	36.69	62.73

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Locke	17.02	48.79	65.82
Bloor Gladstone	32.44	36.84	69.28
Martin Ross Serv Bldg	57.98	13.61	71.59
Northern District	57.53	30.79	88.32

Table 219: Public Library 2012 Energy Intensity

5.3 Target-setting Method and Metrics

21 public libraries 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
Annette Street	426	Electricity
Beaches	456	Electricity
Bendale	398	Electricity
Cliffcrest	335	Gas
Danforth Coxwell	330	Electricity
Deer Park	331	Electricity
Don Mills	334	Electricity
Gerrard Ashdale	332	Electricity
Guildwood	332	Electricity
Jones	427	Electricity
Leaside	huge adj bill in Aug 2012	Electricity
Martin Ross Serv Bldg	329	Electricity
Morningside	335	Gas
Mount Pleasant	397	Electricity
Parliament	454	Electricity
Perth Dupont	332	Electricity
Pleasant View	304	Electricity
Rexdale	459	Electricity
Richview	333	Electricity
Long Branch	huge adj bill in Jun 2012	Electricity
Wychwood	negative consump in Jan bill	Electricity

Table 220: Excluded Facilities

After excluding these 21 facilities, 52 City of Toronto facilities and 4 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.

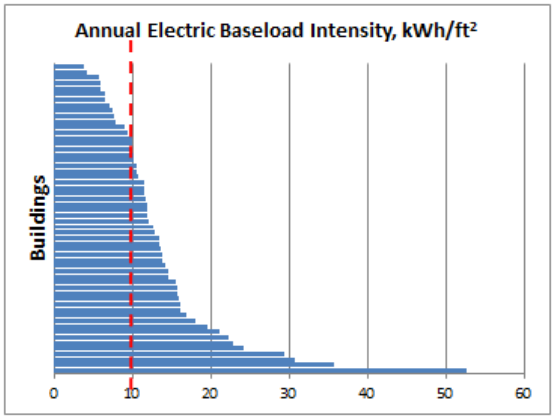

Figure 127: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for public libraries ranges from 3.7 to 52.7 ekWh/ft^2 and the top-quartile is 9.97 ekWh/ft^2.

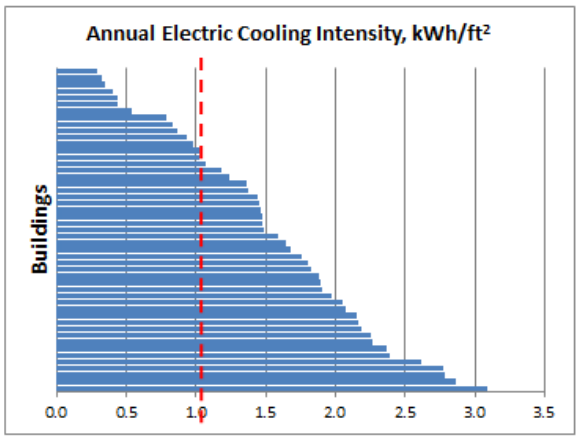

Figure 128: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for public libraries ranges from 0.3 to 3.1 ekWh/ft^2 and the top-quartile is 1.02 ekWh/ft^2.

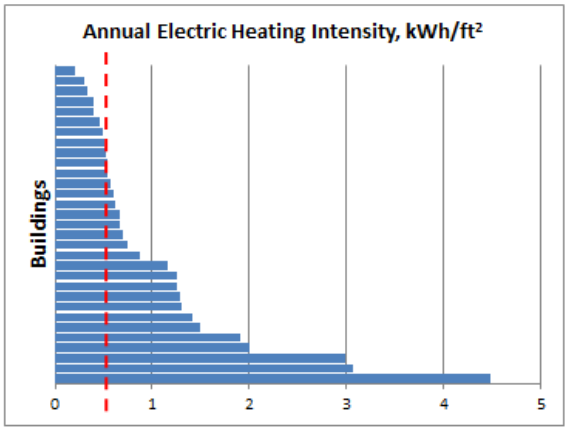

Figure 129: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for public libraries ranges from 0.2 to 4.5 ekWh/ft^2 and the top-quartile is 0.51 ekWh/ft^2.

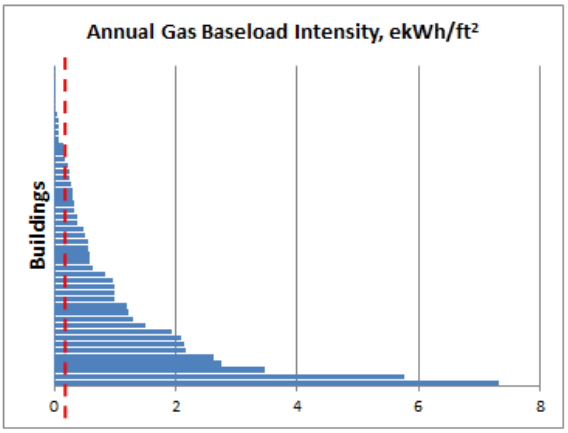

Figure 130: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for public libraries ranges from 0.01 to 7.3 ekWh/ft^2 and the top-quartile is 0.15 ekWh/ft^2.

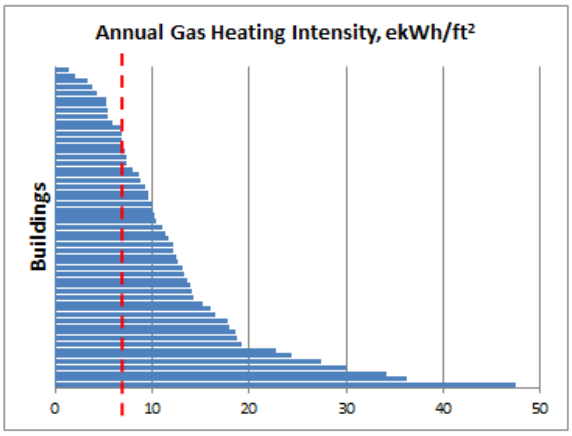

Figure 131: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for public libraries ranges from 1.5 to 47.5 ekWh/ft^2 and the top-quartile is 7.14 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 public libraries, 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 High Savings Potential Public Libraries

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

There are 4 public libraries with over $100,000 in annual savings potential. The highest potential buildings will be focused on first.

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 (4)	50%	52%	63%	54%	$ 980,828	64%	48%	48%	$ 87,166	52%	$1,067,994	$560,473	$33,525	528,755	1,400,593
Toronto Reference Library	38%	53%		39%	$ 421,053		26%	26%	$ 25,976	35%	$ 447,029	$240,602	$ 9,991	416,025	518,553
Northern District	81%		77%	80%	$ 296,311	85%	79%	79%	$ 28,115	80%	$ 324,426	$169,320	$10,813	45,800	435,999
Martin Ross Serv Bldg				80%	$ 182,205			46%	$ 4,446	74%	$ 186,651	$104,117	$ 1,710	27,997	175,290
Lillian H Smith	59%	43%		57%	$ 81,259	54%	80%	80%	$ 28,630	70%	$ 109,889	$ 46,434	$11,011	38,933	270,750

Table 221: Savings Potential for 4 High Savings Potential Public Libraries

Savings Potential by Energy Use Component for the 33 Mid Savings Potential Public libraries

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

There are 33 public libraries with between $5,000 and $100,000 in annual savings potential. The highest potential buildings will be focused on first.

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							
Mid-potential savings facilities (33)	36%	48%	11%	36%	$ 643,612	94%	40%	47%	$102,344	41%	$ 745,956	$367,778	$39,363	723,345	1,245,328
Fairview Mall	44%	53%		47%	$ 82,848	98%	10%	52%	$ 13,007	49%	$ 95,855	$ 47,342	$ 5,003	64,670	159,097
North York Central	23%	25%		22%	$ 77,106	89%		14%	$ 4,826	19%	$ 81,932	$ 44,061	$ 1,856	168,014	95,462
Barbara Frum	49%	67%		52%	$ 64,392	93%	52%	57%	$ 9,184	54%	$ 73,577	$ 36,796	$ 3,532	39,224	116,969
Agincourt District	53%	55%	17%	51%	$ 47,601			0%	$ -	48%	$ 47,601	$ 27,200	$ -	26,996	37,400
York Woods	36%	51%		37%	$ 39,318	100%	34%	38%	$ 4,381	37%	$ 43,699	$ 22,467	$ 1,685	42,173	62,553
Bloor Gladstone	66%	63%		65%	$ 33,795	100%	81%	83%	$ 8,727	74%	$ 42,522	$ 19,311	$ 3,357	11,410	89,625
Cedarbrae	41%	32%		40%	$ 26,995	57%	43%	43%	$ 3,671	41%	$ 30,666	$ 15,425	$ 1,412	26,200	47,742
Deer Park				46%	$ 23,015			81%	$ 5,385	61%	$ 28,400	$ 13,151	$ 2,071	16,576	57,000
Goldhawk Park	67%		31%	68%	$ 24,217	100%	64%	69%	$ 2,214	69%	$ 26,430	$ 13,838	$ 851	7,998	35,024
Albert Campbell District	37%	42%		35%	$ 23,847	75%	34%	40%	$ 1,278	36%	$ 25,125	$ 13,627	$ 491	26,102	27,971
Don Mills				37%	$ 19,964			28%	$ 1,520	33%	$ 21,485	$ 11,408	$ 585	21,560	26,674
Locke	27%	44%		26%	$ 7,314	100%	89%	90%	$ 12,789	73%	$ 20,102	$ 4,179	$ 4,919	11,647	98,169
S Walter Stewart	27%	61%		32%	$ 17,775	85%		11%	$ 504	25%	$ 18,279	$ 10,157	$ 194	24,133	17,609
Yorkville	55%			56%	$ 15,410	100%	55%	55%	$ 1,841	56%	$ 17,251	$ 8,806	$ 708	9,052	25,409
Pleasant View				56%	$ 14,225			46%	$ 1,088	52%	$ 15,313	$ 8,129	$ 418	6,997	19,036
Palmerston	56%			52%	$ 15,068				$ -	52%	$ 15,068	$ 8,610	$ -	8,493	11,839
Riverdale	38%	63%		41%	$ 10,503	94%	45%	53%	$ 2,039	47%	$ 12,542	$ 6,002	$ 784	9,655	22,985
Leaside				32%	$ 9,231			54%	$ 2,533	43%	$ 11,764	$ 5,275	$ 974	11,991	25,562
Albion	16%			15%	$ 8,534	100%	25%	36%	$ 3,180	24%	$ 11,714	$ 4,877	$ 1,223	32,281	29,684
Annette Street				46%	$ 10,660			38%	$ 778	43%	$ 11,437	$ 6,091	$ 299	7,804	13,996
Downsview	16%	57%		23%	$ 9,122	100%	3%	5%	$ 199	17%	$ 9,321	$ 5,213	$ 77	20,021	8,608
Hillcrest	32%	46%	4%	32%	$ 5,795	83%	69%	69%	$ 3,063	54%	$ 8,858	$ 3,311	$ 1,178	7,470	26,690
Beaches				36%	$ 7,103			48%	$ 1,308	41%	$ 8,411	$ 4,059	$ 503	7,804	15,035
Pape Danforth	36%	55%		38%	$ 7,862	74%	17%	21%	$ 393	32%	$ 8,255	$ 4,493	$ 151	8,181	9,016
Runnymede	28%	53%	6%	30%	$ 5,610	85%	60%	61%	$ 2,317	47%	$ 7,928	$ 3,206	$ 891	7,955	21,155
Amesbury Park	38%			35%	$ 5,386		75%	75%	$ 2,244	56%	$ 7,631	$ 3,078	$ 863	6,318	20,452
Cliffcrest				43%	$ 5,974			57%	$ 1,211	50%	$ 7,185	$ 3,414	$ 466	4,898	13,446
Richview				7%	$ 6,277			11%	$ 648	8%	$ 6,925	$ 3,587	$ 249	47,254	9,617
Centennial	31%	14%	75%	35%	$ 5,949	75%	41%	43%	$ 939	38%	$ 6,888	$ 3,399	$ 361	6,867	11,461
Brookbanks	13%	31%		15%	$ 2,222	60%	74%	75%	$ 4,072	56%	$ 6,294	$ 1,270	$ 1,566	7,933	31,174
Wychwood				29%	$ 4,263			65%	$ 1,696	47%	$ 5,959	$ 2,436	$ 652	6,383	15,603
Woodside Square	17%	30%		19%	$ 3,481	51%	57%	56%	$ 2,331	40%	$ 5,812	$ 1,989	$ 897	9,795	19,583
High Park	14%	30%		15%	$ 2,751	100%	66%	66%	$ 2,978	45%	$ 5,728	$ 1,572	$ 1,145	9,494	23,680

Table 222: Savings Potential for 33 Medium Savings Potential Public Libraries

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 36 Low Savings Potential Public libraries

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

There are 36 public libraries 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 (36)	05%	34%	14%	08%	$ 36,103	92%	37%	39%	$ 29,445	23%	$ 65,548	$ 20,630	$11,325	296,804	241,167
Eatonville		57%		10%	$ 2,309	100%	47%	57%	$ 2,493	35%	$ 4,802	$ 1,319	$ 959	12,217	19,833
Morningside				29%	$ 4,670			0%	$ -	22%	$ 4,670	$ 2,669	$ -	6,997	3,669
New Toronto	21%			20%	$ 3,736	62%	27%	28%	$ 650	23%	$ 4,386	$ 2,135	$ 250	9,924	7,635
Dufferin St Clair	12%			11%	$ 1,739	100%	68%	72%	$ 2,462	44%	$ 4,200	$ 993	$ 947	8,966	19,157
Steeles	25%	64%		31%	$ 3,651			0%	$ -	23%	$ 3,651	$ 2,086	$ -	5,005	2,869
Highland Creek	25%			23%	$ 3,327	19%	13%	13%	$ 170	19%	$ 3,497	$ 1,901	$ 65	6,997	3,843
Evelyn Gregory	13%			12%	$ 1,308	100%	67%	68%	$ 2,020	45%	$ 3,328	$ 748	$ 777	6,200	15,623
Weston		46%		7%	$ 1,466	100%	43%	43%	$ 1,481	25%	$ 2,947	$ 838	$ 570	11,948	11,857
Danforth Coxwell				14%	$ 2,625			0%	$ -	10%	$ 2,625	$ 1,500	$ -	9,612	2,063
Taylor Memorial			40%	5%	$ 361	53%	72%	71%	$ 2,237	51%	$ 2,598	$ 206	$ 860	5,005	16,450
Humber Summit	2%		66%	10%	$ 1,452	100%	35%	36%	$ 906	23%	$ 2,357	$ 830	$ 348	9,042	7,686
Mimico				0%	$ -	100%	45%	45%	$ 2,314	32%	$ 2,314	$ -	$ 890	17,470	16,723
Jane & Dundas		38%		6%	$ 1,019	100%	37%	37%	$ 1,097	21%	$ 2,116	$ 582	$ 422	11,603	8,726
Victoria Village	8%			7%	$ 639		56%	56%	$ 1,205	36%	$ 1,844	$ 365	$ 464	5,382	9,214
Jones				3%	$ 178			71%	$ 1,634	49%	$ 1,812	$ 102	$ 628	3,638	11,946
Spadina Road	4%	29%		7%	$ 490	100%	64%	66%	$ 1,249	43%	$ 1,739	$ 280	$ 480	3,950	9,411
Parkdale		26%		3%	$ 1,199	100%	11%	12%	$ 489	6%	$ 1,688	$ 685	$ 188	24,079	4,475
Humber Bay	29%		10%	27%	$ 1,418		30%	30%	$ 169	28%	$ 1,587	$ 810	$ 65	2,400	2,332
Maryvale		46%		9%	$ 530	71%	53%	54%	$ 946	36%	$ 1,477	$ 303	$ 364	4,424	7,254
Parliament				0%	$ 97			45%	$ 1,269	18%	$ 1,366	$ 55	$ 488	14,639	9,250
Woodview Park		39%		7%	$ 495	100%	41%	46%	$ 815	30%	$ 1,309	$ 283	$ 313	5,360	6,277
Oakwood Village		31%		6%	$ 1,099	70%		5%	$ 149	5%	$ 1,248	$ 628	$ 57	17,287	1,943
Bendale				4%	$ 587			30%	$ 647	16%	$ 1,234	$ 336	$ 249	8,503	5,137
College Shaw				0%	$ -	100%	49%	49%	$ 1,197	28%	$ 1,197	$ -	$ 460	7,685	8,649
Long Branch				0%	$ -			43%	$ 884	24%	$ 884	$ -	$ 340	6,415	6,390
Rexdale				0%	$ -			49%	$ 829	32%	$ 829	$ -	$ 319	5,091	5,992
Elmbrook Park	4%	48%		10%	$ 703	100%		9%	$ 50	10%	$ 753	$ 402	$ 19	3,595	914
St Clair Silverthorn		50%		16%	$ 661	100%		0%	$ 1	10%	$ 662	$ 378	$ 0	4,585	527
Gerrard Ashdale				0%	$ -			35%	$ 652	20%	$ 652	$ -	$ 251	6,501	4,710
Mount Pleasant				0%	$ -			39%	$ 545	19%	$ 545	$ -	$ 210	5,834	3,942
Perth Dupont				0%	$ -			48%	$ 545	30%	$ 545	$ -	$ 210	3,627	3,938
Main Street		1%	11%	1%	$ 123	39%	6%	7%	$ 117	4%	$ 239	$ 70	$ 45	8,665	939
Black Creek		18%		3%	$ 221	100%		1%	$ 3	2%	$ 224	$ 126	$ 1	7,093	196
Sanderson				0%	$ -	100%	7%	9%	$ 214	4%	$ 214	$ -	$ 82	12,701	1,548
Guildwood				0%	$ -			1%	$ 7	1%	$ 7	$ -	$ 3	3,014	47
Mount Dennis				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	11,345	0

Table 223: Savings Potential for 36 Low Savings Potential Public libraries

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.

