Corporate Energy Management Plan

Date: **March 27, 2013**

EXERGYAssociates Ltd.

The Corporation of the City of Burlington

1. Introduction

1.1 Background

Energy costs continue to rise for electricity, natural gas, water and fuels. In order to protect the corporation from rising costs, effective energy management is imperative.

In 2009, Council approved the corporate Energy Policy (report CSI-3-09), a high level document that provides guidance and direction to staff on the development and implementation of a comprehensive corporate energy management program, aiming to reduce consumption, achieve cost savings and meet its greenhouse gas (GHG) emission reduction target.

In 2009, Ontario Regulation 397/11 directed all public agencies in Ontario to prepare, publicly report, and implement energy conservation and demand management plans. It also mandates annual reporting of energy consumption and greenhouse gas emissions starting on July 1, 2013. Energy conservation and demand management reports are required by July 1, 2014 and every fifth anniversary thereafter.

In 2011, City Council approved the Burlington: Our Future 2011-2014 strategic plan which defined the city's vision, priorities and actions over the next four years (2011-14). The strategic plan included directions on environmental sustainability and reducing community energy consumption.

These recent developments set the foundation for developing a corporate Energy Management Plan.

1.2 Purpose of the Energy Management Plan

The Energy Management Plan (EMP) is a document that structures resources and methodologies utilized in improving energy efficiency and energy management effectiveness. It is intended to be a long term road map for best practice energy management to deliver energy savings in an effective and flexible manner.

Energy management includes electricity, natural gas and corporate fuel consumption, as well as water commodity management. The EMP defines actions in the following key areas:

- Energy management information system
- Energy training and awareness
- Facility operations
- Energy conservation in existing facilities
- New construction
- Renewable energy
- On-site generation and demand response
- Fleet energy
- Burlington transit fleet
- Street and traffic lighting
- Development of culture of energy conservation
- Financial considerations

1.3 Key Implemented Actions

1.3.1 Corporate Wide Building Automation System

In 2010, an open protocol Building Automation System (BAS) was installed across 27 major energy consuming facilities, including additional controls for arena refrigeration plants.

1.3.2 Energy Management Tool

In 2011, the city implemented an Energy Management Tool (EMT) provided by the Local Authority Services, Association of Municipalities of Ontario (AMO). It is currently used to track ongoing energy usage based on utility bills and assess the data needed to identify opportunities for energy conservation improvements, whether operational or capital.

2. Our Organization

2.1 City of Burlington Profile

2.1.1 Facilities Summary

Energy audits were completed for 51 (two-thirds of the corporate facilities portfolio by area) of the 105 corporate facilities as part of the EMP development process in order to identify and develop measures that can reduce energy consumption and related greenhouse gas emissions, as well as operating costs. Table 2.1 presents a summary of all corporate facilities per category. Additional information for each site where an energy audit was performed is included in Appendix A.

Table 2.1 Overview of corporate facilities

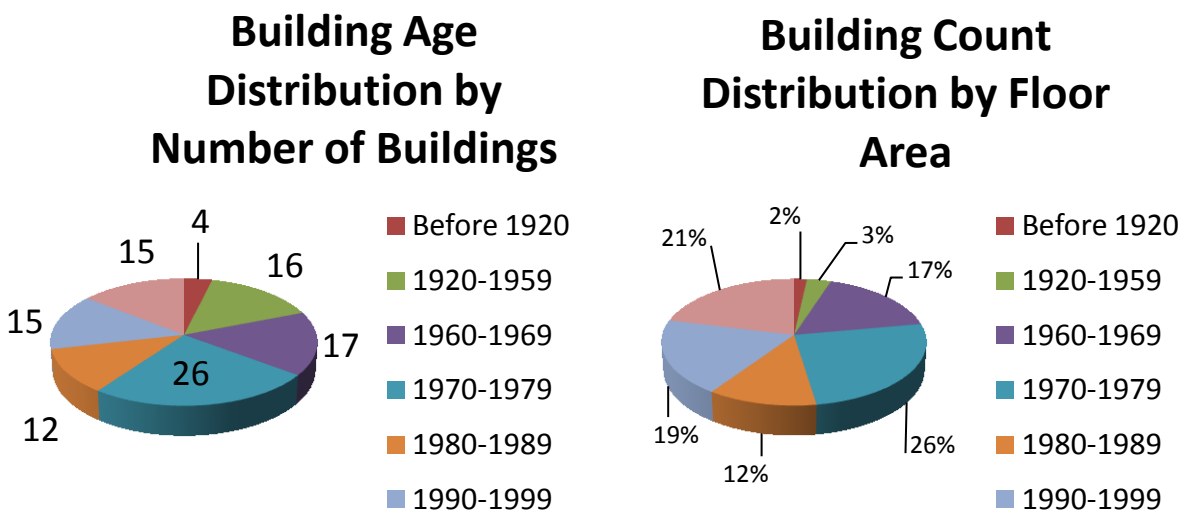
Building Category	Total Gross Floor Area ft2	Number of Facilities
Administrative	398,523	6
Arena	354,014	7
Art Centre	53,680	1
Banquet Centre	32,249	3
Community Centre	154,851	11
Enterprise	30,333	3
Fire Hall	77,675	8
Joint Venture	70,945	16
Library	78,173	3
Museum	16,111	4
Operations	34,789	8
Parks	33,806	28
Performing Arts Centre	69,350	1
Pools	69,175	6
Total	**1,473,673**	**105**

The age of construction varies widely within the facility portfolio, with the oldest construction dated before 1900 and the newest facilities completed after 2000. Table 2.2 and Figure 2.1 present the age and area distribution of city facilities.

Table 2.2 Corporate facility number and area distribution by age

Building Age Category	Number of Facilities	Gross Floor Area (ft2)
Before 1920	4	25,855
1920-1959	16	48,339
1960-1969	17	251,954
1970-1979	26	374,949
1980-1989	12	176,716
1990-1999	15	283,809
After 2000	15	312,052
Total	**105**	**1,473,673**

Figure 2.1 Building age and area distribution



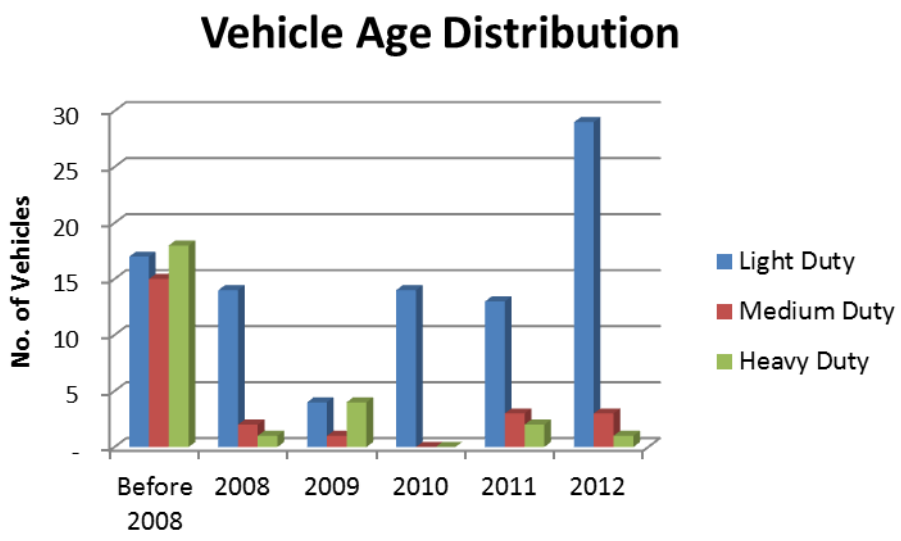
2.1.2 Corporate Fleet Summary

Currently, the city maintains a fleet of light, medium and heavy duty vehicles that serve various departments as well as perform community activities.