Shelter, Support and Housing Administration

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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 11 shelter, support and housing administration buildings in the Energy Conservation Demand Management (ECDM) plan. The names and building areas are provided in Appendix B. The majority of the 11 buildings are residences, but also included is an office type facility.

The total area for all of the buildings is 280,617 ft^2. The buildings range in size from just over 5,000 ft^2 to almost 100,000 ft^2. The average size is approximately 25,000 ft^2.

None of the buildings are equipped with renewable energy systems. Eight of the buildings are 100% air-conditioned. Two are approximately 25% air-conditioned (Birchmount Residence and Seaton House) and only one is not air-conditioned (Women's Residence). Four facilities are reported to be partially served by electric heat (Downsview Dell, Fort York Residence, Seaton House and Family Residence). Even though they are not reported to be using electric heat, the electricity profiles show that the majority of the other facilities have 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). The Family Residence and 129 Peter St. are both served by water source heat pumps (WSHP).

1.1.2 Summary of Energy Use and Costs

This 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 11 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	4,279,694	$599,157
Natural Gas (m^3)	860,380	$223,699
Total		**$822,856**

Table 224: 2012 Energy Use and Costs for 11 City of Toronto Shelter, Support and Housing Administration Buildings

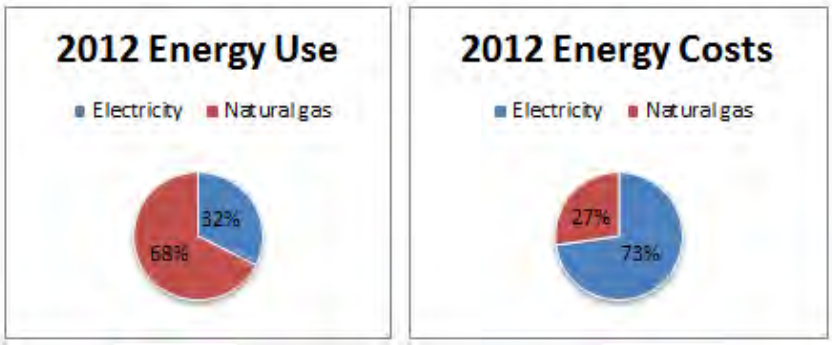

Figure 132: 2012 Energy Use and Cost Breakdown for 11 City of Toronto Shelter, Support and Housing Administration Buildings

There is a wide range of energy use intensities, as presented below, due primarily to differences in efficiency between the 11 buildings. Total energy use ranges from less than 13 to over 70 ekWh/ft^2. There is also a wide range 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.

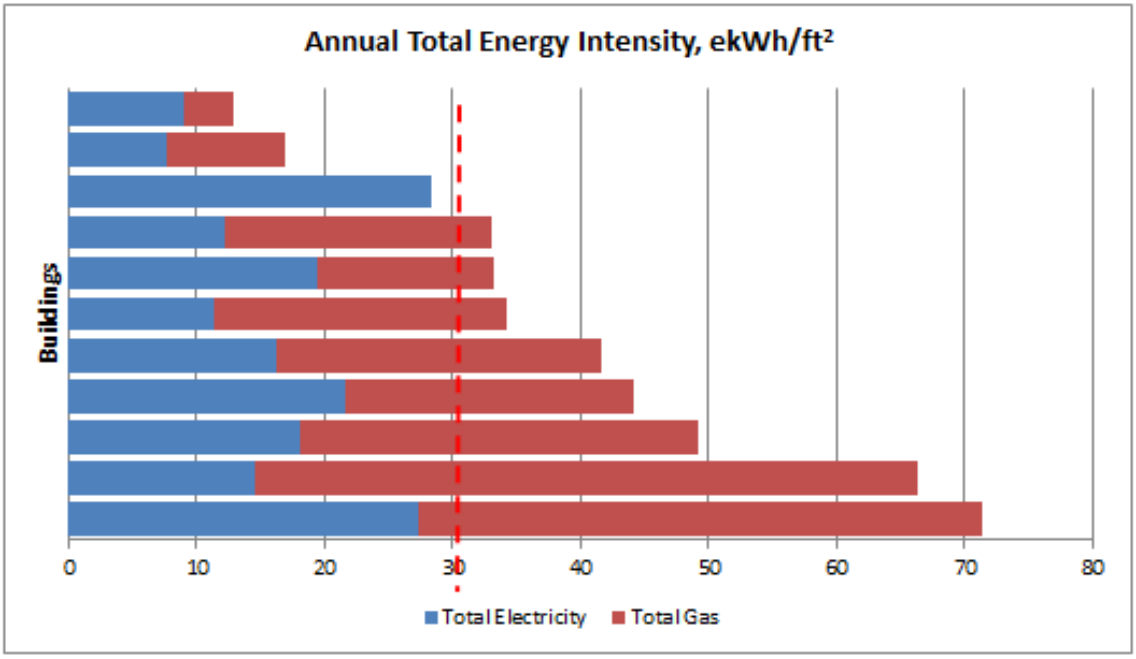

Figure 133: 2012 Total Energy Intensity Benchmark

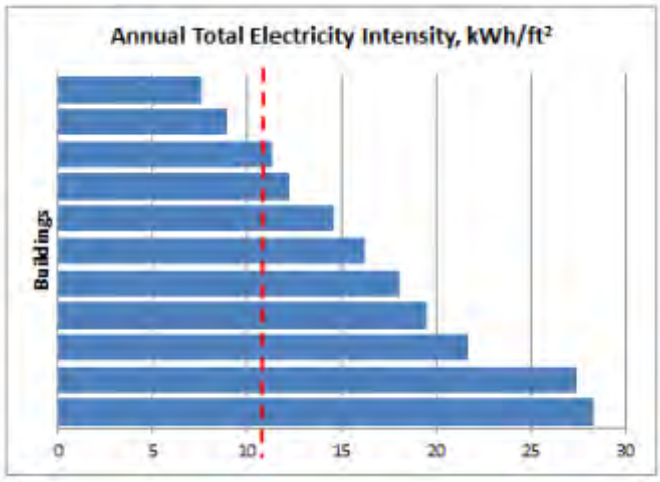

Figure 134: 2012 Total Electricity Intensity Benchmark

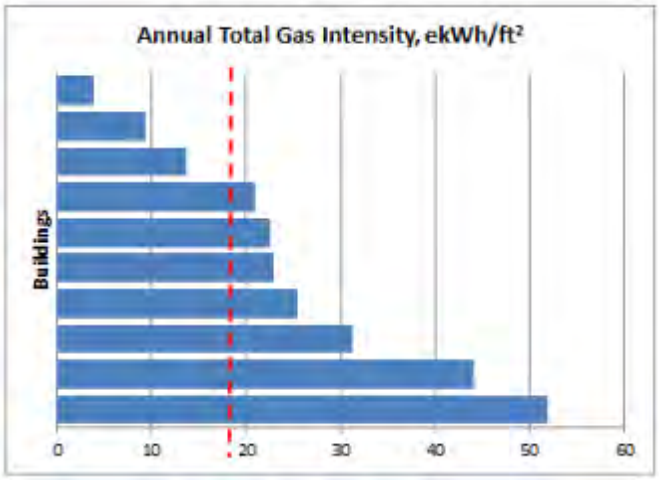

Figure 135: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for shelter, support and housing administration 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 building to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Baseload	9.8	kWh/ft²/year
	Cooling	1.0	kWh/ft²/year
	Heating	0.2	kWh/ft²/year
	Total	11.0	kWh/ft²/year
Gas	Baseload	6.9	ekWh/ft²/year
	Heating	12.5	ekWh/ft²/year
	Total	19.3	ekWh/ft²/year
Total energy	Total	30.3	ekWh/ft²/year

Table 225: Top Quartile Targets

9 buildings made up the data set for target-setting, all of which are City of Toronto buildings with complete and reliable data from the 11 which are part of 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 building. The total savings potential for each building is the sum of savings potential of the components. Some buildings have very high percentage and dollar potential while other more efficient buildings have little or no potential. The 11 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 buildings with annual savings potential greater than $100,000. 7 buildings have annual savings potential between $5,000 and $100,000, and 4 buildings have annual savings potential less than $5,000 (see Table 226).

The total annual savings potential for the 11 buildings is $228,229 ($114,653 for electricity and $113,576 for gas) with an average total energy savings of 41%.

For the 7 mid-potential savings facilities, the total annual savings potential is $225,072 ($112,096 for electricity and $112,976 for gas) with an average total energy savings of 45%.

For the 4 low-potential savings facilities, the total annual savings potential is $3,157 ($2,557 for electricity and $600 for gas) with an average total energy savings of 3%.

	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: 11 facilities	**18%**	**66%**	**20%**	**19%**	**$114,653**	**39%**	**58%**	**51%**	**$113,576**	**41%**	**$228,229**	**$ 65,516**	**$ 43,683**	**280,617**	**910,889**
Mid-potential savings facilities (7)	20%	66%	21%	23%	$112,096	39%	60%	54%	$112,976	45%	$225,072	$ 64,055	$ 43,452	211,017	904,541
Low potential savings facilities (4)	00%	00%	17%	02%	$ 2,557	00%	00%	04%	$ 600	03%	$ 3,157	$ 1,461	$ 231	69,600	6,348

Table 226: 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 227 below shows the total potential savings for all 11 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	11.8	18%	$ 93,480
Electric Cooling (kWh/ft²)	1.1	0.4	66%	$ 17,362
Electric Heating (kWh/ft²)	0.2	0.2	20%	$ 1,623
Total Electricity (kWh/ft²) for facilities w/o component intensities	14.3	13.6	5%	$ 2,189
Gas Baseload (ekWh/ft²)	9.0	5.5	39%	$ 22,313
Gas Heating (ekWh/ft²)	24.5	10.3	58%	$ 90,663
Total Gas (ekWh/ft²) for facilities w/o component intensities	15.2	14.4	6%	$ 600
Total Energy (ekWh/ft²)	**47.0**	**28.0**	**41%**	**$ 228,229**

High savings | Moderate | Low savings

Table 227: Savings Potential Based on Energy Use Components for 11 City of Toronto Shelter, Support and Housing Administration 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 (i.e. Electric Cooling, Gas Heating 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

Error! Reference source not found. shows the full range of possible energy efficiency measures for the entire portfolio of shelter, support and housing administration 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 11 buildings indicate that the largest percentage reductions will come from measures associated with Electric Cooling, Gas Heating and Gas Baseload.

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 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	
	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	3	7	Year 1		Building Occupants
P1	Optimize DHW temperature control	2	3	5	Year 2	annual review	
P3	Test and tune DHW boiler efficiency	3	3	6	Year 2	annual review	
M16	Investigate and repair possible gas leaks	3	3	6	Year 2	annual review	
P2	Implement DHW circulation pump control	1	3	4	Year 2	annual review	
P4	Install low flow showerheads and faucet aerators	1	3	4	Year 4	10 to 15	
M14	Insulate DHW tanks and distribution piping	2	3	5	Year 3	10 to 15	
M15	Replace DHW boilers with more efficient models	1	3	4	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						
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 228: Energy Savings Measures for Shelter, Support and Housing Administration Buildings

The specific measures and implementation timeline for each individual building 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 buildings are summarized in Table 229 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	7	30,145	4.20	$ 886,273	$ 225,072	98.6%	3.94
< $5,000	4	17,400	1.68	$ 116,928	$ 3,157	1.4%	37.04
	11			**$ 1,003,201**	**$ 228,229**		**4.40**

Table 229: 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 230 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	savings potential > $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	7	$ 750	savings potential $5,000 - $100,000	energy analyst
Low Potential	Checklists	4	$ 150	savings potential < $5,000	Division Champion and staff
		11			

Table 230: Assessment Tools Used to Determine Specific Energy-saving Measures

3.2.1 Energy Assessment

There are 7 buildings with between $5,000 and $100,000 in annual energy saving potential. Over 98% of the total energy savings for all 11 buildings can be found in these 7 buildings.

These 7 buildings can save an average of 45% of their total energy use. The total annual energy savings are estimated to be over $225,000 and individual building annual savings range from approximately $5,800 to over $90,000. The annual GHG savings are approximately 900,000 kg.

These 7 buildings can save an average of 23% of their total electricity use (20% Electric Baseload, 66% Electric Cooling and 21% Electric Heating). The total annual electricity savings are estimated to be approximately $112,000 and individual building annual savings range from just over $3,000 to almost $32,000.

These 7 buildings can save an average of 54% of their total gas use (39% Gas Baseload and 60% Gas Heating). The total annual gas savings are estimated to be almost $113,000 and individual building annual savings range from $0 to approximately $83,000.

These 7 buildings will undergo an Energy Assessment with highest potential buildings focused on first (see the Implementation Plan for further details).

Over 90% of the total energy savings can be found at the top 5 buildings with the highest savings potential. Approximately 40% comes from Seaton House alone.

See Appendix B for a list of these 7 buildings and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 7 buildings can be found in Electric Cooling, Gas 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 buildings are eligible to receive over $100,000 in incentives based on current incentives available from the Ontario Power Authority.

3.2.2 Energy Savings Checklist

There are 4 buildings with less than $5,000 in savings potential. In fact, only 2 of these buildings (Adelaide Street Office and Greenfield Family Centre) have savings potential. The other two (Asquith Green Social Housing and Family Residence) have met the top quartile targets and have no savings potential.

Approximately 7% of the total energy savings for all 11 buildings can be found at the Adelaide Street Office and Greenfield Family Centre. These buildings can save an average of 3% of their total energy use. The total annual energy savings are estimated to be approximately $3,000 and the annual GHG savings are approximately 6,300 kg.

All of the electricity savings potential for these 2 buildings is in electric heating, with an average savings potential of 17%. The total annual electricity savings are estimated to be approximately $2,500. Only the Adelaide Street Office has gas savings potential (7% or approximately $600).

The 2 facilities less than $5,000 in savings potential with will undergo a checklist approach with highest potential buildings focused on first (see the Implementation Plan for further details).

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

The energy savings checklist will be used by the Division Champion in conjunction with the building operator and/or service contractor for each 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 231: Total Budget - Energy Management and Retrofit PlanTable 231 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 11 buildings. The total costs to implement the energy management and retrofit plan for shelter, support and housing administration buildings is estimated to be $1,009,051. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	5,250
Checklist	$	600
Implementation	$	1,003,201
Total	**$**	**1,009,051**

Table 231: 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 Energy Assessments will begin in Year 1, with all 7 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 both 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 $861,004. The cumulative net cash flow becomes positive in Year 8.

The implementation plan includes the following assumptions:

- Approximately 70% of the project budget will be spent in the first 5 years, and the other 30% 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. 70% of medium and low potential savings facilities will be retrofitted in the first 5 years and 30% 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).

o 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	2	2	1	1	1	0	0	0	0	0	7
Low Potential - Checklist	0	1	1	1	1	0	0	0	0	0	4
Assessment Costs	$ 1,500	$ 1,656	$ 909	$ 912	$ 916	$ -	$ -	$ -	$ -	$ -	$ 5,893
Implementation Costs	$ -	$ 263,451	$ 299,741	$ 168,689	$ 172,063	$ 175,504	$ -	$ -	$ -	$ -	$ 1,079,448
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 150	$ 26,511	$ 30,065	$ 16,960	$ 17,298	$ 17,550	$ -	$ -	$ -	$ -	$ 108,534
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 13,173	$ 28,160	$ 36,594	$ 45,197	$ 53,972	$ 53,972	$ 53,972	$ 53,972	$ 53,972.40	
Annual Costs	$ 1,650	$ 304,790	$ 358,875	$ 223,155	$ 235,473	$ 247,027	$ 53,972	$ 53,972	$ 53,972	$ 53,972	$ 1,586,861
Estimated Achieved Annual Savings		$ 35,941	$ 126,762	$ 224,393	$ 271,510	$ 297,956	$ 319,085	$ 337,198	$ 354,058	$ 371,761	$ 2,338,666
Estimated Incentives	$ -	$ 57,445	$ 33,939	$ 11,552	$ 3,443	$ 2,820	$ -	$ -	$ -	$ -	$ 109,199
Annual Savings and Incentives	$ -	$ 93,386	$ 160,701	$ 235,945	$ 274,953	$ 300,776	$ 319,085	$ 337,198	$ 354,058	$ 371,761	$ 2,447,865
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 66	-$ 8,522	-$ 16,449	-$ 15,938	-$ 14,358	-$ 12,208	-$ 1,604	$ -	$ -	-$ 69,145
Net Cash Flow incl borrowing costs	-$ 1,650	-$ 211,470	-$ 206,696	-$ 3,660	$ 23,542	$ 39,391	$ 252,905	$ 281,622	$ 300,086	$ 317,789	$ 791,858
Cumulative Net Cash Flow	-$ 1,650	-$ 213,054	-$ 411,229	-$ 398,439	-$ 358,959	-$ 305,210	-$ 40,097	$ 243,129	$ 543,215	$ 861,004	

Table 232: Cash Flow for 10-Year Implementation Plan

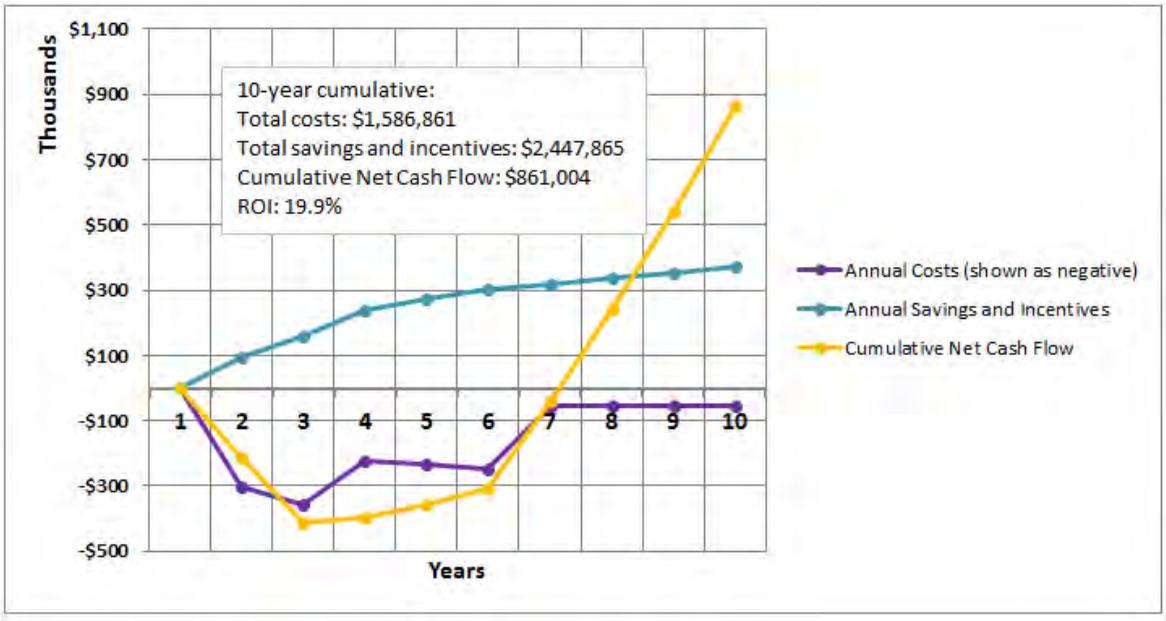

Figure 136: Cash Flow for 10-Year Implementation Plan

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 shelter, support and housing administration 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)

GSH Pump: 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 233: 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 – Shelter, Support and Housing Administration

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 11 buildings included in this report and Plan.

Building	Address	Building Area ft²
129 Peter St	129 Peter St	11,776
Adelaide Street Office	67 Adelaide St. E.	15,888
Asquith Green Social Housing	1673 Kingston Rd	22,002
Birchmount Residence	1651 Sheppard Ave W	5,199
Downsview Dell	4222 Kingston Rd	39,999
Family Residence	38 Bathurst St	25,995
Fort York Residence	305-311 Greenfield Ave	7,384
Greenfield Family Centre	21 Park Rd	6,329
Robertson House	291-295 Sherbourne St	19,795
Seaton House	339 George St	97,995
Women's Residence	674 Dundas St. W	28,256

Table 234: Shelter, Support and Housing Administration Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 11 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)
Greenfield Family Centre	8.06	9.43	17.48
Family Residence	8.93	12.64	21.57
Downsview Dell	26.69	0.00	26.69
Adelaide Street Office	12.24	20.85	33.09
Asquith Green Social Housing	19.46	13.71	33.17
Birchmount Residence	11.27	22.98	34.26
Fort York Residence	15.97	25.52	41.49
129 Peter St	21.58	22.55	44.12
Women's Residence	18.01	31.36	49.37
Seaton House	16.97	51.45	68.41
Robertson House	27.35	43.66	71.01

Table 235: Shelter, Support and Housing Administration 2012 Energy Intensity

5.3 Target-setting Method and Metrics

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

Building	Days in 2012	Energy type
Adelaide Street Office	huge adjustment bill in June	Electricity
Asquith Green Social Housing	adjustment bill for Apr-Sep	Gas

Table 236: Excluded Facilities

After excluding these 2 facilities, 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.

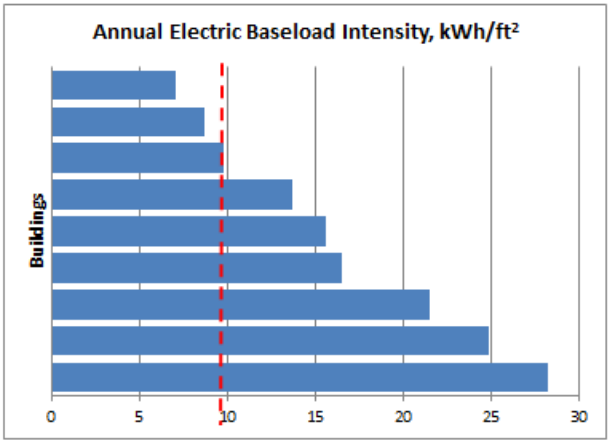

Figure 137: 2012 Electricity Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent**.** Electric Baseload for these buildings ranges from 7.1 to 28.2 ekWh/ft^2 and the top-quartile is 9.8 ekWh/ft^2.

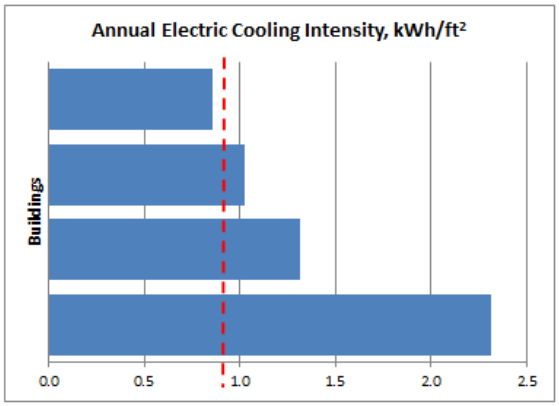

Figure 138: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. There are only 4 buildings with electric cooling. The range is 0.8 to 2.3 ekWh/ft^2 and the top-quartile is 0.98 ekWh/ft^2.

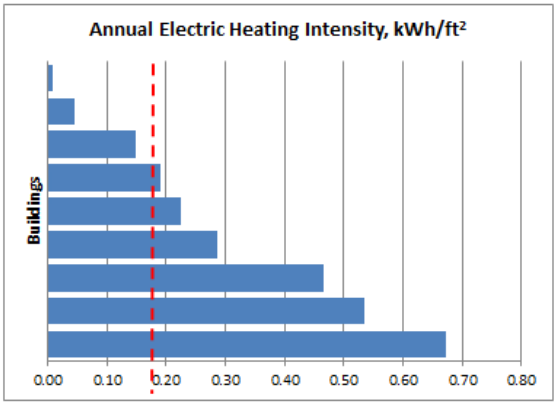

Figure 139: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for these buildings ranges from 0.01 to 0.67 ekWh/ft^2 and the top-quartile is 0.18 ekWh/ft^2.

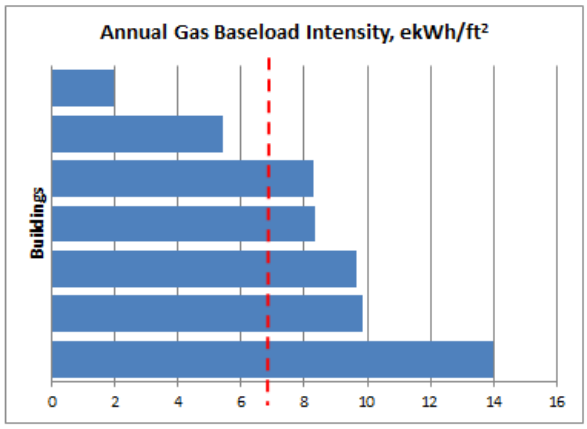

Figure 140: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for these buildings ranges from 1.97 to 13.97 ekWh/ft^2 and the top-quartile is 6.85 ekWh/ft^2.

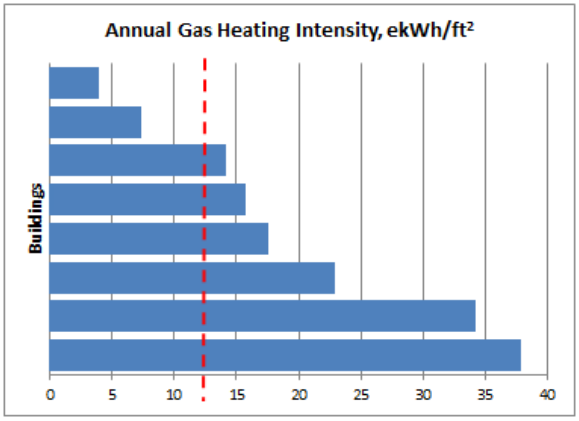

Figure 141: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for these buildings ranges from 3.9 to 37.8 ekWh/ft^2 and the top-quartile is 12.5 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 shelters, support and housing administration 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 7 Mid-Savings Potential Buildings

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

There are 7 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 (7)	20%	66%	21%	23%	$112,096	39%	60%	54%	$112,976	45%	$225,072	$ 64,055	$ 43,452	211,017	904,541
Seaton House		63%		3%	$ 7,360	51%	70%	66%	$ 82,957	50%	$ 90,318	$ 4,206	$ 31,907	97,995	605,310
Women's Residence	41%	100%	61%	44%	$ 31,669	18%	45%	38%	$ 8,413	40%	$ 40,082	$ 18,097	$ 3,236	28,256	85,679
Robertson House	30%	45%	20%	32%	$ 23,883	30%	63%	57%	$ 12,294	47%	$ 36,177	$ 13,647	$ 4,728	19,795	107,611
Fort York Residence	37%			36%	$ 20,877	29%	37%	34%	$ 5,595	34%	$ 26,472	$ 11,930	$ 2,152	25,995	56,839
129 Peter St	54%			54%	$ 19,219	17%	12%	14%	$ 936	34%	$ 20,155	$ 10,982	$ 360	11,776	21,863
Downsview Dell	29%			31%	$ 6,025				$ -	31%	$ 6,025	$ 3,443	$ -	5,199	4,734
Birchmount Residence		76%		9%	$ 3,063		29%	22%	$ 2,781	18%	$ 5,844	$ 1,750	$ 1,070	22,002	22,505

Table 237: Savings Potential for 7 Mid-Savings Potential 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 4 Low-Savings Potential Buildings

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

There are 4 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 (4)	00%	00%	17%	02%	$ 2,557	00%	00%	04%	$ 600	03%	$ 3,157	$ 1,461	$ 231	69,600	6,348
Adelaide Street Office				8%	$ 2,189			7%	$ 600	8%	$ 2,789	$ 1,251	$ 231	15,888	6,059
Greenfield Family Centre			66%	4%	$ 368			0%	$ -	2%	$ 368	$ 210	$ -	7,384	289
Asquith Green Social Housing				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	6,329	0
Family Residence				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	39,999	0

Table 238: Savings Potential for 4 Low-Savings Potential 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.

Service Yards and Storage 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 50 storage facilities in the Energy Conservation Demand Management (ECDM) Plan.

These storage facilities fall under the following 5 Divisions:

- Facilities Management
- Parks, Forestry and Recreation
- Transportation Services
- Solid Waste Management
- Toronto Water

There are 13 facilities included in the ECDM Plan for Facilities Management. They are:

1. Central Garage
2. Disco Yard
3. Dohme Ave 3
4. Eastern Ave Yard / Office
5. Eastern Ave Yard / Shop
6. Ellesmere Yard
7. Fire Dept Repair Shop
8. Hamilton Street Yard
9. Health Materials Warehouse
10. Ingram Works Yard
11. Property Operation Workshop
12. Purchasing WH and Yard
13. Ramsden Yard

The names, addresses and building areas are provided in Appendix B.

There are 15 facilities included in the ECDM Plan for Parks, Forestry and Recreation. They are:

1. Alness Service Yard
2. Bentworth Park Yard
3. Birchmount Parks Yard
4. Brimley Parks Yard
5. Centennial Pk Svc Bldg
6. Eglinton Flats Service Bldg
7. Emery Parks Yard
8. Kipling Maintenance Yard

9. Nashdene Yard
10. Northern Services Building
11. Northline Garage and Offices
12. Pharmacy Yard
13. Rockcliffe Yard
14. Train Storage Building
15. Western Services Yard

The names, addresses and building areas are provided in Appendix B.

There are 18 facilities included in the ECDM Plan for Transportation Services. They are:

1. Bartonville Park
2. Bering Yard
3. Castlefield Yard
4. Eastern & Booth Blocks
5. Emery Works Yard
6. King St Garage
7. Maintenance Yard #1&2
8. Maintenance Yard #3
9. Maintenance Yard #6
10. Maintenance Yard #7
11. Morningside Yard
12. North District Serv Yard
13. Oriole Yd- Signs and Markings
14. Oriole Yd- Works
15. Sixth St Garage
16. Wellington Yard & Office
17. Wellington Yard & Storage
18. Winter Maintenance Depot

The names, addresses and building areas are provided in Appendix B.

There are 2 facilities included in the ECDM Plan for Solid Waste Management. They are:

1. Dufferin Maintenance Yard
2. Old Eglinton Yard (former Bermondsey Yard)

The names, addresses and building areas are provided in Appendix B.

There are 2 facilities included in the ECDM Plan for Toronto Water. They are:

1. Central Equipment Yard
2. Kipling Yard

The names, addresses and building areas are provided in Appendix B.

The total area for all of the buildings is 1,740,016 ft^2. Storage facilities range in size from approximately 800 ft^2 to over 236,000 ft^2.

The Central Maintenance Garage on 843 Eastern Avenue is equipped with a solar air heating system.

The facilities range from 0% to 60% air-conditioned. Three facilities (Wellington Yard & Office, Maintenance Yard #3 and the Winter Maintenance Depot) are fully served by electric heat and there are a number of other facilities using between 5 and 60% electric heat. No facilities are served by a ground or water source heat pump.

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 50 buildings are summarized below.

	2012 Energy Use	
	Unit	**$**
Electricity (kWh)	17,760,078	$2,486,411
Natural Gas (m^3)	3,127,491	$813,148
Total		**$3,299,559**

Table 239: 2012 Energy Use and Costs for 50 City of Toronto Storage Facilities

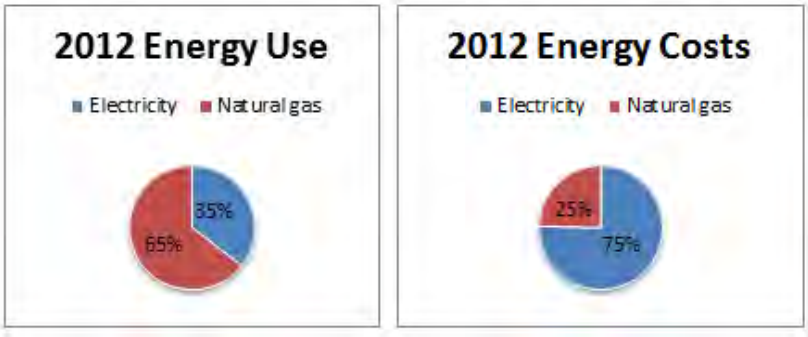

Figure 142: 2012 Energy Use and Cost Breakdown for 50 City of Toronto Storage Facilities

There is a wide range of energy use intensities as presented below, due primarily to differences in efficiency between the 50 buildings. Total energy use ranges from approximately 1.8 to 164.6 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.