Table 2.3 Corporate fleet – Vehicle age distribution

Vehicle Age	Light Duty	Medium Duty	Heavy Duty
Before 2008	17	15	18
2008	14	2	1
2009	4	1	4
2010	14		
2011	13	3	2
2012 (incl. first 2 months of 2013)	29	3	1
Total	**91**	**24**	**26**

Figure 2.2 Corporate Fleet – Vehicle age distribution



The Fire department maintains a number of emergency fire trucks and support vehicles. The fire department is transitioning its support fleet to fuel efficient vehicles.

Table 2.4 below lists the fire fleet inventory and provides an age distribution of the vehicles.

Table 2.4 Fire Fleet – Vehicle age distribution

Vehicle age	Fire - Emergency	Fire - Support	Fire - Reserve	Fire - Antique
2000 and before	4		3	1
2001-2004	5			
2006-2009	5	6		
2010-2013	5	8		
Total number of vehicles	19	14	3	1

Figure 2.3 Fire Fleet – Vehicle age distribution

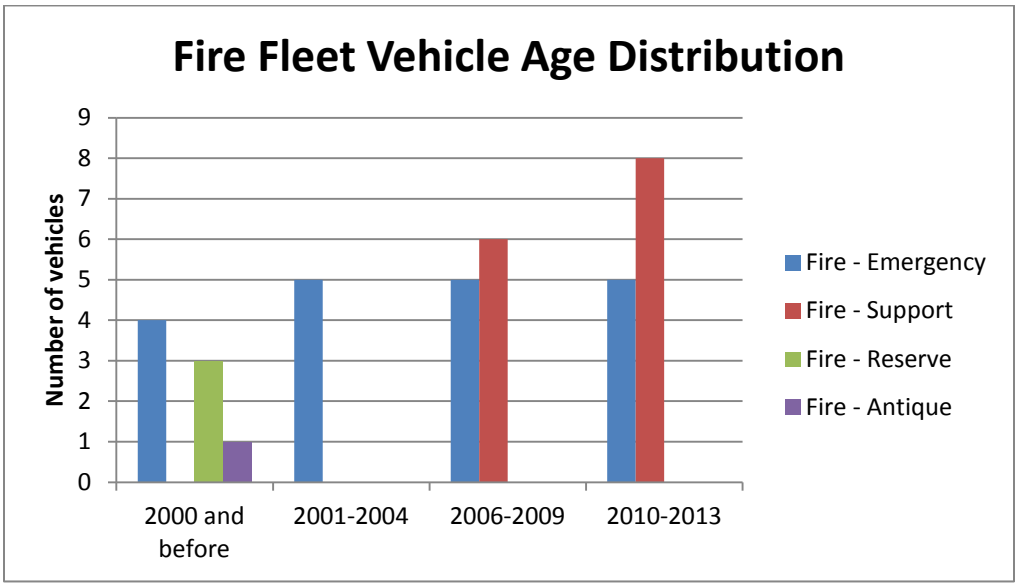


Table 2.5 presents the key performance indicator [litre/100 km] for various departments within the city.

Table 2.5 Fuel efficiencies of corporate vehicles by department

Department	Fuel Efficiency in 2012
Roads and Parks Dept. – Light duty	16.20 l/100 km
Roads and Parks Dept. – Medium Duty	24.57 l/100 km
Roads and Parks Dept. – Heavy Duty	62.75 l/100 km
Parks and Recreation Dept.	15.25 l/100 km
Engineering Dept.	11.73 l/100 km
Building Dept.	11.75 l/100 km
Animal Control	16.33 l/100 km
Fire Dept.	
Emergency Response Vehicles	65.74 l/100 km
Support Vehicles	10.2 l/100 km
Traffic (By-law)	9.36 l/100 km
CSI Dept.	5.58 l/100 km

2.1.3 Transit Fleet Summary

Burlington Transit has been providing public transportation within the City since 1975. Currently, it operates buses and specialized Handi-Van vehicles to serve the community's transit needs.

Table 2.6 Burlington transit fleet – Vehicle age distribution

Vehicle Age	Conventional Bus	Handi-Van	Support Vehicle
Before 2001	1	-	-
2001-2004	9	3	
2005-2008	18	2	4
2009-2012	24	4	2
Total	**52**	**9**	**6**

Figure 2.4 Transit fleet – Vehicle age distribution

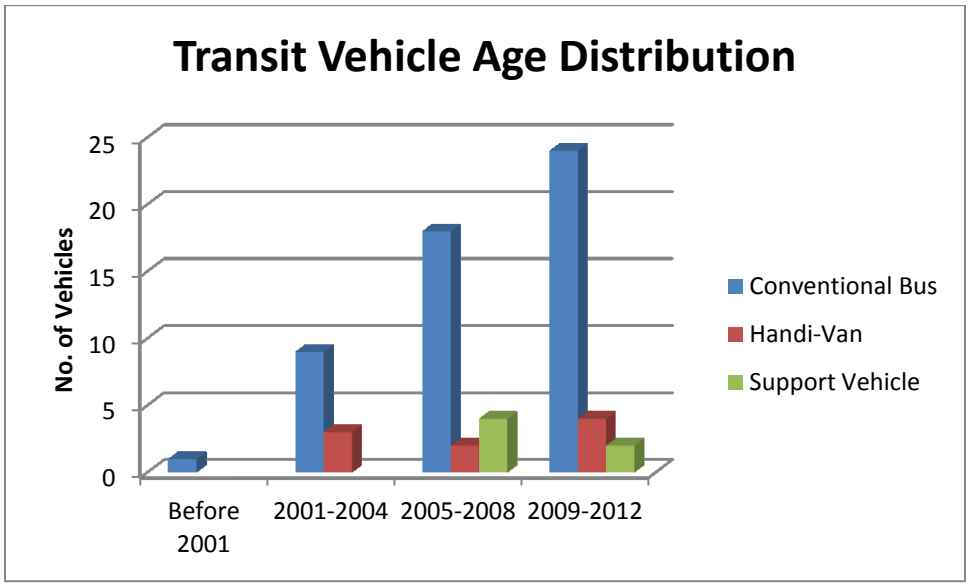


Table 2.7 presents the key performance indicator [litre/100 km] per vehicle category.

Table 2.7 Transit fleet fuel efficiency (litre/ 100 km) by category

Vehicle Category	Fuel Efficiency in 2012
Conventional Bus (Diesel)	56.78 l/100 km
Handi-Van	
Diesel	28.26 l/100 km
Gasoline	29.65 l/100 km
Support Vehicle (Gasoline)	10.85 l/100 km

2.1.4 Street Light Summary

Street lighting fixtures utilize a mix of 70, 100, 150, 200 and a few 400 W high pressure sodium lamps.

RPM staff are currently developing a detailed inventory of the approximately 15,000 street lighting assets.

Engineering staff are leading a review of the city's street light design standards including a review of energy efficient LED street light fixtures.

2.2 Corporate Energy and Environmental Policies

This section highlights all of the applicable corporate energy and environmental policies, plans and strategies.

Burlington, Our Future (Strategic Plan for 2011-2014)			
Strategic Direction	Action List Item	Expected Results	Milestones to Reach
Excellence in Government	4.a. Prepare corporate energy reduction targets	• Reduced costs and energy use	• Gather baseline data • Complete energy audits of city facilities
	4.b. Implement a plan to reduce the City's GHG emissions	• Reduced GHG emissions • The local environment is cleaner • Community leadership is demonstrated	• Complete corporate EMP • GHG emissions reduced by 20 per cent per capita from 1994 levels
Prosperity	3.b. Expand renewable energy initiatives	• Less reliance on non-renewable sources • Lower greenhouse gas emissions	• Report on pilot projects • Increased number of renewable energy projects

Additional Policies	
Policy	Purpose
Corporate Energy Policy (CSI-03-09)	To implement a comprehensive corporate energy management program to reduce consumption, achieve cost savings and meet GHG emission reduction targets.
Corporate Sustainable Building Policy (CSI-04-10)	Mandates LEED (Leadership in Energy and Environmental Design) silver rating for new construction facilities and major retrofits greater than 500 m^2.
Corporate Green Procurement Policy (F-36-11)	To acquire goods and services that minimize impacts on the environment and perform efficiently and effectively.