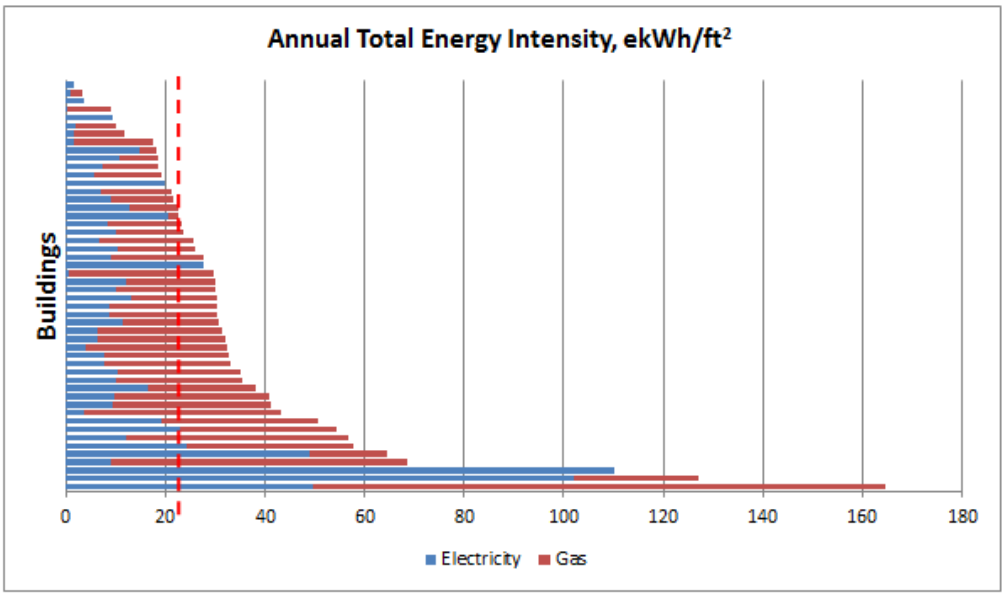

Figure 143: 2012 Total Energy Intensity Benchmark

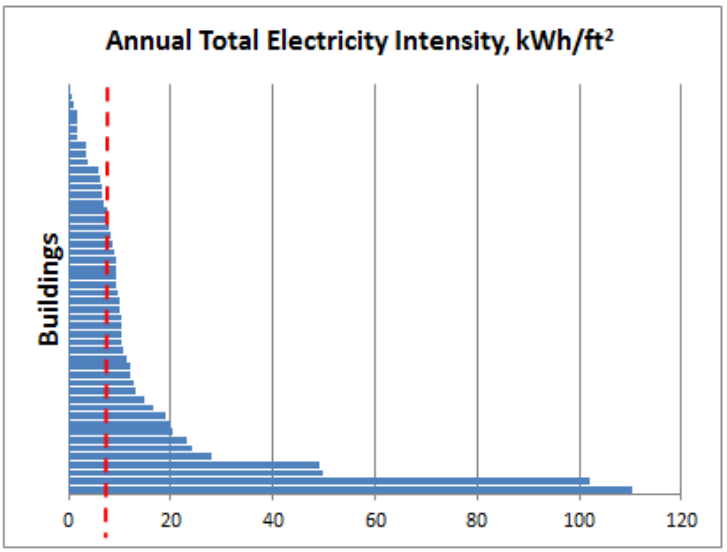

Figure 144: 2012 Total Electricity Intensity Benchmark

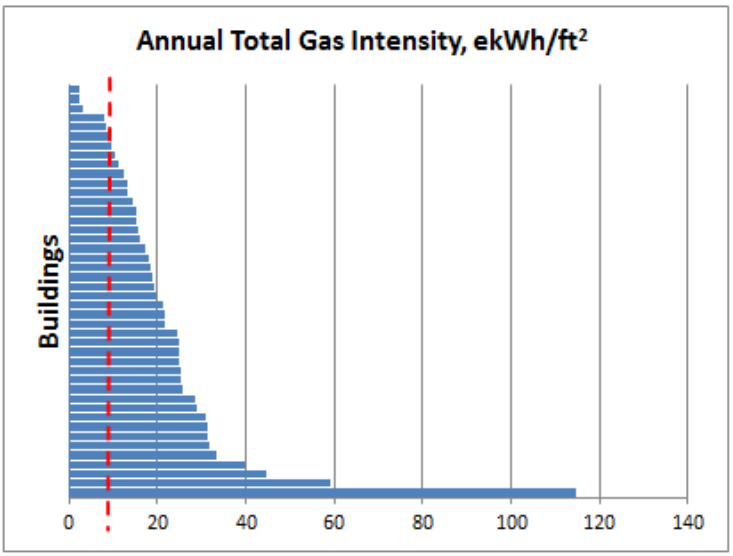

Figure 145: 2012 Total Gas Intensity Benchmark

1.2 Energy Targets

The energy targets for storage 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 storage facility to achieve its target over the duration of the ECDM Plan.

Energy type	Component	Value	Unit
Electricity	Baseload	6.4	kWh/ft²/year
	Cooling	0.2	kWh/ft²/year
	Heating	1.2	kWh/ft²/year
	Total	7.9	kWh/ft²/year
Gas	Baseload	0.9	ekWh/ft²/year
	Heating	13.3	ekWh/ft²/year
	Total	14.2	ekWh/ft²/year
Total Energy	Total	22.1	ekWh/ft²/year

Table 240: Top Quartile Targets

The data set for target-setting is made up of 50 storage 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) 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 storage facility. The total savings potential for each storage 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 50 storage 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 Division is summarized in the Tables below. The savings potential for each individual building (under each Division) is summarized in Appendix B.

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 13 facilities	**32%**	**40%**	**4%**	**28%**	**$ 193,964**	**18%**	**48%**	**48%**	**$ 150,413**	**42%**	**$ 344,377**	**$ 110,836**	**$ 57,851**	**561,821**	**1,239,424**
High potential savings facilities (1)	44%	0%	0%	42%	$ 60,384	0%	70%	69%	$ 65,900	64%	$ 126,285	$ 34,505	$ 25,346	84,701	523,702
Mid-potential savings facilities (9)	28%	43%	4%	26%	$ 133,579	20%	35%	40%	$ 83,916	36%	$ 217,495	$ 76,331	$ 32,275	368,491	711,407
Low potential savings facilities (3)	0%	0%	0%	0%	$ -	0%	0%	6%	$ 597	3%	$ 597	$ -	$ 230	108,629	4,315

Table 241: Savings Potential Summary for Facilities Management Buildings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 15 facilities	**33%**	**59%**	**6%**	**36%**	**$ 131,623**	**31%**	**42%**	**41%**	**$ 44,694**	**39%**	**$ 176,317**	**$ 75,213**	**$ 17,190**	**276,056**	**426,421**
High potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (6)	49%	79%	14%	53%	$ 126,361	33%	57%	56%	$ 30,023	55%	$ 156,384	$ 72,206	$ 11,547	117,702	316,257
Low potential savings facilities (9)	4%	26%	0%	4%	$ 5,261	30%	27%	27%	$ 14,671	20%	$ 19,933	$ 3,007	$ 5,643	158,353	110,164

Table 242: Savings Potential Summary for Parks, Forestry and Recreation Buildings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 18 facilities	**31%**	**40%**	**18%**	**28%**	**$ 293,847**	**86%**	**32%**	**33%**	**$ 95,103**	**31%**	**$ 388,951**	**$ 167,913**	**$ 36,578**	**656,592**	**918,185**
High potential savings facilities (1)	34%	0%	0%	27%	$ 120,263	100%	41%	42%	$ 42,444	35%	$ 162,707	$ 68,722	$ 16,325	236,644	401,231
Mid-potential savings facilities (11)	35%	54%	31%	35%	$ 171,712	80%	45%	47%	$ 50,072	42%	$ 221,784	$ 98,121	$ 19,258	253,139	496,782
Low potential savings facilities (6)	1%	37%	0%	2%	$ 1,872	97%	0%	3%	$ 2,588	3%	$ 4,460	$ 1,070	$ 995	166,809	20,172

Table 243: Savings Potential Summary for Transportation Services Buildings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 2 facilities	**14%**	**100%**	**0%**	**13%**	**$ 15,695**	**8%**	**8%**	**8%**	**$ 1,894**	**11%**	**$ 17,590**	**$ 8,969**	**$ 729**	**86,349**	**26,023**
High potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (1)	19%	100%	0%	23%	$ 15,695	9%	0%	1%	$ 122	10%	$ 15,818	$ 8,969	$ 47	54,681	13,217
Low potential savings facilities (1)	0%	0%	0%	0%	$ -	0%	29%	28%	$ 1,772	12%	$ 1,772	$ -	$ 682	31,667	12,806

Table 244: Savings Potential Summary for Solid Waste Management Buildings

Operation name	Electricity Savings Potential					Gas Savings Potential				Total Energy Savings Potential		Incentives		Indoor Area	GHG Emissions
	Average %				$/yr	Average %			$/yr	Avg %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 2 facilities	**40%**	**100%**	**34%**	**40%**	**$ 103,287**	**4%**	**36%**	**35%**	**$ 29,425**	**37%**	**$ 132,712**	**$ 59,021**	**$ 11,317**	**159,198**	**293,804**
High potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (2)	40%	100%	34%	40%	$ 103,287	4%	36%	35%	$ 29,425	37%	$ 132,712	$ 59,021	$ 11,317	159,198	293,804
Low potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0

Table 245: Savings Potential Summary for Toronto Water Buildings

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 8 below shows the total potential savings for all 50 storage facilities as a whole and highlights where the greatest percentage savings are.

Energy and Water Components	2012 Use	Target	Savings Potential %	Savings Potential $
Electric Baseload (kWh/ft²)	8.8	6.0	32%	$ 629,400
Electric Cooling (kWh/ft²)	0.4	0.2	46%	$ 33,037
Electric Heating (kWh/ft²)	1.6	1.4	14%	$ 47,274
Total Electricity (kWh/ft²) for facilities w/o component intensities	5.0	3.4	31%	$ 28,705
Gas Baseload (ekWh/ft²)	0.7	0.4	43%	$ 11,900
Gas Heating (ekWh/ft²)	19.0	11.7	38%	$ 285,515
Total Gas (ekWh/ft²) for facilities w/o component intensities	12.8	5.4	57%	$ 24,115
Total Energy (ekWh/ft²)	**28.8**	**18.4**	**36%**	**$ 1,059,946**

High savings | Moderate | Low savings

Table 246: Savings Potential Based on Energy Use Component for 50 Storage 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 9 below shows the full range of possible energy efficiency measures for the entire portfolio of 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 50 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	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	
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	1	5	Year 1	annual review	Building Occupants
B9	Avoid use of electric heaters	4	1	5	Year 1		Building Occupants
B10	Use recommended thermostat set points (in winter set to 68 degrees or less during daytime)	4	1	5	Year 1		Building Occupants
M8	Control fan coil and entrance heaters to optimize run-times	3	1	4	Year 2	seasonal review	
M9	Evaluate conversion from electric heating to natural gas	2	1	3	Year 5	n/a	
M5	Install snow sensors to control the snow-melting system	1	1	2	Year 5	seasonal review	
M6	Upgrade base building heating system to avoid use of electric heaters	1	1	2	Year 5	seasonal review	
M7	Upgrade electric heating controls to optimize space temperatures and operating periods	1	1	2	Year 5	seasonal review	
M10	Install controls on vehicle plug-in heaters	1	1	2	Year 5	10 to 15	
	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
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

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

	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
M19	Optimize operating periods of ventilation systems supplying heated spaces	2	3	5	Year 2	seasonal review	
M20	Test and adjust ventilation systems to optimize outside air volumes	3	3	6	Year 2	seasonal review	
M23	Test and tune boiler efficiency	3	3	6	Year 2	seasonal review	
M25	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	
M26	Optimize fan-coil unit and entrance heater controls	3	3	6	Year 2	seasonal review	
M27	Consider heating system zoning	2	3	5	Year 2	n/a	
M18	Use controls to prevent heaters from running when overhead doors are open	1	3	4	Year 2	seasonal review	
M22	Test, repair, replace and right-size heating control valves and outside air dampers	2	3	5	Year 3	10 to 15	
M21	Apply CO control to vehicle area exhaust fans	1	3	4	Year 4	10 to 15	
M24	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	
M28	Install high efficiency burners	1	3	4	Year 4	15 to 20	
M29	Replace boilers with more efficient models	1	3	4	Year 4	15 to 20	
M30	Replace old rooftop units with energy efficient units	1	3	4	Year 4	15 to 20	
M31	Install heat recovery or solar heating units	1	3	4	Year 4	10 to 15	
	Other:_____						

Behavioural Measures
Operational Measures
Retrofit/Capital Measures

Table 247: Energy Saving Measures for Storage Facilities

Proposed / Future Renewable Energy Installations

Building Name	Building Address	Renewable Installation	System Size	Unit
PMMD warehouse	3 Dohme Ave	Geothermal	175	kW
Booth Yard Block D	433 Eastern Ave	Solar PV	86	kW
Disco Yard	150 Disco Rd	Solar PV	300	kW
Ellesmere Yard	1050 Ellesmere Rd	Solar PV	362	kW
King Yard	1116 King St	Solar PV	175	kW
Northline Yard - Office & Storage	30 Northline Rd	Solar PV	138	kW
Toryork Yard - Road Opertion Garage & EMS	61 Toryork	Solar PV	103	kW

Table 248: Proposed Renewable Energy Systems on Service Yards & Storage Facilities

3 Energy Management and Retrofit Plan

3.1 Implementation Costs and Modeled Savings for all Service Yards & Storage Facilities

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.

Note that due to the lower savings potential at Solid Waste Management facilities, lower implementation costs were used to provide a rational ROI for this Division. Specifically for this Division, the budget allowance for mid-potential buildings is set at 40 percent of that of the other Divisions and the budget allowance for low-potential buildings is set at $\$0.75/ft^2$.

The total implementation costs, payback and cash flows for each of the Divisions are summarized in their respective sections below.

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 their respective Plans below.

3.3 Facilities Management Plan

The total implementation costs, payback and cash flows for Facilities Management facilities are summarized in Table 10 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	1	84,701	5.04	$ 426,894	$ 126,285	36.7%	3.38
$5,000 - $100,000	9	40,943	4.20	$ 1,547,663	$ 217,495	63.2%	7.12
< $5,000	3	36,210	1.68	$ 182,497	$ 597	0.2%	305.69
	13			**$ 2,157,053**	**$ 344,377**		**6.26**

Table 249: Estimated Implementation Costs and Modeled Savings for Facilities Management

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).

The three implementation tools, budgeted analysis cost and numbers of Facilities Management facilities to which they apply are summarized in Table 11 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	1	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	9	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	3	$ 150	< $5,000	Division Champion and staff
		13			

Table 250: Assessment Tools Used to Determine Specific Energy-saving Measures for Facilities Management

3.3.1 Building Performance Audit

There is 1 facilities management building with over $100,000 in annual energy saving potential. This building can save an average of 64% of its total energy use. The total annual energy savings are estimated to be over $126,280 and the annual GHG savings are estimated to be approximately 523,700 kg.

This building can save an average of 42% of its total electricity use (44% Electric Baseload, 0% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $60,384.

This building can save an average of 69% of its total gas use (0% Gas Baseload and 70% Gas Heating). The total annual gas savings are estimated to be approximately $65,900.

This building 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 highest percentage reductions for this building can be found in Electric Baseload and Gas Heating. After the implementation of the proposed measures, these facilities are eligible to receive over $59,850 in incentives based on current incentives available from the Ontario Power Authority.

3.3.2 Energy Assessment

There are 9 facilities management buildings with between $5,000 and $100,000 in annual energy saving potential.

These 9 buildings can save an average of 36% of their total energy use. The total annual energy savings are estimated to be over $217,490 and the annual GHG savings are approximately 711,400 kg.

These 9 buildings can save an average of 26% of their total electricity use (28% Electric Baseload, 43% Electric Cooling and 4% Electric Heating). The total annual electricity savings are estimated to be approximately $133,580.

These 9 buildings can save an average of 40% of their total gas use (20% Gas Baseload and 35% Gas Heating). The total annual gas savings are estimated to be approximately $83,900.

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

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

The highest percentage reductions for this group of 9 buildings 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 buildings are eligible to receive over $108,600 in incentives based on current incentives available from the Ontario Power Authority.

3.3.3 Energy Savings Checklist

There are 3 buildings with less than $5,000 in savings potential.

These 3 buildings can save an average of 3% of their total energy use. The total annual energy savings are estimated to be approximately $600 and the annual GHG savings are approximately 4,300 kg.

These 3 buildings can save an average of 0% of their total electricity use and an average of 6% of their total gas use. The total annual gas savings are estimated to be approximately $600.

These 3 buildings will undergo a checklist approach with highest potential buildings focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 3 buildings and their associated energy savings potential by energy use component.

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

3.3.4 Implementation Budget

Table 12 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 13 facilities. The total costs to implement the energy management and retrofit plan for buildings are estimated to be $2,171,753.Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	7,500
Energy Assessment	$	6,750
Checklist	$	450
Implementation	$	2,157,053
Total	**$**	**2,171,753**

Table 251: Total Budget - Energy Management and Retrofit Plan for Facilities Management

3.3.5 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 13 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. 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 3 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 $317,496. The cumulative net cash flow becomes positive in Year 9.

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	1	1	1	0	0	0	0	0	0	3
Assessment Costs	$ 9,000	$ 1,656	$ 1,659	$ 1,662	$ 750	$ -	$ -	$ -	$ -	$ -	$ 14,728
Implementation Costs	$ -	$ 801,960	$ 429,532	$ 438,122	$ 446,885	$ 193,658	$ -	$ -	$ -	$ -	$ 2,310,157
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 900	$ 80,362	$ 43,119	$ 43,978	$ 44,763	$ 19,366	$ -	$ -	$ -	$ -	$ 232,488
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 40,098	$ 61,575	$ 83,481	$ 105,825	$ 115,508	$ 115,508	$ 115,508	$ 115,508	$ 115,508	
Annual Costs	$ 9,900	$ 924,075	$ 535,885	$ 567,244	$ 598,223	$ 328,531	$ 115,508	$ 115,508	$ 115,508	$ 115,508	$ 3,425,890
Estimated Achieved Annual Savings		$ 65,774	$ 213,460	$ 349,725	$ 408,425	$ 450,721	$ 482,597	$ 508,801	$ 534,241	$ 560,953	$ 3,574,699
Estimated Incentives	$ -	$ 119,094	$ 25,180	$ 14,613	$ 7,140	$ 2,660	$ -	$ -	$ -	$ -	$ 168,688
Annual Savings and Incentives	$ -	$ 184,868	$ 238,640	$ 364,338	$ 415,565	$ 453,382	$ 482,597	$ 508,801	$ 534,241	$ 560,953	$ 3,743,386
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 396	-$ 29,964	-$ 41,854	-$ 49,970	-$ 57,277	-$ 52,283	-$ 37,599	-$ 21,867	-$ 5,118	-$ 296,328
Net Cash Flow incl borrowing costs	-$ 9,900	-$ 739,603	-$ 327,209	-$ 244,760	-$ 232,628	$ 67,574	$ 314,806	$ 355,694	$ 396,866	$ 440,328	$ 21,168
Cumulative Net Cash Flow	-$ 9,900	-$ 749,107	-$ 1,046,352	-$ 1,249,258	-$ 1,431,916	-$ 1,307,065	-$ 939,976	-$ 546,683	-$ 127,950	$ 317,496	

Table 252: Cash Flow for 10-Year Implementation Plan for Facilities Management

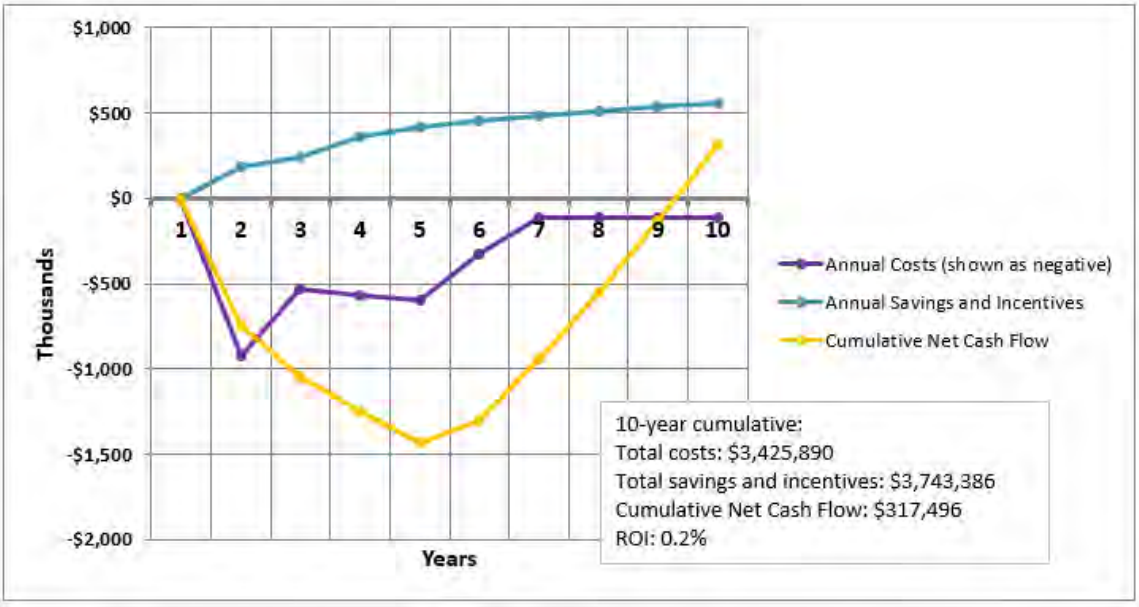

Figure 146: Cash Flow for 10-Year Implementation Plan for Facilities Management

3.4 Parks, Forestry & Recreation Plan

The total implementation costs, payback and cash flows for Parks, Forestry & Recreation facilities are summarized in Table 14 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%	0.00
$5,000 - $100,000	6	19,617	4.20	$ 494,350	$ 156,384	88.7%	3.16
< $5,000	9	17,595	1.68	$ 266,033	$ 19,933	11.3%	13.35
	15			**$ 760,384**	**$ 176,317**		**4.31**

Table 253: Estimated Implementation Costs and Modeled Savings for Parks, Forestry & Recreation

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).

The three implementation tools, budgeted analysis cost and numbers of Parks, Forestry & Recreation facilities to which they apply are summarized in Table 15 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%	0.00
$5,000 - $100,000	6	19,617	4.20	$ 494,350	$ 156,384	88.7%	3.16
< $5,000	9	17,595	1.68	$ 266,033	$ 19,933	11.3%	13.35
	15			**$ 760,384**	**$ 176,317**		**4.31**

Table 254: Assessment Tools Used to Determine Specific Energy-saving Measures for Parks, Forestry & Recreation

3.4.1 Building Performance Audit

There are no parks, forestry & recreation buildings with over $100,000 in annual energy saving potential so none will undergo a Building Performance Audit.

3.4.2 Energy Assessment

There are 6 buildings with between $5,000 and $100,000 in annual energy saving potential.

These 6 buildings can save an average of 55% of their total energy use. The total annual energy savings are estimated to be over $156,380 and the annual GHG savings are approximately 316,260 kg.

These 6 buildings can save an average of 53% of their total electricity use (49% Electric Baseload, 79% Electric Cooling and 14% Electric Heating). The total annual electricity savings are estimated to be approximately $126,360.

These 6 buildings can save an average of 56% of their total gas use (33% Gas Baseload and 57% Gas Heating). The total annual gas savings are estimated to be approximately $30,000.

These 6 buildings will undergo an Energy Assessment with highest potential buildings focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 6 buildings and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 6 buildings 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 buildings are eligible to receive over $83,750 in incentives based on current incentives available from the Ontario Power Authority.

3.4.3 Energy Savings Checklist

There are 9 buildings with less than $5,000 in savings potential.

These 9 buildings can save an average of 20% of their total energy use. The total annual energy savings are estimated to be approximately $19,900 and the annual GHG savings are approximately 110,160 kg.

These 9 buildings can save an average of 4% of their total electricity use (4% Electric Baseload, 26% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $5,260.

These 9 buildings can save an average of 27% of their total gas use (30% Gas Baseload and 27% Gas Heating). The total annual gas savings are estimated to be approximately $14,670.

These 9 buildings will undergo a checklist approach with highest potential buildings focused on first (see the Implementation Plan for further details).

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

The highest percentage reductions for this group of 9 buildings can be found in Electric Cooling and Gas Baseload.

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

3.4.4 Implementation Budget

Table 16 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 15 facilities. The total costs to implement the energy management and retrofit plan for buildings are estimated to be $766,234. Note the Implementation costs are not adjusted for inflation.

BUDGET	
Building Performance Audit (BPA)	$ -
Energy Assessment	$ 4,500
Checklist	$ 1,350
Implementation	$ 760,384
Total	**$ 766,234**

Table 255: Total Budget - Energy Management and Retrofit Plan for Parks, Forestry & Recreation

3.4.5 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 17 and Figure 6 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 6 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 9 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 $652,936. The cumulative net cash flow becomes positive in Year 8.

The implementation plan includes the following assumptions:

- Approximately 74% of the project budget will be spent in the first 5 years, and the other 26% 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. 74% of facilities will be retrofitted in the first 5 years and 26% 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	0	0	0	0	0	0	0	0	0	0	0
Mid Potential - Energy Assessment	2	1	1	1	1	0	0	0	0	0	6
Low Potential - Checklist	0	3	3	3	0	0	0	0	0	0	9
Assessment Costs	$ 1,500	$ 1,218	$ 1,228	$ 1,237	$ 750	$ -	$ -	$ -	$ -	$ -	$ 5,933
Implementation Costs	$ -	$ 171,441	$ 181,540	$ 185,171	$ 188,874	$ 92,786	$ -	$ -	$ -	$ -	$ 819,813
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 150	$ 17,266	$ 18,277	$ 18,641	$ 18,962	$ 9,279	$ -	$ -	$ -	$ -	$ 82,575
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 8,572	$ 17,649	$ 26,908	$ 36,351	$ 40,991	$ 40,991	$ 40,991	$ 40,991	$ 40,991	
Annual Costs	$ 1,650	$ 198,497	$ 218,694	$ 231,957	$ 244,938	$ 143,056	$ 40,991	$ 40,991	$ 40,991	$ 40,991	$ 1,202,754
Estimated Achieved Annual Savings		$ 26,933	$ 91,531	$ 158,827	$ 195,790	$ 223,766	$ 245,212	$ 260,500	$ 273,525	$ 287,202	$ 1,763,286
Estimated Incentives	$ -	$ 53,901	$ 19,334	$ 9,178	$ 6,193	$ 3,798	$ -	$ -	$ -	$ -	$ 92,403
Annual Savings and Incentives	$ -	$ 80,833	$ 110,865	$ 168,004	$ 201,983	$ 227,564	$ 245,212	$ 260,500	$ 273,525	$ 287,202	$ 1,855,689
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 66	-$ 4,773	-$ 9,086	-$ 11,644	-$ 13,362	-$ 9,982	-$ 1,813	$ -	$ -	-$ 50,725
Net Cash Flow incl borrowing costs	-$ 1,650	-$ 117,729	-$ 112,601	-$ 73,038	-$ 54,600	$ 71,146	$ 194,240	$ 217,697	$ 232,535	$ 246,211	$ 602,211
Cumulative Net Cash Flow	-$ 1,650	-$ 119,313	-$ 227,142	-$ 291,095	-$ 334,050	-$ 249,542	-$ 45,320	$ 174,190	$ 406,724	$ 652,936	

Table 256: Cash Flow for 10-Year Implementation Plan for Parks, Forestry & Recreation

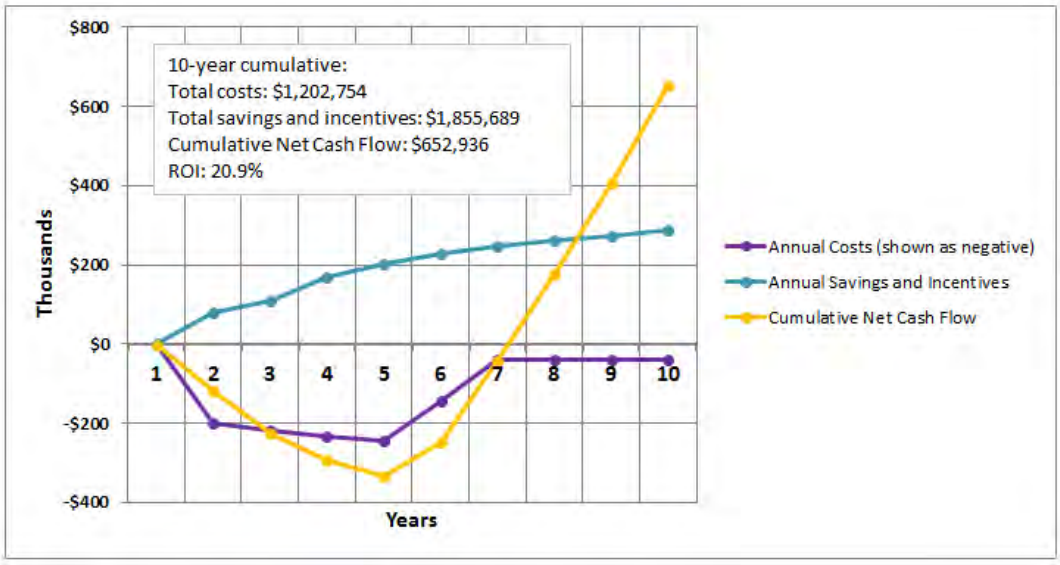

Figure 147: Cash Flow for 10-Year Implementation Plan for Parks, Forestry & Recreation

3.5 Transportation Services Plan

The total implementation costs, payback and cash flows for Transportation Services facilities are summarized in Table 18 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	1	236,644	5.04	$ 1,192,687	$ 162,707	41.8%	7.33
$5,000 - $100,000	11	23,013	4.20	$ 1,063,186	$ 221,784	57.0%	4.79
< $5,000	6	27,801	1.68	$ 280,239	$ 4,460	1.1%	62.84
	18			**$ 2,536,112**	**$ 388,951**		**6.52**

Table 257: Estimated Implementation Costs and Modeled Savings for Transportation Services

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).

The three implementation tools, budgeted analysis cost and numbers of Transportation Services facilities to which they apply are summarized in Table 19 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	1	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	11	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	6	$ 150	< $5,000	Division Champion and staff
		18			

Table 258: Assessment Tools Used to Determine Specific Energy-saving Measures for Transportation Services

3.5.1 Building Performance Audit

There is 1 Transportation Services building with over $100,000 in annual energy saving potential.

This building can save an average of 35% of its total energy use. The total annual energy savings are estimated to be over $162,700 and the annual GHG savings are estimated to be approximately 401,230 kg.

This building can save an average of 35% of its total electricity use (34% Electric Baseload, 0% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $120,260.

This building can save an average of 42% of its total gas use (100% Gas Baseload and 41% Gas Heating). The total annual gas savings are estimated to be approximately $42,444.

This building 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 highest percentage reductions for this building can be found in Gas Baseload and Gas Heating. After the implementation of the proposed measures, these facilities are eligible to receive over $85,000 in incentives based on current incentives available from the Ontario Power Authority.

3.5.2 Energy Assessment

There are 11 transportation services buildings with between $5,000 and $100,000 in annual energy saving potential.

These 11 buildings can save an average of 42% of their total energy use. The total annual energy savings are estimated to be over $221,780. The annual GHG savings are approximately 496,780 kg.

These 11 buildings can save an average of 35% of their total electricity use (35% Electric Baseload, 54% Electric Cooling and 31% Electric Heating). The total annual electricity savings are estimated to be approximately $171,700.

These 11 buildings can save an average of 47% of their total gas use (80% Gas Baseload and 45% Gas Heating). The total annual gas savings are estimated to be approximately $50,000.

These 11 buildings will undergo an Energy Assessment with highest potential buildings focused on first (see the Implementation Plan for further details).

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

The highest percentage reductions for this group of 11 buildings 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 transportation services are eligible to receive over $117,380 in incentives based on current incentives available from the Ontario Power Authority.

3.5.3 Energy Savings Checklist

There are 6 transportation services buildings with less than $5,000 in savings potential.

These 6 buildings can save an average of 3% of their total energy use. The total annual energy savings are estimated to be approximately $4,460 and the annual GHG savings are approximately 20,170 kg.

These 6 buildings can save an average of 2% of their total electricity use (1% Electric Baseload, 37% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $1,870.

These 6 buildings can save an average of 3% of their total gas use (all in Gas Baseload). The total annual gas savings are estimated to be approximately $2,590.

These 6 buildings will undergo a checklist approach with highest potential transportation services buildings focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 6 transportation services buildings and their associated energy savings potential by energy use component.

The highest percentage reductions for this group of 6 buildings can be found in Electric Cooling and Gas Baseload.

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

3.5.4 Implementation Budget

Table 20 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for all 18 facilities. The total costs to implement the energy management and retrofit plan for transportation services are estimated to be $2,552,762. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	7,500
Energy Assessment	$	8,250
Checklist	$	900
Implementation	$	2,536,112
Total	**$**	**2,552,762**

Table 259: Total Budget - Energy Management and Retrofit Plan for Transportation Services

3.5.5 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 21 and Figure 7 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 and the implementation of these measures will occur in Year 2. Identification of measures from Energy Assessments will begin in Year 1, with all 11 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 6 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 $72,637. The cumulative net cash flow becomes positive in Year 10.