Corporate Green Fleet Transition Strategy (D&I-11-08)	To continue greening the corporate fleet by improving efficiency and reducing emissions through: • Right-sizing fleet vehicles • Use of hybrid technology • Alternative fuels • Driver training • Transportation demand management initiatives (Smart Commute) • Anti-idling by-law
Towards Zero Waste Strategy (CSI-12-09)	Directs staff to implement measures to reduce waste from corporate operations.

2.3 Current Energy Consumption

Quantifying corporate energy consumption is one of the key processes in managing corporate energy consumption and greenhouse gas emissions. In 2010, staff standardized an energy tracking tool process that is used to quantify energy consumption in corporate facilities. The 2012 data is presented below.

In 2012, the city's total energy cost from all sources was approximately $7,082,000 (pre-tax).

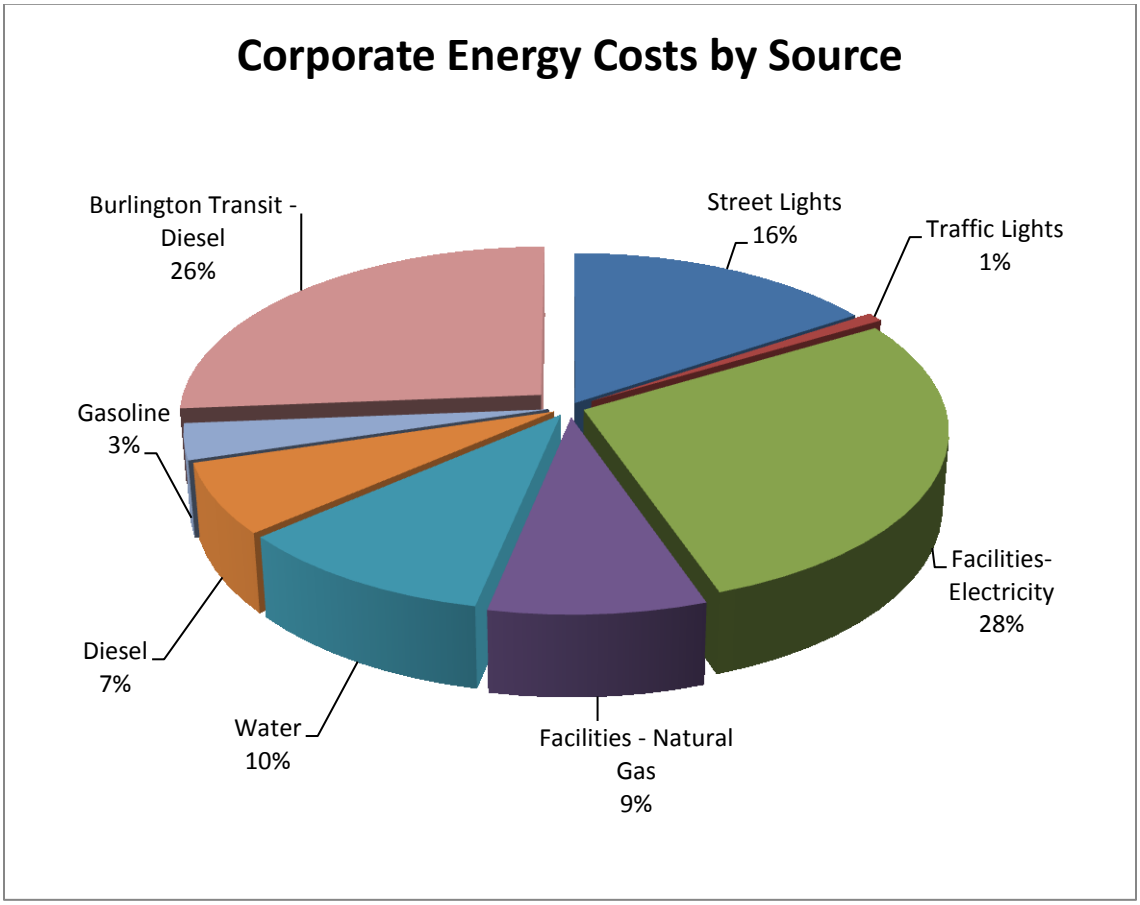
Table 2.8 below provides a detailed breakdown of the energy commodity consumption quantity and costs.

Table 2.8 Corporate energy consumption and costs for 2012

Commodity	Quantity		Cost ($)	Rate per Unit	
Electricity (kWh)					
Street Lights	9,745,000	kWh	$1,105,000	0.11	$/kWh
Traffic Lights	465,000	kWh	$60,000	0.12	$/kWh
Facilities	18,300,000	kWh	$2,000,000	0.11	$/kWh
Natural Gas (m3)	2,400,000	m^3	$605,000	0.25	$/$m^3$
Water (m3)	355,000	m^3	$735,000	2.10	$/$m^3$
Vehicle Fuel (litres)					
Corporate Vehicles (includes RPM and Fire Department)					
Gasoline	224,845	litres	$241,000	1.07	$/litre
Diesel	469,459	litres	$475,000	1.01	$/litre
Community Vehicles (Burlington Transit)					
Diesel	2,090,000	litres	$1,861,000	0.89	$/litre
		Total	$7,082,000		

Note: Numbers may not add up due to rounding

Figure 2.5 Energy cost break down by source for 2012



2.4 Greenhouse Gas Emissions

Table 2.9 provides a breakdown of total GHG emissions by sector for 2012.

Table 2.9 Corporate CO_2e emissions by source – 2012[1]

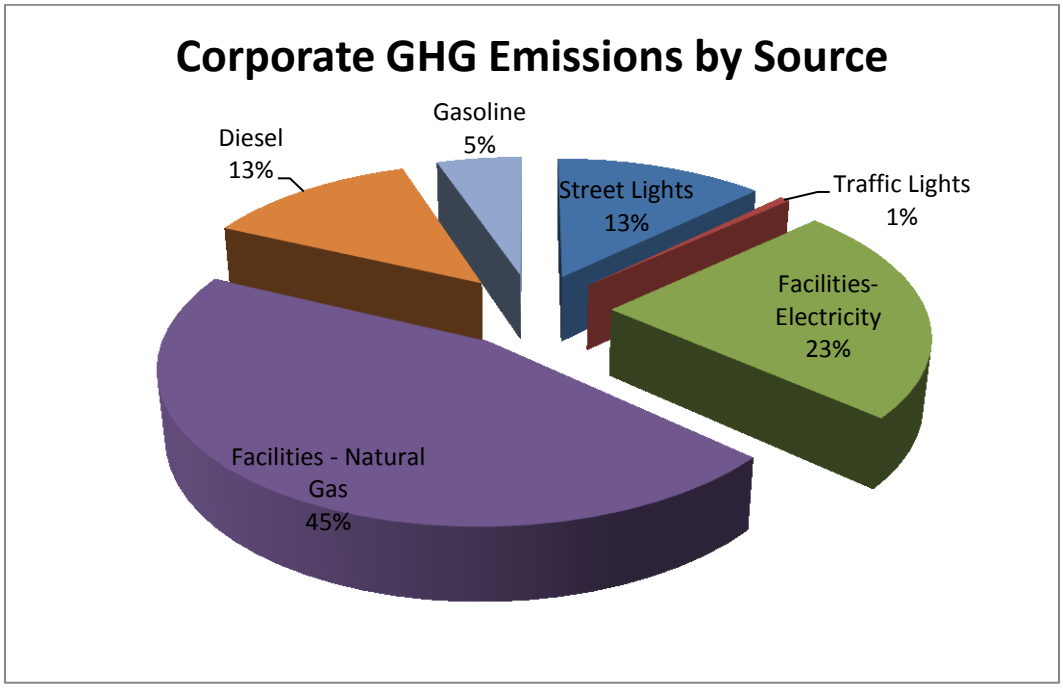
Source Category	Total CO_2e (t)
Street Lights	1,266
Traffic Lights	60
Facilities - Electricity	2,380
Facilities - Natural Gas	4,538
Corporate Fleet - Gasoline	517
Corporate Fleet - Diesel	1,284
Total	**10,045**

[1] CO_2e emissions are calculated using the Partners for Climate Protection Milestone Tool developed by ICLEI Canada (www.icleicanada.org/pcptool)

Based on the total city population of 175,779 people in 2012, the GHG emissions represent 0.057 tonnes CO_2e per person.