The implementation plan includes the following assumptions:

- Approximately 74% of the project budget will be spent in the first 5 years, and the other 26% 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. 74% of facilities will be retrofitted in the first 5 years and 26% 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	2	1	0	0	0	0	11
Low Potential - Checklist	0	2	2	2	0	0	0	0	0	0	6
Assessment Costs	$ 9,000	$ 1,812	$ 1,818	$ 1,825	$ 1,500	$ 750	$ -	$ -	$ -	$ -	$ 16,705
Implementation Costs	$ -	$ 1,441,988	$ 304,269	$ 310,354	$ 316,561	$ 217,695	$ 111,024	$ -	$ -	$ -	$ 2,701,891
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 900	$ 144,380	$ 30,609	$ 31,218	$ 31,806	$ 21,844	$ 11,102	$ -	$ -	$ -	$ 271,860
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 72,099	$ 87,313	$ 102,831	$ 118,659	$ 129,543	$ 135,095	$ 135,095	$ 135,095	$ 135,095	
Annual Costs	$ 9,900	$ 1,660,280	$ 424,009	$ 446,227	$ 468,526	$ 369,832	$ 257,221	$ 135,095	$ 135,095	$ 135,095	$ 4,041,279
Estimated Achieved Annual Savings		$ 70,626	$ 224,855	$ 362,453	$ 425,420	$ 483,569	$ 533,459	$ 572,093	$ 603,390	$ 633,560	$ 3,909,425
Estimated Incentives	$ -	$ 136,940	$ 23,610	$ 15,811	$ 15,067	$ 9,097	$ 3,967	$ -	$ -	$ -	$ 204,491
Annual Savings and Incentives	$ -	$ 207,565	$ 248,465	$ 378,264	$ 440,487	$ 492,666	$ 537,426	$ 572,093	$ 603,390	$ 633,560	$ 4,113,916
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 396	-$ 58,505	-$ 65,526	-$ 68,245	-$ 69,366	-$ 64,453	-$ 53,245	-$ 35,765	-$ 17,033	-$ 432,534
Net Cash Flow incl borrowing costs	-$ 9,900	-$ 1,453,111	-$ 234,048	-$ 133,490	-$ 96,284	$ 53,467	$ 215,752	$ 383,754	$ 432,531	$ 481,432	-$ 359,898
Cumulative Net Cash Flow	-$ 9,900	-$ 1,462,615	-$ 1,638,158	-$ 1,706,122	-$ 1,734,161	-$ 1,611,327	-$ 1,331,122	-$ 894,124	-$ 425,828	$ 72,637	

Table 260: Cash Flow for 10-Year Implementation Plan for Transportation Services

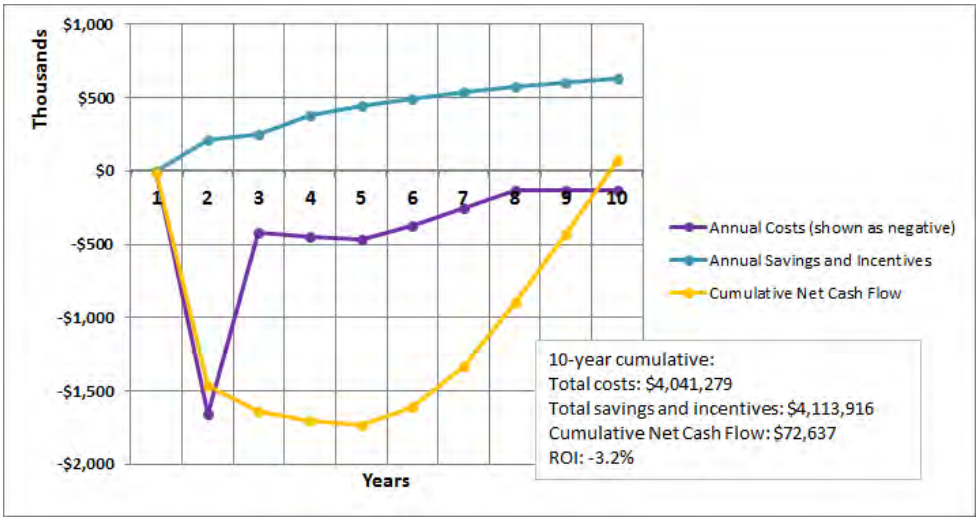

Figure 148: Cash Flow for 10-Year Implementation Plan for Transportation Services

3.6 Solid Waste Management Plan

The total implementation costs, payback and cash flows for Solid Waste Management facilities are summarized in Table 261Table 261 below.

Annual Savings Potential	Number of facilities	Average Area (ft^2)	Estimated Implementation Cost	Estimated Implementation Cost $	Estimated Savings potential $	% of total savings	Payback
> $100,000	0	-	5.04	$ -	$ -	0.0%	0.00
$5,000 - $100,000	1	54,681	1.68	$ 91,864	$ 15,818	89.9%	5.81
< $5,000	1	31,667	0.75	$ 23,751	$ 1,772	10.1%	13.40
	2			**$ 115,615**	**$ 17,590**		**6.57**

Table 261: Estimated Implementation Costs and Modeled Savings for Solid Waste Management

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).

The three implementation tools, budgeted analysis cost and numbers of Solid Waste Management facilities to which they apply are summarized in Table 23 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	1	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	1	$ 150	< $5,000	Division Champion and staff
		2			

Table 262: Assessment Tools Used to Determine Specific Energy-saving Measures for Solid Waste Management

3.6.1 Building Performance Audit

There are no Solid Waste Management buildings with over $100,000 in annual energy saving potential so none will undergo a Building Performance Audit.

3.6.2 Energy Assessment

There is 1 Solid Waste Management building with between $5,000 and $100,000 in annual energy saving potential.

This building can save an average of 10% of its total energy use. The total annual energy savings are estimated to be over $15,800 and the annual GHG savings are approximately 13,200 kg.

This building can save an average of 23% of its total electricity use (19% Electric Baseload, 100% Electric Cooling and 0% Electric Heating). The total annual electricity savings are estimated to be approximately $15,700.

This building can save an average of 1% of its total gas use (all in Gas Baseload). The total annual gas savings are estimated to be approximately $120.

This building will undergo an Energy Assessment (see the Implementation Plan for further details).

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

The highest percentage reductions for this Solid Waste Management facility can be found in Electric Baseload and Electric Cooling. 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, this building is eligible to receive over $9,000 in incentives based on current incentives available from the Ontario Power Authority.

3.6.3 Energy Savings Checklist

There is 1 Solid Waste Management building with less than $5,000 in savings potential.

This building can save an average of 12% of its total energy use. The total annual energy savings are estimated to be approximately $1,770 and the annual GHG savings are approximately 12,800 kg.

This building can save 0% of their total electricity use and an average of 28% of their total gas use (all in Gas Heating). The total annual gas savings are estimated to be approximately $1,770.

This building will undergo a checklist approach (see the Implementation Plan for further details).

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

The highest percentage reductions for this building can be found in Gas Heating.

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

3.6.4 Implementation Budget

Table 24 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for both facilities. The total costs to implement the energy management and retrofit plan for Solid Waste Management are estimated to be $116,515. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	750
Checklist	$	150
Implementation	$	115,615
Total	**$**	**116,515**

Table 263: Total Budget - Energy Management and Retrofit Plan for Solid Waste Management

3.6.5 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 25 and Figure 8 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 occur in Year 1 and the implementation of these measures will occur in Year 2. Identification of measures from the Checklist will occur in Year 2, and 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 $16,298. The cumulative net cash flow becomes positive in Year 10.

The implementation plan includes the following assumptions:

- Approximately 84% of the project budget will be spent in the first 5 years, and the other 16% 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. 84% of facilities will be retrofitted in the first 5 years and 16% 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	0	0	0	0	0	0	0	0	0	0	0
Mid Potential - Energy Assessment	1	0	0	0	0	0	0	0	0	0	1
Low Potential - Checklist	0	1	0	0	0	0	0	0	0	0	1
Assessment Costs	$ 750	$ 156	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 906
Implementation Costs	$ -	$ 95,576	$ 25,204	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 120,780
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 75	$ 9,573	$ 2,520	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,169
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 4,779	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	
Annual Costs	$ 825	$ 110,084	$ 33,764	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 6,039	$ 186,945
Estimated Achieved Annual Savings		$ 4,848	$ 14,618	$ 21,380	$ 22,449	$ 23,572	$ 24,751	$ 25,988	$ 27,287	$ 28,652	$ 193,546
Estimated Incentives	$ -	$ 9,697	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,697
Annual Savings and Incentives	$ -	$ 14,546	$ 14,618	$ 21,380	$ 22,449	$ 23,572	$ 24,751	$ 25,988	$ 27,287	$ 28,652	$ 203,243
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 33	-$ 3,855	-$ 4,620	-$ 4,007	-$ 3,350	-$ 2,649	-$ 1,900	-$ 1,103	-$ 253	-$ 21,769
Net Cash Flow incl borrowing costs	-$ 825	-$ 95,571	-$ 23,000	$ 10,721	$ 12,404	$ 14,183	$ 16,063	$ 18,049	$ 20,146	$ 22,360	-$ 5,471
Cumulative Net Cash Flow	-$ 825	-$ 96,363	-$ 115,509	-$ 100,167	-$ 83,757	-$ 66,224	-$ 47,512	-$ 27,563	-$ 6,315	$ 16,298	

Table 264: Cash Flow for 10-Year Implementation Plan for Solid Waste Management

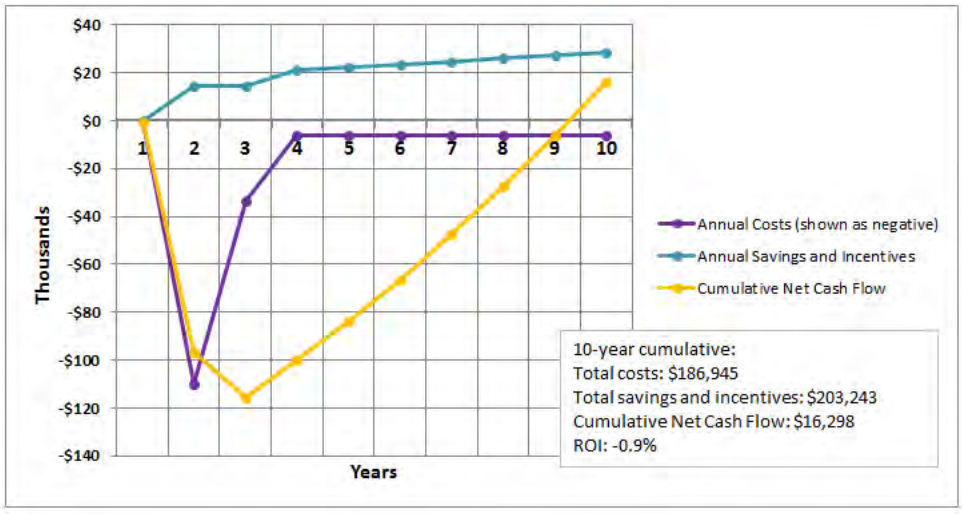

Figure 149: Cash Flow for 10-Year Implementation Plan for Solid Waste Management

3.7 Toronto Water Plan

The total implementation costs, payback and cash flows for Toronto Water facilities are summarized in Table 26 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%	0.00
$5,000 - $100,000	2	79,599	4.20	$ 668,632	$ 132,712	100.0%	5.04
< $5,000	0	-	1.68	$ -	$ -	0.0%	0.00
	2			**$ 668,632**	**$ 132,712**		**5.04**

Table 265: Estimated Implementation Costs and Modeled Savings for Toronto Water

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).

The three implementation tools, budgeted analysis cost and numbers of Toronto Water facilities to which they apply are summarized in Table 27 below.

		#	Cost	Savings Potential	Resources
High Potential	Building Performance Audit (BPA)	0	$ 7,500	> $100,000	engineer; energy analyst
Mid Potential	Energy Assessments	2	$ 750	$5,000 - $100,000	energy analyst
Low Potential	Checklists	0	$ 150	< $5,000	Division Champion and staff
		2			

Table 266: Assessment Tools Used to Determine Specific Energy-saving Measures for Toronto Water

3.7.1 Building Performance Audit

There are no buildings with over $100,000 in annual energy saving potential, so no buildings will receive a Building Performance Audit.

3.7.2 Energy Assessment

There are 2 Toronto Water buildings with between $5,000 and $100,000 in annual energy saving potential.

These 2 buildings can save an average of 37% of their total energy use. The total annual energy savings are estimated to be over $132,700 and the annual GHG savings are approximately 293,800 kg.

These 2 buildings can save an average of 40% of their total electricity use (40% Electric Baseload, 100% Electric Cooling and 34% Electric Heating). The total annual electricity savings are estimated to be approximately $103,280.

These 2 buildings can save an average of 35% of their total gas use (4% Gas Baseload and 36% Gas Heating). The total annual gas savings are estimated to be approximately $29,400.

These 2 buildings will undergo an Energy Assessment with highest potential buildings focused on first (see the Implementation Plan for further details).

See Appendix B for a list of these 2 buildings and their associated energy savings potential by energy use component.

The highest percentage reductions for these 2 buildings can be found in Electric Baseload and Electric Cooling. 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 2 buildings are eligible to receive over $70,300 in incentives based on current incentives available from the Ontario Power Authority.

3.7.3 Energy Savings Checklist

There are no Toronto Water buildings with less than $5,000 in savings potential, so no buildings will undergo a checklist approach.

3.7.4 Implementation Budget

Table 28 below shows the total budget to implement the energy management and retrofit plan, including costs for identifying measures and the implementation costs for the 2 buildings. The total costs to implement the energy management and retrofit plan for Toronto Water buildings are estimated to be $670,132. Note the Implementation costs are not adjusted for inflation.

BUDGET		
Building Performance Audit (BPA)	$	-
Energy Assessment	$	1,500
Checklist	$	-
Implementation	$	668,632
Total	**$**	**670,132**

Table 267: Total Budget - Energy Management and Retrofit Plan for Toronto Water

3.7.5 10-Year Implementation Plan

The 10-year implementation plan is summarized in Table 29 and Figure 9 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 both Energy Assessments completed by the end of Year 2. The implementation of these measures will begin in Year 2, and will be completed by the end of 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 $385,578. 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	0	0	0	0	0	0	0	0	0	0	0
Mid Potential - Energy Assessment	1	1	0	0	0	0	0	0	0	0	2
Low Potential - Checklist	0	0	0	0	0	0	0	0	0	0	0
Assessment Costs	$ 750	$ 750	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,500
Implementation Costs	$ -	$ 347,822	$ 354,779	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 702,601
Training and M&V costs (10.0% of Assessment and Implementation Costs)	$ 75	$ 34,857	$ 35,478	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 70,410
Maintenance costs (5.0% of Implementation Costs, cumulative)	$ -	$ 17,391	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	
Annual Costs	$ 825	$ 400,821	$ 425,387	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 35,130	$ 1,072,943
Estimated Achieved Annual Savings		$ 18,927	$ 75,315	$ 141,851	$ 169,377	$ 177,846	$ 186,738	$ 196,075	$ 205,879	$ 216,173	$ 1,388,182
Estimated Incentives	$ -	$ 33,799	$ 36,539	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 70,338
Annual Savings and Incentives	$ -	$ 52,726	$ 111,854	$ 141,851	$ 169,377	$ 177,846	$ 186,738	$ 196,075	$ 205,879	$ 216,173	$ 1,458,521
Borrowing costs based on cumulative cash flows (4.0% per annum)		-$ 33	-$ 13,957	-$ 26,498	-$ 22,229	-$ 16,859	-$ 11,151	-$ 5,086	$ -	$ -	-$ 95,814
Net Cash Flow incl borrowing costs	-$ 825	-$ 348,128	-$ 327,489	$ 80,223	$ 112,018	$ 125,857	$ 140,458	$ 155,859	$ 170,749	$ 181,043	$ 289,764
Cumulative Net Cash Flow	-$ 825	-$ 348,920	-$ 662,452	-$ 555,732	-$ 421,484	-$ 278,768	-$ 127,160	$ 33,786	$ 204,535	$ 385,578	

Table 268: Cash Flow for 10-Year Implementation Plan for Toronto Water

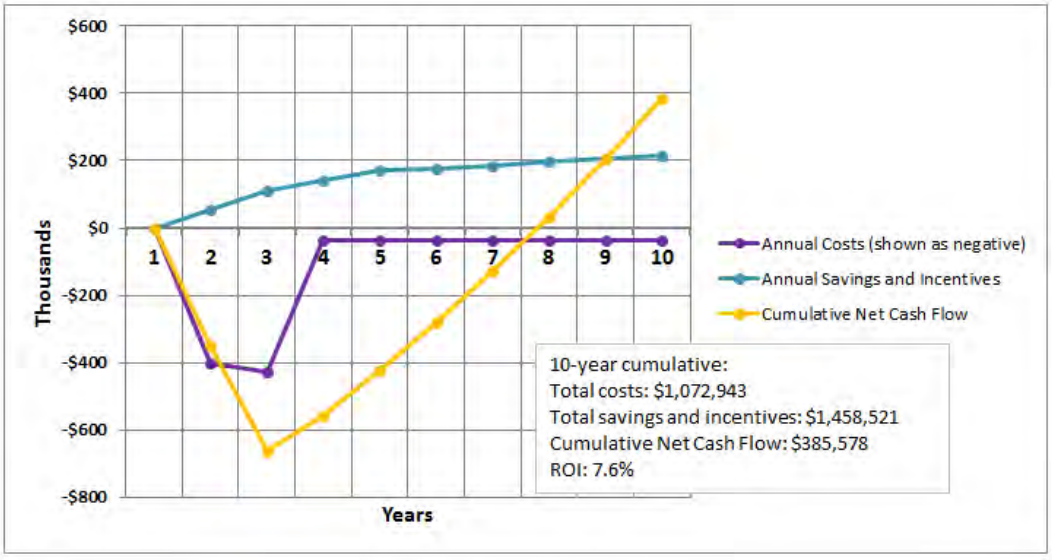

Figure 150: Cash Flow for 10-Year Implementation Plan for Toronto Water

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 storage facilities 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 Buildings and Buildings:

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 269: 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 – Service Yards & Storage Facilities

5.1 Buildings and Building Characteristics

Below are the names, addresses and building areas for the 50 storage facilities included in this report and Plan.