Figure 2.3 provides a corporate overview of the GHG (CO_2e) emissions breakdown by source for the year 2012.

Figure 2.6 Corporate GHG emissions by source – 2012



* All GHG values are CO_2e values in metric tonnes and are estimated based on best practices.
** Burlington Transit fuel emissions have not been included in the chart due to its "Community" classification under the Partners for Climate Protection Program.
*** As water commodity is supplied by The Region of Halton, GHG emissions are not incurred by the City.

2.5 Energy Procurement

City of Burlington departments work with the Halton Cooperative Purchasing Group (HCPG) in the procurement of energy commodities, including:

- Electricity
- Natural Gas
- Fleet Fuel (diesel, biodiesel and gasoline)

The Halton Cooperative Purchasing Group is dedicated to providing optimum value and resources to its member agencies and client groups through innovative and progressive cooperative purchasing. Core member agencies for the procurement of energy commodities are:

- Burlington Hydro
- Burlington Public Library (Central)
- City of Burlington
- Conservation Halton
- Regional Municipality of Halton
- Town of Halton Hills
- Town of Milton
- Town of Oakville

2.5.1 Electricity

Burlington Hydro Inc. (BHI) is the local distribution company for electricity, serving all municipal facilities. BHI is wholly owned by the City of Burlington. The City, as a member of HCPG, has procured the services of Wattsworth Analysis Inc. for all matters relating to the contracting and management of electricity supplies including establishing purchasing strategy, market intelligence on pricing, fixed price financial arrangements with suppliers, risk management, assistance on annual energy budgeting forecasting and so forth. The duration of Wattsworth Analysis' contract with HCPG is 2 years, expiring in 2013, unless renewed for additional duration by mutual agreement of the parties.

2.5.2 Natural Gas

Union Gas Limited is the local distribution company for natural gas. The city, as a member of HCPG, has procured the services of E2 Energy Inc. for all matters relating to the contracting and management of natural gas supplies including establishing purchasing strategy, market intelligence on pricing, fixed price financial arrangements with suppliers, risk management, assistance on annual energy budgeting forecasting and so forth. The duration of E2 Energy's contract with HCPG is 3 years, expiring in late 2014, unless renewed for additional duration by mutual agreement of the parties.

2.5.3 Water

Water service is provided by Halton Region and billing for water consumption is facilitated by Burlington Hydro Inc. under an agreement with the Region. Halton Region is also responsible for the collection of wastewater, treating it, and discharging it safely per provincial standards.

2.5.4 Fleet Fuel

City of Burlington departments work with the Halton Cooperative Purchasing group in the procurement of vehicle fuel. Currently, the following fuel types are utilized by the city fleet:

- Diesel
- Bio-diesel
- Gasoline

2.6 Key Stakeholders

2.6.1 Burlington City Council

City Council is comprised of the Mayor and six councillors, and has a crucial role in setting the political framework for the Energy Management Plan. Proving its commitment towards sustainable development, council approved the strategic plan *Burlington, Our Future*, and other energy and environmentally related policies presented in Section 2.2 of the plan.

2.6.2 Senior Management Team

The senior management team is responsible for creating the administrative framework and leading city staff in developing and implementing the Energy Management Plan.

2.6.3 City Staff

Numerous City staff were involved in developing the Energy Management Plan, and will help execute energy management actions across City facilities. The Energy Team is formed by the following representatives:

-	**Manager of Fleet – Roads and Parks Maintenance (liaison for Parks Bldgs)**
-	**Supervisor of Traffic Operations**
-	**Manager – Parks & Recreation**
-	**Supervisor of Operations – Pools**
-	**Supervisor of Operations – Arenas**
-	**Supervisor of Operations – Specialty Facilities**
-	**Supervisor of Operations – Community Centres**
-	**Supervisor of Operations – Joint Ventures / City Hall**
-	**Manager – Transit**
-	**Manager of Purchasing**
-	**Manager of IT Infrastructure & Operations**
-	**Deputy Chief – Fire**
-	**Director of Facilities – Libraries**
-	**Manager – Burlington Art Centre**
-	**Operation & Facility Sales Manager – Burlington Performing Arts Centre**
-	**Manager of Facility Assets – Corporate Strategic Initiatives**
-	**Coordinator of Asset Management – Corporate Strategic Initiatives**
-	**Senior Sustainability Coordinator – Corporate Strategic Initiatives**
-	**Coordinator, Project Management - Energy – Corporate Strategic Initiatives**

Appendix B presents the Action Plan Responsibility Matrix for the Energy Team.

3. Goals and Objectives

3.1.1 Vision

In early 2011, city council embarked on a strategic planning process engaging members of the community to define its vision, priorities and actions over the next four years (2011-14). The vision is defined as:

Where people, nature and business thrive

3.1.2 Goals

Consistent with the strategic plan vision, the City of Burlington Energy Management Plan establishes the following triple bottom line goals:

-	**Economy:**	**1. Manage energy costs**
-	**Society:**	**2. Support a vibrant, prosperous community**
-	**Environment:**	**3. Reduce greenhouse gas (GHG) emissions**

Commitment towards these goals will guide the **City to comply with Ontario Regulation 397/11** under the *Green Energy Act* that requires public agencies to prepare, make available and implement energy conservation and demand management plans.

3.1.3 Objectives

Implementation of the Energy Management Plan will achieve the following objectives aligned with the above goals:

1. **To create a culture of energy efficiency and sustainability**
2. **To promote sustainable use of resources through:**
• **Energy conservation**
• **Energy efficiency**
• **Renewable energy**
3. **To reduce energy operating costs through implementation of best practices and advanced technologies**
4. **To increase the comfort and safety of occupants in city facilities**
5. **To increase equipment reliability and reduce maintenance costs**

3.1.4 Targets

Concerns over sharp increases in energy prices and the negative environmental impact of fossil fuel consumption have raised interest in energy conservation, sustainability, local control and predictable energy rates.

The City of Burlington Energy Management Plan includes comprehensive actions designed to manage the city's energy use.

Using 2012 as baseline, the following targets are established within this five year EMP:

1.	**15% overall reduction of energy consumption for facilities (ekWh/ft2)**
2.	**10% reduction of water consumption for facilities[2] (m3/ft2)**
3.	**20% reduction of energy cost for facilities (adjusted for utility escalation rate)[3] ($/ft2)**
4.	**10% reduction of corporate fleet fuel consumption[4] (Litres /100 km)**
5.	**10% reduction of fire fleet fuel consumption (Litres /100 km)**
6.	**5% reduction for transit fuel consumption (Litres /100 km)**
7.	**20% reduction of electricity consumption for street lighting[5] (kWh)**

[2] This water reduction target does not include water consumption for parks irrigation and road side horticulture.
[3] The cost reduction target is greater than the above energy consumption target as a result of shifting consumption from higher cost energy (electricity) to lower cost energy (natural gas) as well as implementing demand response and load shifting from higher cost peak hours to lower cost off peak hours for electrical consumption
[4] Fleet fuel consumption target is based on the current Corporate Green Fleet Transition Strategy (2008) excluding transit.
[5] Assumes a street light retrofit program is initiated in years 4/5 of the plan subject to satisfactory business case.

4. Information System Integration

4.1 Energy Metering

For a large user of energy, the first requirement is to develop a thorough understanding of all energy consumption and associated costs. This can be accomplished with comprehensive metering, measurement and an Energy Management Information System (EMIS).

Real time management requires real time consumption data to be collected by the EMIS for analysis. This allows facility managers to react and respond to higher priced times of the day by managing energy in concert with the market. Therefore meters and EMIS must have the ability to transmit and receive real time energy data.