Building	Address	Building Area (ft^2)
Alness Service Yard	21 Alness St	25,715
Arrow Bus Garage	700 Arrow Road	223,861
Bentworth Park Yard	140 Bentworth Ave	12,981
Bering Yard	320 Bering Ave	53,798
Birchmount Bus Garage	400 Danforth Road	112,004
Birchmount Parks Yard	1901 Birchmount Rd /101 Ridgetop	15,317
Brimley Parks Yard	451 Brimley Rd	2,809
Castlefield Yard	1401 Castlefield Ave	36,447
Centennial Pk Svc Bldg	149 Elmcrest Rd	33,470
Central Equipment Yard	1026 Finch Ave W	148,197
Davenport Building, Harvey and Duncan Shops	1138 Bathurst Street	648,757
Davisville Carhouse	29 Lascalles Boulevard	75,024
Disco Yard	150 Disco Rd	98,446
Dohme Ave 3	3 Dohme Ave	25,898
Dufferin Maintenance Yard	75 Vanley Cres	31,667
Eastern & Booth Blocks	433 Eastern Ave	236,644
Eastern Ave Yard / Office	843 Eastern Ave	84,701
Eastern Ave Yard / Shop	875 Eastern Ave	9,698
Eglinton Bus Garage	38 Comstock Road	116,605
Eglinton Flats Service Bldg	101 Emmett Ave	5,705
Ellesmere Yard	1050 Ellesmere Rd	138,069
Emery Parks Yard	27 Toryork Dr	18,998
Emery Works Yard	61 Toryork Dr	26,404
Fire Dept Repair Shop	35 Strachan Ave	71,978
Greenwood Complex	400 Greenwood Avenue	363,430
Hamilton Street Yard	138 Hamilton St	818
Ingram Works Yard	86 Ingram Dr	23,907
King St Garage	1116 King St W	83,485
Kipling Maintenance Yard	441 Kipling Ave	27,373
Kipling Yard	435 Kipling Ave	11,001
Lakeshore Bus Garage	580 Commissioners Street	131,320
Maintenance Yard #1&2	170 Plewes Road	38,760

Maintenance Yard #3	195 Berdmondsy Rd	4,618
Maintenance Yard #6	7 Leslie St	6,135
Maintenance Yard #7	100 Turnberry Rd	11,862
Malvern Bus Garage	5050 Sheppard Avenue E.	231,796
McCowan Carhouse	1720 Ellesmere Road	23,605
Mt. Dennis Bus Garage	121 Industry Street	258,186
Nashdene Yard	70 Nashdene Rd	24,176
North District Serv Yard	140 Merton St	32,044
Northline Garage and Offices	30 Northline Road	54,529
Old Eglinton Bus Garage	2200 Yonge Street	112,523
Old Danforth Bus Garage	1627 Danforth Road	71,611
Oriole Yd- Signs and Markings	2755 Old Leslie Street	16,264
Oriole Yd- Works	2751 Old Leslie St	39,805
Pharmacy Yard	135 Pharmacy Ave	1,851
Property Operation Workshop	133 River St	12,034
Queensway Bus Garage	400 Evans Avenue	124,537
Ramsden Yard	1008 Yonge St	20,247
Rockcliffe Yard	301 Rockcliffe Blvd	14,047
Roncesvalles Carhouse	20 The Queensway	41,387
Russell Carhouse	1411 Queen Street E.	48,734
Sixth St Garage	297 Sixth St	6,997
Western Services Yard	235 Edenbridge Dr	4,133
Wilson Complex	160 Transit Road	414,990
Bartonville Park	5 Bartonville Ave E	3,606
Old Eglinton Yard (former Bermondsey Yard)	25 Old Eglinton Ave	54,681
Central Garage	35 Strachan Ave	39,375
Health Materials Warehouse	160 Rivalda Rd	22,604
Morningside Yard	891 Morningside Ave	14,655
Northern Services Building	4801 Dufferin St.	4,101
Purchasing WH and Yard	423 Old Weston Rd	14,047
Train Storage Building	20 Centre Road	30,850
Wellington Yard & Office	677 Wellington St W	10,570
Wellington Yard & Storage	677 Wellington St W	22,346
Winter Maintenance Depot	8270 Sheppard Ave E	12,153

Table 270: Storage Facility Building Information

5.2 Energy Use Intensities

Below are the energy use intensities (total electricity, total gas and total energy) for the 50 storage facilities included in this report and Plan. They are sorted by total energy use intensity, from lowest to highest energy use intensity. They are also sorted by Division.

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Fire Dept Repair Shop	3.5	0.0	3.5
Health Materials Warehouse	0.3	8.8	9.1
Purchasing WH and Yard	1.5	15.9	17.5
Dohme Ave 3	4.8	13.2	18.0
Disco Yard	8.8	18.5	27.3
Central Garage	5.0	25.0	30.0
Ellesmere Yard	11.2	19.0	30.3
Eastern Ave Yard / Shop	10.0	25.5	35.5
Ingram Works Yard	16.4	21.5	37.9
Property Operation Workshop	3.5	39.7	43.2
Eastern Ave Yard / Office	11.9	44.2	56.1
Ramsden Yard	9.2	59.3	68.5
Hamilton Street Yard	91.3	0.0	91.3

Table 271: 2012 Energy Intensities for Facilities Management Buildings

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Centennial Pk Svc Bldg	1.0	2.5	3.4
Bentworth Park Yard	1.8	8.3	10.0
Northline Garage and Offices	13.9	3.2	17.1
Alness Service Yard	6.8	14.5	21.3
Kipling Maintenance Yard	8.1	15.1	23.2
Train Storage Building	6.2	19.0	25.3
Brimley Parks Yard	10.3	15.4	25.6
Nashdene Yard	10.2	19.9	30.0
Birchmount Parks Yard	8.5	21.7	30.2
Western Services Yard	6.1	25.0	31.1
Rockcliffe Yard	5.3	25.8	31.1
Eglinton Flats Service Bldg	10.0	24.8	34.9
Emery Parks Yard	9.8	30.5	40.3
Pharmacy Yard	102.0	24.9	126.9
Northern Services Building	49.0	115.3	164.4

Table 272: 2012 Energy Intensities for Parks, Forestry & Recreation Buildings

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Wellington Yard & Storage	1.5	0.0	1.5
Wellington Yard & Office	9.0	0.0	9.0
Sixth St Garage	1.4	10.4	11.8
Maintenance Yard #3	18.5	0.0	18.5
Oriole Yd- Works	7.3	11.3	18.6
Maintenance Yard #1&2	20.1	2.4	22.4
Castlefield Yard	12.7	9.8	22.4
North District Serv Yard	9.2	13.3	22.5
Winter Maintenance Depot	27.2	0.0	27.2
Emery Works Yard	11.8	17.7	29.5
Oriole Yd- Signs and Markings	0.7	29.2	29.8
Eastern & Booth Blocks	13.1	17.3	30.5
Bering Yard	7.6	24.8	32.4
King St Garage	3.8	28.9	32.7
Bartonville Park	9.1	31.9	41.0
Maintenance Yard #7	18.9	31.0	49.9
Maintenance Yard #6	22.2	30.9	53.1
Morningside Yard	23.8	33.6	57.4

Table 273: 2012 Energy Intensities for Transportation Services Buildings

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Dufferin Maintenance Yard	10.3	7.9	18.2
Old Eglinton Yard	8.8	12.4	21.2

Table 274: 2012 Energy Intensities for Solid Waste Management Buildings

Building	2012 Total Electricity Intensity (kWh/ft²)	2012 Total Gas Intensity (ekWh/ft²)	2012 Total Energy Intensity (ekWh/ft²)
Central Equipment Yard	8.7	21.8	30.5
Kipling Yard	47.6	15.3	62.9

Table 275: 2012 Energy Intensities for Toronto Water Buildings

5.3 Target-setting Method and Metrics

5 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
Fire Dept Repair Shop	451	Electricity
Ramsden Yard	Huge adjustment bill in October 2012, followed by negative consumption in Nov 2012 bill	Electricity
Health Materials Warehouse	579	Electricity
Purchasing WH and Yard	No 2012 data	Electricity
Pharmacy Yard	330	Electricity

Table 276: Excluded Facilities

After excluding these 5 facilities, 45 storage 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.

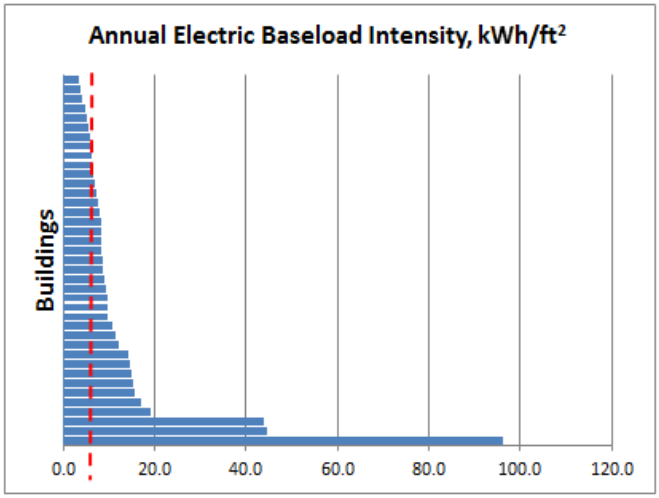

Figure 151: 2012 Electric Baseload Intensity Benchmark

Electric Baseload refers to year-round electricity use for lighting, fans, equipment and other systems that are not weather dependent. Electric Baseload for storage facilities ranges from 3.4 to 96.3 kWh/ft^2 and the top-quartile is 6.44 ekWh/ft^2.

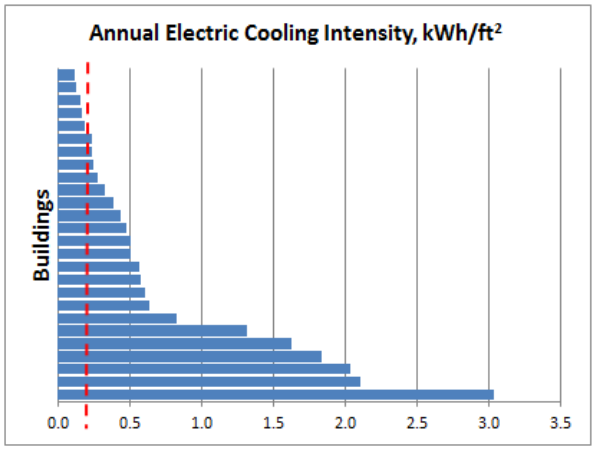

Figure 152: 2012 Electric Cooling Intensity Benchmark

Electric Cooling refers to additional electricity use in summer for cooling purposes. Electric Cooling for storage facilities ranges from 0.1 to 3.0 ekWh/ft^2 and the top-quartile is 0.24 ekWh/ft^2.

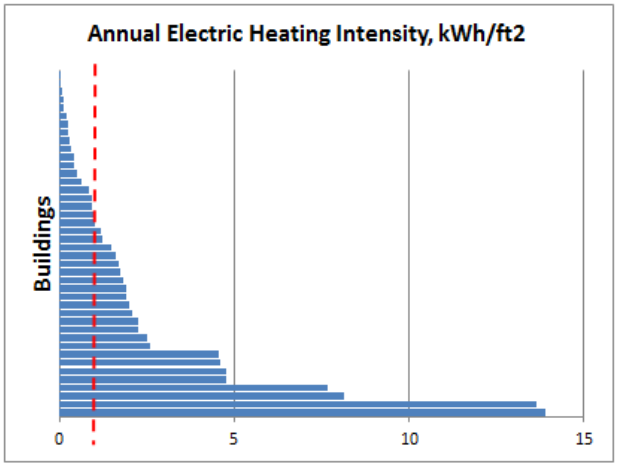

Figure 153: 2012 Electric Heating Intensity Benchmark

Electric Heating refers to additional electricity use in winter months for heating purposes**.** Electric Heating for storage facilities ranges from 0.6 to 13.9 ekWh/ft^2 and the top-quartile is 1.21 ekWh/ft^2.

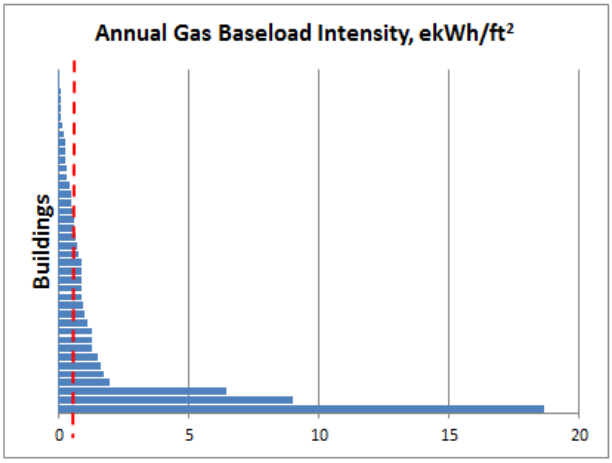

Figure 154: 2012 Gas Baseload Intensity Benchmark

Gas Baseload refers to natural gas used for domestic hot water and other equipment that runs year round. Gas Baseload for storage facilities ranges from 0.6 to 18.7 ekWh/ft^2 and the top-quartile is 0.91 ekWh/ft^2.

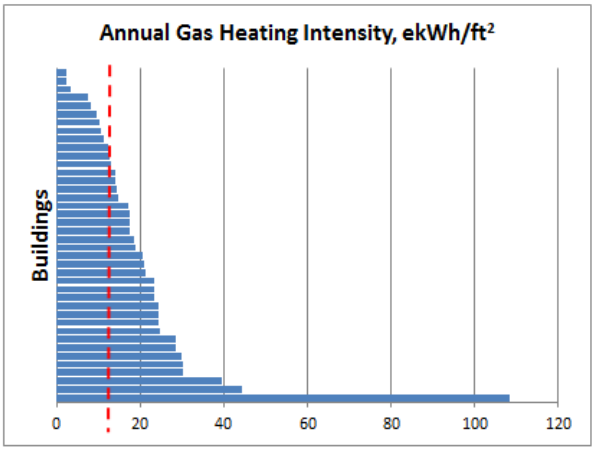

Figure 155: 2012 Gas Heating Intensity Benchmark

Gas Heating refers to the additional energy used in winter for heating and humidification. Gas Heating for storage facilities ranges from 3.3 to 108.4 ekWh/ft^2 and the top-quartile is 13.32 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 storage 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

5.4.1 Facilities Management

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

There is 1 facilities management building with over $100,000 in annual savings potential, 9 with between $5,000 and $100,000 in annual savings potential and 3 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 %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 13 facilities	**32%**	**40%**	**4%**	**28%**	**$ 193,964**	**18%**	**48%**	**48%**	**$ 150,413**	**42%**	**$ 344,377**	**$ 110,836**	**$ 57,851**	**561,821**	**1,239,424**
High potential savings facilities (1)	44%	0%	0%	42%	$ 60,384	0%	70%	69%	$ 65,900	64%	$ 126,285	$ 34,505	$ 25,346	84,701	523,702
Mid-potential savings facilities (9)	28%	43%	4%	26%	$ 133,579	20%	35%	40%	$ 83,916	36%	$ 217,495	$ 76,331	$ 32,275	368,491	711,407
Low potential savings facilities (3)	0%	0%	0%	0%	$ -	0%	0%	6%	$ 597	3%	$ 597	$ -	$ 230	108,629	4,315
Eastern Ave Yard / Office	44%			43%	$ 60,384		70%	70%	$ 65,900	64%	$ 126,285	$ 34,505	$ 25,346	84,701	523,702
Ellesmere Yard	31%			25%	$ 54,987	0%	35%	34%	$ 22,128	30%	$ 77,115	$ 31,421	$ 8,511	138,069	203,123
Ingram Works Yard	58%	100%		56%	$ 30,825		36%	34%	$ 4,411	44%	$ 35,236	$ 17,614	$ 1,697	23,907	56,099
Disco Yard	12%	34%		13%	$ 15,677	1%	28%	27%	$ 12,259	22%	$ 27,937	$ 8,959	$ 4,715	98,446	100,916
Ramsden Yard				17%	$ 4,301			76%	$ 22,928	68%	$ 27,230	$ 2,458	$ 8,819	20,247	169,081
Central Garage	16%			25%	$ 6,814	45%	43%	43%	$ 10,620	40%	$ 17,434	$ 3,893	$ 4,085	39,375	82,103
Hamilton Street Yard	93%		88%	111%	$ 11,611				$ -	111%	$ 11,611	$ 6,635	$ -	818	9,123
Property Operation Workshop				0%	$ -		68%	68%	$ 8,152	62%	$ 8,152	$ -	$ 3,135	12,034	58,913
Dohme Ave 3		73%	17%	38%	$ 6,688	100%	1%	6%	$ 477	14%	$ 7,164	$ 3,821	$ 183	25,898	8,699
Eastern Ave Yard / Shop	22%			20%	$ 2,677	100%	43%	47%	$ 2,940	40%	$ 5,617	$ 1,530	$ 1,131	9,698	23,349
Purchasing WH and Yard				0%	$ -			11%	$ 597	10%	$ 597	$ -	$ 230	14,047	4,315
Fire Dept Repair Shop				0%	$ -				$ -	0%	$ -	$ -	$ -	71,978	0
Health Materials Warehouse				0%	$ -			0%	$ -	0%	$ -	$ -	$ -	22,604	0

Table 277: Savings Potential by Energy Use Component for Facilities Management 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.