Advantages of real time data include:

- Identifying poor performance, thereby quickly allowing staff to correct a problem and achieve savings
- Providing a better understanding of historical operation to produce better targets and to improve activity-based costing
- Allowing for initiatives such as demand response during times of extremely high energy prices or energy reduction on smog days

The main objective of the energy data analysis and reports created by the EMIS is to identify opportunities for improvement, reduce energy consumption, control energy costs, mitigate risk, and optimize conservation and demand management.

The major steps in achieving this objective are:

1. Acquisition and installation of an EMIS
2. Installation and connection of interval meters to EMIS
3. Expansion of collected data (database) through interoperability of EMIS with existing and new information systems (refer to Section5.2 Smart Buildings)

4.1.1 Acquisition and installation of an EMIS

There are many opportunities to improve energy use efficiency by eliminating waste through process optimization. Modern computing and control equipment and techniques are among the most cost-effective and significant tools used to address this matter.

Early detection of poor performance, support for decision-making and effective energy reporting are benefits of an EMIS, making this system a key element of an Energy Management Plan.

The main goals of an EMIS are:

- Collect, store, analyze and report on energy information
- Provide enhanced management information and decision making tools to different levels of users
- Enable auditing and transparency of energy information
- Enable the implementation of corporate integration of energy management and control systems

Current Status

The city has implemented an EMIS – Energy Management Tool (EMT) from Local Authority Services, Association of Municipalities of Ontario (AMO).
The EMT can:

- Store, track and report energy usage load profiling
- Benchmark and monitor performance
- Validate the automated bill process
- Acquire and Display near real-time utility data
- Support the measurement and verification process (M&V)
- Present data in personalized online 'dashboards'
- Provide interactive reports and graphs
- Calculate weather normalized consumption information
- Report greenhouse gas (GHG) emissions
- Forecast consumption and costs for budgeting
- Measure and report demand response initiatives
- Allocate costs
- Provide flexibility for growth

Currently, the utility analysis within EMIS is based on monthly utility bills uploaded in the EMT database.

4.1.2 Installation and connection of interval meters to EMIS

Metering and measurement of energy consumption represent a key component of the overall EMIS.

City of Burlington facilities have utility meters administered by utility distribution companies as follows:

- 108 electricity accounts
- 50 natural gas accounts
- 116 water accounts

The fleet fuel inventory is managed internally by city staff.

Currently the electrical consumption at eight sites is metered with interval meters. The remaining sites are metered with smart meters installed by Burlington Hydro. Natural gas and water meters are read periodically by the utility distribution company. Fleet fuel inventories are maintained separately for the City fleet and Burlington Transit.

The process of meter installation and connection to the EMIS requires the following:

1. **Selection of the loads which need to be metered**. The preferred approach is to start with a smaller number of accounts that have a large share in the overall energy use. The EMP recommends installing real time data meters according to the following criteria:

Electricity
electric demand over 150kW
Natural Gas
ten largest accounts

   This approach offers the benefit of starting with a minimal investment and earning the capital for the next step from savings realized. Before installing new interval meters in the selected facilities, the utility revenue metering system should be considered. Usually the utility company automatically collects the metering data on 15 minute intervals.

   Sometimes a direct interface of the EMIS with the utility data collection system is possible. In this situation near real time data can be collected, processed and reported. Near real time data allows data collection every 24 hours. This option should be evaluated to determine if it is compliant with the requirements of the metering and EMIS strategy.

   If the direct interface is not possible then modifications of the utility revenue meters should be considered, by adding an interface that allows City access to meter data.

2. **Define the data required to be collected from the meters** and establish the requirements for the meter acquisition. Standardization of meters, meter functionality, wiring and ancillary equipment is beneficial as it improves the long term manageability of this equipment by reducing the common parts inventory and simplifying maintenance, operation and troubleshooting.

3. **Meter acquisition, installation and connection to the EMIS**

   Sub-metering allows for energy use accountability at the level of the end use area that has the greatest influence on operating costs. Gathering information at the system/equipment level such as energy consumption, thermal performance, output from renewable energy systems will allow in-depth analysis that can evaluate equipment performance and develop predictive maintenance routines for the asset management program.

Selection of the facilities to be sub-metered will be based on the energy intensity load and will target the greatest consumers where the opportunities for energy savings are substantial.

Current Status:

Currently the city is investigating with LAS the technical options for integrating selected facility meters within the EMIS in order to allow real time utility data readings.

Next Steps:

The next steps are:

- Select technical solution for meter integration with EMIS
- Define meter specifications
- Install and connect meters at facilities having the following characteristics:
  - Electric demand over 150kW
  - Ten largest natural gas consumers

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q5 - 2015	73,000	4986.50	14.64	13.5	Measure is included in Table 7.2 recommendation "Building Automation".

4.2 Smart Buildings

A smart or intelligent building integrates building systems (Heating Ventilation Air Conditioning, Lighting, Security, EMIS, Elevator/Escalators, etc.) in order to reduce energy consumption, environmental impact and make the building as efficient as possible.

Intelligent buildings provide:

- Optimal lighting level
- Reduced energy use
- Increased security
- Increased efficiency
- Operational and energy cost savings

This EMP recommends the comprehensive system integration for all new facilities and major retrofit projects. The following systems should be included:

Core energy related systems:
EMIS
Building automation systems (BAS)
Lighting controls
Ice plant controls
Pool equipment controls
Auxiliary energy related systems:
Security & access control
IT network
Facility booking system (Class Software)
Asset management systems (Avantis, VFA Software)

Current Status:

Currently, the city has initiated the integration of lighting system controls with the Building Automation System (BAS). Ice plant controls integration at the corporate level is under investigation with the system suppliers.

Next Steps:

The next steps are:

- Complete ice plant controls integration
- Define integration specifications for new buildings or major retrofit projects

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q5 - 2017	143,976	19,946	7.22	54	Ice plant controls integration is included in Table 7.2 recommendation "Building Automation" along with other building controls recommendations of the energy audits. Integration specifications are to be developed by Corporate Strategic Initiatives staff.

4.3 Key Performance Indicators

Designing the Energy Management Information System (EMIS) starts by defining the set of measurements required to monitor progress in achieving the goals of an EMP. These measurements are called Key Performance Indicators (KPI).

The following KPIs are considered to support the key objectives set through the EMP and their implementation is scheduled in three annual phases:

KPI	Unit	Implementation
Energy Utilisation Index (EUI)	ekWh/ft^2, ekW/ft^2,ekWh/user/yr	Year 1
Total Energy Cost Intensity (ECI)	\$/ft^2/yr	Year 1
Renewable Energy Use Intensity	ekWh/m^2 and ekW/ft^2/yr	Year 1
GHG Footprint (facilities)	Annual CO_2e/ft^2	Year 1
Fleet Fuel Efficiency	litre/100km	Year 1
Employee Awareness Index	Hours of training/employee/year	Year 2
Reliability	Duration of interruption hr/year	Year 3
Occupant Satisfaction Index	% increase	Year 3

These KPI's would be reviewed annually to evaluate their effectiveness in advancing the key objectives and modified accordingly.

4.4 Monitoring and Targeting

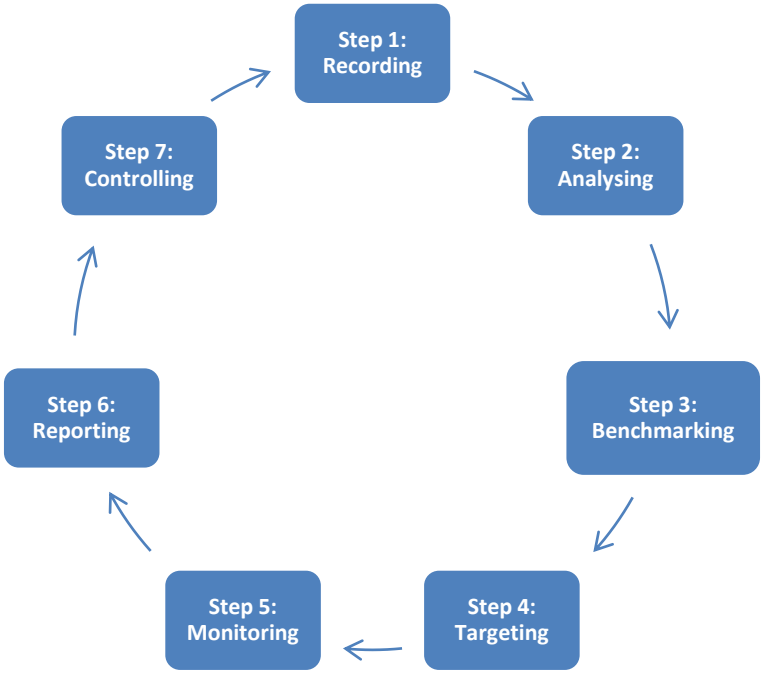
Monitoring and Targeting (M&T) is an energy efficiency technique built on the principle that it is impossible to manage what cannot be measured. M&T helps control and reduce the energy use and improves the existing operating procedures.

Monitoring focuses on the existing pattern of energy consumption while targeting identifies a desirable consumption level as the energy conservation goal.

The steps of the M&T process are:

- **Step 1: Recording** (Measuring and recording energy consumption)
- **Step 2: Analysing** (Correlating energy consumption to a measured output)
- **Step 3: Benchmarking** (Comparing energy consumption to an appropriate standard)
- **Step 4: Targeting** (Setting targets to reduce energy consumption)
- **Step 5: Monitoring** (Comparing energy consumption to the target)
  Involves observing consumption patterns and making day to day operational adjustments to energy consuming equipment as required to satisfy requirements. This increases energy use knowledge and contributes to achieving targets.
- **Step 6: Reporting** (Reporting results including variances from the targets)
- **Step 7: Controlling** (Implementing energy efficiency measures to correct variances)

Figure 4.1 Visual representation of the M&T process



A phased approach of the M&T implementation process for city facilities is recommended for the following benefits:

- Simplified initial installation
- Lower initial capital cost
- Allows for process improvement based on the experience gathered during original installation

4.4.1 Phase 1 - Building Level (BL)

- Phase 1 M&T activities will focus on the larger energy consumers, those facilities identified under the Energy Metering section
- Each facility will be individually analysed based on the energy information and reports provided by the EMIS
- Energy Utilisation Index (ekWh/ft^2) will be used as a benchmarking metric (KPI)
- Targets will be set at the building level – they can be set specifically for each building or as a general rule (i.e. 3% energy intensity reduction/year)
- Facilities will be monitored and variances will be reported
- Energy efficiency measures will be implemented to help achieve the targets

4.4.2 Phase 2 - System and Equipment Level (SEL)

While M&T in phase 1 measures, analyses and sets targets for the total energy used at the building level, the M&T process in phase 2 focuses on energy reduction at the system/equipment level in the facilities identified as candidates for real time meter installation.

Examples of a system include a chiller plant, boiler plant, lighting, domestic hot water, refrigeration plant, compressed air system, or a roof top unit.

The M&T at the system/equipment level involves a systematic, disciplined division of the facility into Energy Cost Centres (ECC). Each ECC represents the energy used by a system/equipment. This phase cannot be implemented if the sub-metering process does not take place.

The utilities used in each energy cost centre are closely monitored, and the energy used is compared with the industry standard. Once this information is available on a regular basis, targets can be set, variances can be described, and remedial actions planned and implemented.

4.4.3 Phase 3 – Short-term M&T for Troubleshooting

When Phase 1 or 2 M&T identifies discrepancies that cannot be clearly explained by the available data, further investigation is required. Under Phase 3 M&T, temporary measurement is installed to collect data deemed necessary for understanding the energy use pattern and identify corrective actions.

Examples of measurement devices include power meters with data logging capability, indoor air quality analysers and air velocity meters.

Current Status:

Following the implementation of the EMIS, the city team will develop the framework for performing M&T at the building level. Staff are familiar with this process after recently completing M&T on some building systems and large equipment in the City Hall chiller plant and the Appleby Arena A plant.

Next Steps:

The next steps are:

- Continue the M&T activities at building level based on the EMIS and expand the analysis as real time data becomes available
- Develop M&T for all large building systems and equipment, based on BAS information
- Plan M&T for troubleshooting where required

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2014	(If required) from facility operations budget	40,622		96.5	Measure is consolidated in Table 7.2 recommendation "Training and Awareness".

5. Energy Communication Plan

The EMP budget includes funding for launching energy awareness and energy training activities during the first year of implementation. For the following years, these activities will be funded by energy savings achieved.

5.1 Energy Awareness

The key to creating an organizational culture of energy efficiency and sustainability is to embed it into the corporate culture through ongoing communication and training. Even though energy-efficient buildings are healthier places to work and can increase the comfort and productivity of employees, the efforts to adopt energy-efficient equipment together with better operations and maintenance practices can be challenging.

Creating and implementing an energy awareness program is crucial to promote energy efficiency as a core corporate value. The ultimate goal of the EMP is to motivate people to actually modify their behaviour and their mindset, so that energy use is reduced over a period of time.

One way to engage facility operators in reducing energy consumption in their facilities is to organize an annual competition aiming to reduce energy consumption. In order to be able to compare the results, similar facilities would be grouped together (for example, arenas, pools, community centres, and fire stations). The winner in each category will be selected based on the KPI analysis.

The following items are steps to develop and implement a successful energy awareness program:

5.1.1 Establish a direct relationship between the organization's vision and EMP

The City of Burlington's vision as defined in the Strategic Plan 2011-2014:

Where people, nature and business thrive

Energy Management activities are key factors in sustaining the city's vision. Most people are unaware of how their everyday actions and activities at home and work affect energy use and impact the environment. An energy awareness program will help them identify their roles and responsibilities in supporting the city's vision.

5.1.2 Gain management support

Usually managers not directly involved in energy management are not aware of how energy use affects the organization. Increasing the awareness of managers can help to build support for energy management initiatives.

5.1.3 Create a corporate energy team

The energy team is comprised of representatives from all organization's layers and key departments. The energy team's mandate is to ensure implementation of the EMP by promoting and communicating the City's energy initiatives, energy use and savings, by providing input, and integrating energy policies and initiatives into city departments.

Key team members should be:

- **Manager of Fleet – Roads and Parks Maintenance (liaison for Parks Buildings)**
- **Supervisor of Traffic Operations**
- **Manager – Parks & Recreation**
- **Supervisor of Operations – Pools**
- **Supervisor of Operations – Arenas**
- **Supervisor of Operations - Specialty Facilities**
- **Supervisor of Operations - Community Centres**
- **Supervisor of Operations - Joint Ventures / City Hall**
- **Manager – Transit**
- **Manager of Purchasing**
- **Manager of IT Infrastructure & Operations**
- **Deputy Chief – Fire**
- **Director Facilities – Libraries**
- **Manager – Burlington Art Centre**
- **Operation & Facility Sales Manager – Burlington Performing Arts Centre**
- **Manager of Facility Assets – Corporate Strategic Initiatives**
- **Coordinator of Asset Management – Corporate Strategic Initiatives**
- **Senior Sustainability Coordinator – Corporate Strategic Initiatives**
- **Coordinator, Project Management - Energy – Corporate Strategic Initiatives**

5.1.4 Design and implement the Awareness Program

- Gather input from employees to develop program content (refer to Appendix C for initial results of the EMP Self-Assessment Tool)
- Identify the desired behaviours/actions and identify ways to motivate employees to take these actions (incentives and awards)
- Identify the communications channels to be used to convey the desired information (for example, FOCUS Magazine, City Talk, COBNet, or other presentations, posters, and videos)

- Select the activities/methods to distribute the messages/information (new employee orientation programs, Earth Day events, Intra and Internet sites and summits).
- Select appropriate energy management messages such as "Energy management involves everyone!"
- Develop a schedule based on a specific timeframe (e.g., one fiscal year) for the development and implementation of the program
- Produce visuals, products, and materials and conduct activities

5.1.5 Evaluate the achieved results

- Gather feedback on the program's effectiveness through surveys, results analysis, dialogues with city employees
- Document the energy and water savings. Share results based on measures implemented and employee achievements. The Energy Team will create and maintain an In-House Technical Database of Best Practices

5.1.6 Adjust and improve the process

- If the achieved results are not as expected, find opportunities to enhance the strengths and minimize the weaknesses of the program
- Publicly recognize employee accomplishments while continuing implementation of the incentives and reward programs
- Recruit new team members and conduct regular meetings with the team. Continue to plan the program into the next year

Current Status:

Using results obtained through utility analysis at building level, case studies were prepared for successful initiatives (for example, Brant Hill CC, Fire Station 4 Heat Recovery Unit).