5.4.2 Parks, Forestry and Recreation

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

There are no parks, forestry and recreation buildings with over $100,000 in annual savings potential, 6 with between $5,000 and $100,000 in annual savings potential and 9 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 %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 15 facilities	**33%**	**59%**	**6%**	**36%**	**$ 131,623**	**31%**	**42%**	**41%**	**$ 44,694**	**39%**	**$ 176,317**	**$ 75,213**	**$ 17,190**	**276,056**	**426,421**
High potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (6)	49%	79%	14%	53%	$ 126,361	33%	57%	56%	$ 30,023	55%	$ 156,384	$ 72,206	$ 11,547	117,702	316,257
Low potential savings facilities (9)	4%	26%	0%	4%	$ 5,261	30%	27%	27%	$ 14,671	20%	$ 19,933	$ 3,007	$ 5,643	158,353	110,164
Northline Garage and Offices	56%			60%	$ 63,163			0%	$ -	48%	$ 63,163	$ 36,093	$ -	54,529	49,628
Northern Services Building	85%	100%	73%	86%	$ 24,186	86%	88%	87%	$ 10,365	87%	$ 34,552	$ 13,821	$ 3,987	4,101	93,914
Pharmacy Yard				92%	$ 24,404			51%	$ 589	84%	$ 24,993	$ 13,945	$ 227	1,851	23,434
Emery Parks Yard	23%			19%	$ 5,061	1%	62%	61%	$ 8,900	51%	$ 13,960	$ 2,892	$ 3,423	18,998	68,293
Nashdene Yard	22%			18%	$ 6,091		47%	45%	$ 5,429	36%	$ 11,520	$ 3,480	$ 2,088	24,176	44,019
Rockcliffe Yard		84%		33%	$ 3,456	30%	54%	52%	$ 4,740	49%	$ 8,196	$ 1,975	$ 1,823	14,047	36,969
Birchmount Parks Yard	2%	44%		4%	$ 809		46%	45%	$ 3,764	34%	$ 4,573	$ 463	$ 1,448	15,317	27,838
Eglinton Flats Service Bldg	25%			24%	$ 1,927	100%	54%	53%	$ 1,902	45%	$ 3,829	$ 1,101	$ 732	5,705	15,261
Train Storage Building				0%	$ -	41%	24%	25%	$ 3,690	19%	$ 3,690	$ -	$ 1,419	30,850	26,669
Kipling Maintenance Yard	6%			5%	$ 1,445		20%	19%	$ 2,004	14%	$ 3,449	$ 826	$ 771	27,373	15,621
Alness Service Yard				0%	$ -		19%	18%	$ 1,720	12%	$ 1,720	$ -	$ 661	25,715	12,429
Western Services Yard		84%		9%	$ 311	48%	43%	43%	$ 1,111	36%	$ 1,422	$ 178	$ 427	4,133	8,275
Brimley Parks Yard	23%			19%	$ 770	1%	22%	21%	$ 232	20%	$ 1,001	$ 440	$ 89	2,809	2,279
Centennial Pk Svc Bldg				0%	$ -	100%		11%	$ 222	8%	$ 222	$ -	$ 85	33,470	1,605
Bentworth Park Yard				0%	$ -	100%		1%	$ 26	1%	$ 26	$ -	$ 10	12,981	187

Table 278: Savings Potential by Energy Use Component for Parks, Forestry and Recreation 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.

5.4.3 Transportation Services

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

There is 1 transportation services building with over $100,000 in annual savings potential, 11 with between $5,000 and $100,000 in annual savings potential and 6 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 %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 18 facilities	**31%**	**40%**	**18%**	**28%**	**$ 293,847**	**86%**	**32%**	**33%**	**$ 95,103**	**31%**	**$ 388,951**	**$ 167,913**	**$ 36,578**	**656,592**	**918,185**
High potential savings facilities (1)	34%	0%	0%	27%	$ 120,263	100%	41%	42%	$ 42,444	35%	$ 162,707	$ 68,722	$ 16,325	236,644	401,231
Mid-potential savings facilities (11)	35%	54%	31%	35%	$ 171,712	80%	45%	47%	$ 50,072	42%	$ 221,784	$ 98,121	$ 19,258	253,139	496,782
Low potential savings facilities (6)	1%	37%	0%	2%	$ 1,872	97%	0%	3%	$ 2,588	3%	$ 4,460	$ 1,070	$ 995	166,809	20,172
Eastern & Booth Blocks	34%			27%	$ 120,263	100%	41%	42%	$ 42,444	35%	$ 162,707	$ 68,722	$ 16,325	236,644	401,231
Maintenance Yard #1&2	46%	68%	58%	51%	$ 56,824			0%	$ -	47%	$ 56,824	$ 32,471	$ -	38,760	44,648
Morningside Yard	59%	61%	55%	57%	$ 28,394	90%	59%	67%	$ 8,312	63%	$ 36,706	$ 16,225	$ 3,197	14,655	82,383
Maintenance Yard #7	58%	73%		53%	$ 16,830	100%	67%	68%	$ 6,390	63%	$ 23,220	$ 9,617	$ 2,458	11,862	59,402
Castlefield Yard	27%	70%		24%	$ 15,453	100%	30%	31%	$ 2,795	27%	$ 18,248	$ 8,831	$ 1,075	36,447	32,341
Bering Yard				0%	$ -		49%	47%	$ 16,185	37%	$ 16,185	$ -	$ 6,225	53,798	116,965
Winter Maintenance Depot	50%		18%	34%	$ 16,131				$ -	35%	$ 16,131	$ 9,218	$ -	12,153	12,674
Maintenance Yard #6	63%	92%		59%	$ 11,645	100%	67%	68%	$ 3,262	65%	$ 14,908	$ 6,655	$ 1,255	6,135	32,726
Emery Works Yard	25%			20%	$ 8,881	100%	43%	44%	$ 5,242	35%	$ 14,123	$ 5,075	$ 2,016	26,404	44,860
North District Serv Yard	17%	53%		23%	$ 10,612	100%		8%	$ 901	15%	$ 11,513	$ 6,064	$ 347	32,044	14,852
Oriole Yd- Signs and Markings				0%	$ -	100%	58%	59%	$ 6,985	57%	$ 6,985	$ -	$ 2,686	16,264	50,477
Maintenance Yard #3	52%	95%		54%	$ 6,942				$ -	58%	$ 6,942	$ 3,967	$ -	4,618	5,454
Bartonville Park	25%	100%		26%	$ 1,223	95%		56%	$ 1,610	49%	$ 2,834	$ 699	$ 619	3,606	12,598
Wellington Yard & Storage		53%		10%	$ 545				$ -	11%	$ 545	$ 311	$ -	22,346	428
King St Garage				0%	$ -	100%		1%	$ 500	1%	$ 500	$ -	$ 192	83,485	3,610
Oriole Yd- Works				0%	$ -	100%		4%	$ 458	2%	$ 458	$ -	$ 176	39,805	3,310
Sixth St Garage		58%		7%	$ 103	100%		1%	$ 20	2%	$ 123	$ 59	$ 8	6,997	225
Wellington Yard & Office				0%	$ -				$ -	0%	$ -	$ -	$ -	10,570	0

Table 279: Savings Potential by Energy Use Component for Transportation 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.

5.4.4 Solid Waste Management

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

There are no solid waste management buildings with over $100,000 in annual savings potential, 1 with between $5,000 and $100,000 in annual savings potential and 1 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 %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 2 facilities	**14%**	**100%**	**0%**	**13%**	**$ 15,695**	**8%**	**8%**	**8%**	**$ 1,894**	**11%**	**$ 17,590**	**$ 8,969**	**$ 729**	**86,349**	**26,023**
High potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (1)	19%	100%	0%	23%	$ 15,695	9%	0%	1%	$ 122	10%	$ 15,818	$ 8,969	$ 47	54,681	13,217
Low potential savings facilities (1)	0%	0%	0%	0%	$ -	0%	29%	28%	$ 1,772	12%	$ 1,772	$ -	$ 682	31,667	12,806
Old Eglinton Yard (former Bermondsey Yard)	19%	100%		23%	$ 15,695	9%		1%	$ 122	10%	$ 15,818	$ 8,969	$ 47	54,681	13,217
Dufferin Maintenance Yard				0%	$ -		29%	28%	$ 1,772	12%	$ 1,772	$ -	$ 682	31,667	12,806

Table 280: Savings Potential by Energy Use Component for Solid Waste Management 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.

5.4.5 Toronto Water

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

There are no Toronto Water buildings with over $100,000 in annual savings potential, 2 with between $5,000 and $100,000 in annual savings potential and none 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 %	$/yr	Electricity	Gas	ft²	kg/yr
	Base-load	Cooling	Heating	Total		Base-load	Heating	Total							
TOTAL: 2 facilities	**40%**	**100%**	**34%**	**40%**	**$ 103,287**	**4%**	**36%**	**35%**	**$ 29,425**	**37%**	**$132,712**	**$ 59,021**	**$ 11,317**	**159,198**	**293,804**
High potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Mid-potential savings facilities (2)	40%	100%	34%	40%	$ 103,287	4%	36%	35%	$ 29,425	37%	$132,712	$ 59,021	$ 11,317	159,198	293,804
Low potential savings facilities (0)	0%	0%	0%	0%	$ -	0%	0%	0%	$ -	0%	$ -	$ -	$ -	0	0
Central Equipment Yard	23%	100%		22%	$ 39,548		37%	36%	$ 29,121	32%	$ 68,669	$ 22,599	$ 11,201	148,197	241,531
Kipling Yard	86%		74%	84%	$ 63,739	30%	5%	7%	$ 303	67%	$ 64,042	$ 36,422	$ 117	11,001	52,273

Table 281: Savings Potential by Energy Use Component for Toronto Water 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.

Toronto Water

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1.1 Background

Toronto Water owns and is responsible for the operation and maintenance of the City's water and wastewater treatment plants and pumping stations. Toronto Water has set significant standards to achieve energy efficiency through these facilities. This includes an internal energy management program which consists of annually updated facility specific energy management plans, an intranet energy management website and energy use and cost databases. Energy audits were completed at various facilities and recommendations are in different stages of completion and implementation. An Energy Team has also been formed to facilitate the development of a long term energy communication strategy and to help build a sustainable energy saving culture. Three Ministry of Environment director approved Energy Management Training courses were developed and training has been delivered to our management and front-line staff.

This report was prepared in accordance to Ontario Regulation 397/11 and it is structured to provide descriptions as well as a forecast of the expected results of current and proposed energy management measures that are given in section 1, 2, 3 and 4 respectively. Annual energy consumption and green house gas emissions are submitted as part of City overall template under another submission.

1.2 Major Current Energy Management Initiatives

- Optimizing pump operation and natural gas use
- Demand Response (DR3)
- Submetering at wastewater treatment plants
- On-going lighting upgrades at various facilities

1.3 Major Proposed Energy Management Initiatives

- Transmission Operation Optimizer
- Cogeneration studies at Ashbridges Bay and Humber Wastewater Treatment Plant
- System Sustainability Project During a City and Region Wide Area Power Failure
- Long Term Energy Optimization Plan

1.4 Current Energy Management Initiatives Results

The current and proposed projects listed above are expected to reduce or optimize energy use. However, one of the challenges of managing energy savings at multiple treatment facilities emanates from balancing between energy optimization and compliance with more stringent codes and regulations (such as NFPA 820 and wastewater system effluent regulations) and the applications of more energy intensive advanced treatment methods (such as disinfection and ozonation) as well as other operation constraints (such as aging infrastructures which lead to ongoing capital projects to improve the treatment processes).

Toronto Water has an on-going pump optimization initiative. This includes regular pump monitoring, testing, pump retrofit and upgrades. Variable speed drives are applied whenever

applicable at raw water pumps, treated water pumps or raw sewage and return activated sludge pumps.

Natural gas use has also been optimized and reduced by maximizing digester gas use at wastewater treatment plants. For example, boilers have been retrofitted with dual fuel burners and digester gas trains are being upgraded to improve gas delivery. Toronto Water has also been taking advantage of a number of incentive programs offered by Toronto Hydro and Enbridge Gas as we implement various energy retrofit projects.

Some examples of current measures savings and incentives generated are provided below:

Facility	Demand Savings (kW)	Energy Savings (kWh)	Annual Electricity Savings	Incentive Payment
F J Horgan WTP	1,838	8,907,775	$891,000	$516,489
Parkdale Pumping Station	1,183	3,744,402	$374,000	$681,164
William Johnston Pumping Station	95	953,320	$95,000	$93,280

Facility	Gas Savings	Incentive Payment
Highland Creek WWTP	1.8 million cubic meters	$100,000
Humber WWTP	1.1 million cubic meters	$100,000

Toronto Water is currently enrolled in two DR3 agreements. The first agreement for pumping stations has a contracted curtailment of 1500 kW. The second agreement for the F.J. Horgan Water Treatment Plant has a contracted curtailment of 2000 kW. Toronto Water is one of the first water utilities which has participated in the OPA DR3 program and has been contributing 3.5 MW to the province's demand response program when the grid is under constraint.

Submetering is currently being rolled out at various wastewater treatment plants while lighting upgrades are taking place as part of various capital projects. Some examples of renewable energy applications at Toronto Water include an 86 kW photovoltaic system at the F.J. Horgan water treatment plant, green-roofs at John St. and Milliken pumping stations as well as a solar air heating application at Ashbridges Bay WWTP.

1.5 Proposed Energy Management Initiatives Descriptions (2014-2019)

Toronto Water's Energy Conservation and Demand Management Plan consists of the current on-going energy initiatives given in Section 1 as well as the proposed initiatives provided in Section 2. Detailed descriptions of proposed energy management initiatives are given below.

1.5.1 Transmission Operation Optimizer

Toronto Water and the Region of York have been working together to investigate the development of an 'Optimizer' that will automatically determine control strategies for the Water Transmission System. The proposed system would preserve water quality while providing adequate pressure and flow at the lowest energy cost. Plans for the optimizer include a 'Simulator' that will allow system performance prediction under various "what-if" situations. The Optimizer would work "on-line" alongside City of Toronto and Region of York's SCADA (Supervisory Control and Data Acquisition) Systems, while the simulator would be an "off-line" tool.

1.5.2 Cogeneration- Ashbridges Bay Wastewater Treatment Plant

In 2008, Toronto Hydro proposed a cogeneration facility to utilize the digester gas (biogas) produced at the Ashbridges Bay Treatment Plant (ABTP) to generate 10 MW of electrical power and return the recovered thermal energy to ABTP in the form of hot water. The cogeneration facility will physically be located on a small portion of City owned land (adjacent to ABTP) currently occupied by the Transportation Division. Other project proposal features include:

- Electrical connection to 15 kV bus at the North Substation within ABTP
- 10 MW of emergency power (with natural gas supply)
- 20 year term plus 10 year extension option
- Lease payment by Toronto Hydro to the City (Transportation Division)
- Toronto Hydro to cover all capital and operating costs of the project
- Toronto Hydro to pay Toronto Water for biogas while Toronto Water pays Toronto Hydro for returned thermal energy (details under negotiation)

The design of the facility is approximately 10% complete. Toronto Hydro had previously applied for the approval of the project under the FIT Program, but recently submitted an application for a separate OPA incentive program.

1.5.3 Cogeneration- Humber WWTP

The Humber Treatment Plant has two co-gen engines installed in the late 1990s and initially commissioned in 2000. The engines are capable of delivering 2.35 MW of electricity and 2.9 MW of heat each when running at rated capacity. Since the commissioning, numerous issues

related to fuel availability, unreliable fuel preparation system (compression and drying), questionable natural gas and digester gas blending, and repetitive backfires due to exhaust system configuration, rendered this facility non-operable for the last several years.

A recent City initiative has resulted in an upgrade project aimed to address the above mentioned issues and resume routine operation of the facility. It is envisioned that following the improvements that are currently under construction, one of the co-generation engines will be operated solely on digester gas. The second engine will be operated on natural gas if and when the City chooses to do so. Most of the waste heat from the co-gen engines will be utilized by the plant year round with the requirement to supplement winter space heating needs by the natural gas-fired boilers.

1.5.4 System Sustainability Project

The purpose of this assignment is to update the analysis previously completed in 2008, up to the planning horizon of 2041 and evaluate the optimum solution for continuing to reliably supply drinking water to the City of Toronto service area and the integrated York Region water system by recommending and updating emergency power back-up requirements. This study will also recommend the cost benefits and feasibility of using new back-up generator systems to expand demand response participation.

1.5.5 Energy Optimization Plan

Toronto Water Energy Optimization Plan - review the status of the current energy management plans and initiatives, identify and develop short and long term (5-10 years and 10–20 years) goals and objectives as well as provide cost-benefit analysis for the recommended strategies to address all energy aspects of the water and wastewater operations.