Next Steps:

The next steps are:

- Continue to identify best practice case studies to be presented to city staff
- Develop a questionnaire to measure user awareness and satisfaction

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q2 - 2015					Corporate staff would be performing the work with the energy team (Appendix B). External consulting peer review may be required (Estimated $ 5,000 cost).

5.2 Energy Training

Training helps staff understand the importance of energy performance providing the information necessary to make informed decisions. It also provides an excellent opportunity for gathering employee feedback and evaluation.

Training will aim to achieve two objectives:

1. Develop skills and knowledge of equipment operation and new technologies
2. Develop new attitudes toward energy waste and waste reduction

The staff training will be performed at three levels:

- Management
- Engineering/Technical/Supervisory
- Operators

The following matrix depicts the type of training and objectives at each level.

Organization Level	Type of Training	Objectives to Accomplish
Management	- Awareness of energy conservation opportunities - Familiarity with reporting and presentation of information - Evaluation of progress	- Acquire the insight into energy cost drivers and efficiency - Provide support in EMP implementation - Provide guidance, motivation and encouragement to city staff
Engineering, Technical, Supervisory	- New technology and energy efficiency - Awareness of energy conservation opportunities - Familiarity with reporting and presentation of information - Evaluation of progress	- Become familiar with new energy efficient technologies - Provide operator training - Train staff to initiate and present energy conservation proposals to senior management
Operators	- Technical knowledge of systems and equipment they operate: pumps, boilers, chillers, roof top units, electrical, thermal systems, vehicles, - Maintenance - Reduction of loss/waste - Operating procedures for energy efficiency - Awareness of energy conservation opportunities	- Operate systems and equipment more efficiently - Reduce operating costs - Participate effectively in preventive maintenance plans - Learn the culture of efficiency - Become more proactive than reactive

As the training program is implemented, energy performance measures will be included in performance evaluations for facility operations staff.

Current Status:

During the development of this EMP, the self-assessment completed by city staff (energy team listed in section 2.6.3) revealed the need for staff training in energy management and facilities operation. Consequently, four training sessions were organized that covered technical operations, as well as supervisory actions for the following target groups:

- Arena operations staff
- Community centre, library, pools, specialty facilities operations staff
- City hall operations staff, Joint Venture staff, other corporate staff
- Operations centre, transit, fire stations operations staff

Next Steps:

The next steps are:

- Develop an energy related training program to be implemented for operators, supervisors and managers

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q2 - 2015	72,900	40,622	1.79	96.5	Measure included in Table 7.2 recommendation "Training and Awareness).

5.3 Measurement and Verification

The primary purpose of measurement and verification (M&V) is to validate that time, effort and money invested to reduce energy usage in buildings achieves the expected results. This is accomplished by accurately determining the savings generated from any type of energy efficiency project, including major renovations, retrofits, facility improvements, and operational and behavioural changes.

It is important to design the M&V plan based on the scope of the corresponding energy efficiency project. The most recognized M&V guide or standard in the industry is the International Performance Measurement and Verification Protocol (IPMVP)[6].

Current Status:

Currently, achieved energy savings are measured at the facility level on an annual basis.

Next Steps:

The next steps are:

- Develop M&V guidelines to be included in all projects that target energy savings

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2013					Corporate Strategic Initiatives staff would be developing the guidelines. M&V results in confirming that estimated project energy savings are being achieved.

[6]IPMVP is an international measurement and verification standard for energy and water efficiency investments. Itprovides an overview of current best practice techniques available for verifying results of energy efficiency, water efficiency, and renewable energy projects in commercial and industrial facilities. It may also be used by facility operators to assess and improve facility performance. The standard is freely available at: http://www.evo-world.org

5.4 Reporting

Energy management reports are designed to provide each group of stakeholders with the information required for successfully performing their role in the implementation of the Energy Management Plan. The level of data aggregation increases as the reports are addressed to a higher level in the decision making process.

The following reports will be generated by the EMIS:

	Timeline
Summary of annual energy consumption and GHG emissions as required by O.Reg 397/11	July 2013 and every year thereafter
Energy conservation and demand management measures as required by O.Reg 397/11	July 2014 and every 5 years thereafter
Council update reports	Annually – ongoing
Energy dashboard / KPIs	December 2013
Stakeholder level custom reports	As required

6. Facility Operations

6.1 Building System Documentation

The current status of building documentation varies significantly amongst city facilities, from complete building manuals with as-built drawings and systems/equipment specifications, to no information available.

As part of the EMP implementation, building operating manuals will be prepared for all city facilities.

All new facilities and existing facilities with large energy consumption (selected for real time data metering) will have complete building manuals including:

- As-built drawings (architectural, structural, electric, mechanical)
- Equipment schedules and corresponding specifications
- Equipment O&M manuals
- Energy model
- Operation procedures

All remaining facilities will have building manuals including existing available information. Information for any new additions or retrofits will be consistent with the requirements listed above.

In order to ensure that accurate and complete documentation is available, a transition towards an interactive electronic document management system will be initiated.

Current Status:

Currently, the city stores available building information on the corporate network:

S:\Common\Building Operating Manuals

Next Steps:

The next steps are:

- Develop complete building operating manuals, using information provided by each department

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2015					Complete documentation results in lower operational and maintenance cost savings. The next steps would be completed using facility operating budgets.

6.2 Operation Procedures

Standard operation procedures will be developed for major electrical and mechanical systems in similar facilities (arenas, pool, libraries, etc.). These operation procedures will allow the optimization of building systems and easy transfer of knowledge between facility operation personnel.

6.3 Maintenance Program

Monitoring energy use through the EMIS will assist with identifying anomalies in building performance. Individual meter testing on equipment can also assist with equipment diagnostics and troubleshooting.

By recording energy use for equipment parameters, the EMIS can identify hydro peaks and abnormal energy consumption. Regular maintenance work orders can be issued to monitor and correct the performance of the equipment before the equipment fails, increasing reliability and flexibility in planning for replacement.

At the same time, maintenance work orders can trigger the implementation of energy conservation measures. For example, a work order can be issued for a scheduled pump replacement, but can also include installation of a high efficiency motor with variable frequency drive (VFD).

Maintenance Management Software Tool - AVANTIS

Current Status:

Currently, the Avantis maintenance management software is being updated with current Parks & Recreation facility asset data. Some Preventative Maintenance triggers have been set up. Asset identification labels (Avantis tag numbers) have been applied to Parks & Recreation facility assets.

Next Steps:

- Test triggers for scheduled PMs
- Run reports
- Update remaining corporate facility asset data into the Avantis software
- Complete remaining preventative maintenance work order triggers
- Analyse results and modify maintenance program as required

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2015					The initiative would be completed using facility operating budgets.

7. Energy Conservation in Existing Facilities

7.1 ENERGY STAR® Portfolio Manager

Portfolio Manager is an interactive energy management tool that allows you to track and assess energy and water consumption across an entire portfolio of buildings in a secure online environment. Whether an organization owns, manages, or holds properties for investment, Portfolio Manager can help set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive recognition for superior energy performance.

The ENERGY STAR® tool will offer a starting point in benchmarking City facilities until enough data is collected by the EMIS.

Next Steps:

The next steps are:

- Upload utility data on ENERGY STAR® Portfolio Manager for City Hall as a pilot case.
- Further evaluation of the program for additional facilities would be completed based on pilot results.

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2013					Corporate Strategic Initiatives staff resources would be utilized for the work. The ENERGY STAR® program is funded by the Federal Government – no cost to the City.

7.2 Building Retrofit Actions:

As part of the energy management process, energy audits were completed in 51 city facilities. The audit reports identified energy conservation measures grouped in the following categories:

- Building envelope
- Lighting systems and controls
- Mechanical systems
- Electrical systems
- Building automation
- Water systems
- Training and awareness

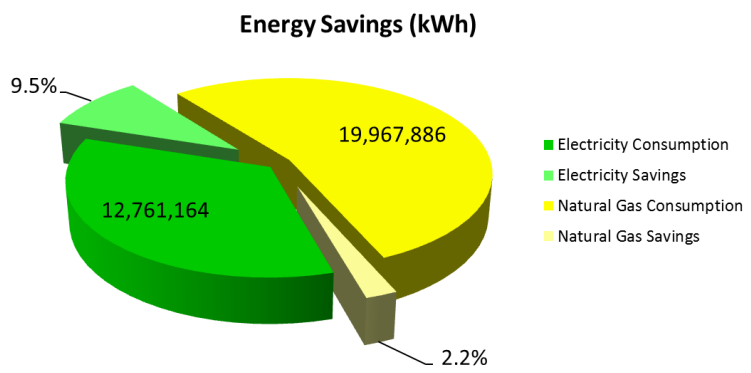
Utility savings for electricity, natural gas and water are presented in Table 7.1. Also the total energy savings and greenhouse gas emissions are calculated for each category of energy retrofit measures.

Table 7.2 presents the overall energy retrofit program identified in the audited facilities.

Table 7.1 Annual energy retrofit savings in buildings

MEASURE CATEGORY	ANNUAL UTILITY SAVINGS				
	ELECTRICITY (kWh/yr)	NATURAL GAS (m^3/yr)	WATER (m^3/yr)	ENERGY (GJ/yr)	EMISSIONS (tCO_2/yr)
Building Envelope	64,100	51,339	-	2,153	109
Lighting	1,640,948	(60,569)	-	3,640	216
Mechanical Measures	187,650	52,399	-	2,637	136
Electrical Measures	866,400	(16,441)	-	2,503	143
Building Automation	149,620	12,684	-	1,014	54
Water Conservation	-	-	19,700	-	-
Training and Awareness	601,800	38,350	2,000	3,602	193
Total	**3,510,518**	**77,761**	**21,700**	**15,549**	**852**

The pie charts below represent the energy savings from Table 7.1 as a percent of the overall current commodity usage:



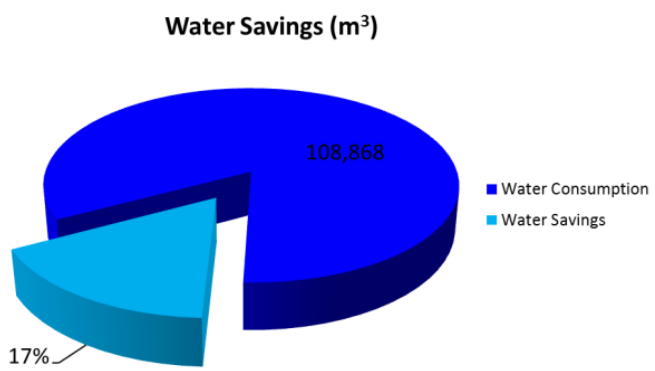
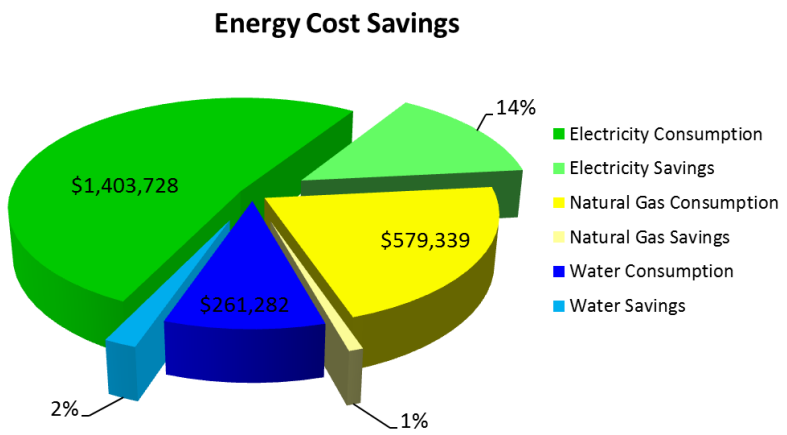
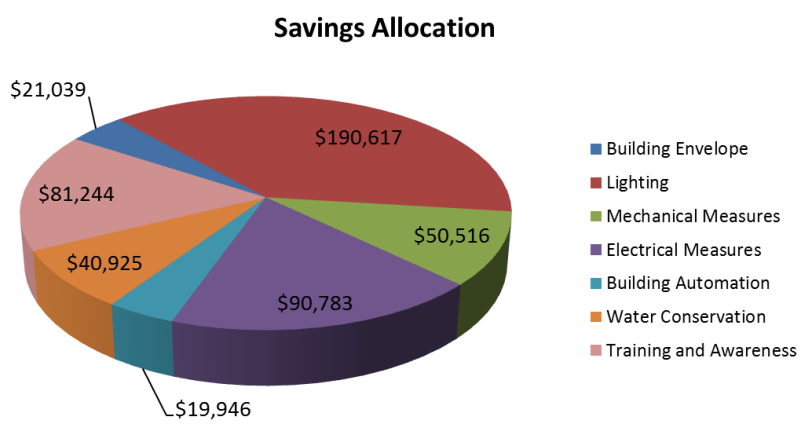


Table 7.2 Energy retrofit program in audited facilities

ENERGY CONSERVATION MEASURES	TOTAL ANNUAL SAVINGS[7]	TOTAL COST	INCENTIVES	SIMPLE PAYBACK
	($)/yr	($)	($)	(yr)
Building Envelope	$21,039	$250,668	-	11.9
Lighting	$190,617	$1,619,114	$84,872	8.0
Mechanical Measures	$50,516	$757,188	$18,000	14.6
Electrical Measures	$90,783	$443,824	$86,640	3.9
Building Automation	$19,946	$143,976	-	7.2
Water Conservation	$40,925	$256,640	$198	6.3
Training and Awareness	$81,244	$72,900	$17,000	0.7
Total	**$495,069**	**$3,544,310**	**$206,710**	**6.7**

Figure 7.2 Estimated energy $ cost savings by energy commodity and retrofit measure





[7] Energy cost savings are calculated using the following utility rates:

- Electricity $0.11/kWh (blended rate - includes consumption rate and demand charge)
- Natural Gas $0.25/m^3
- Water $2.10/m^3

Implementing energy conservation measures identified within the energy audits is a **key** element of the EMP implementation.

Next Steps:

The next steps are:

- Schedule energy retrofit measures implementation according to building priority and funding available for each year of the EMP
- Coordinate capital retrofit measures recommended in the EMP with the corporate facility capital improvements funding available for each year of the EMP.
- Initiatives to be reviewed and presented with the Capital Budget annually.

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Timeline based on approved funding					Complete information on the steps is available in Table 7.1 Table 7.2.

7.3 Retro-commissioning

Retro-commissioning involves applying the systematic commissioning process to existing buildings in order to improve performance of building systems.

The following list provides some guidance for selecting buildings for retro-commissioning.

- High energy-use index, based on the KPI analysis
- Persistent failure of equipment and/or control system
- Occupant complaints

Retro-commissioning is one of the most cost-effective methods of improving building energy efficiency, as it relies less on new equipment that requires capital costs and more on returning equipment operation to the initial performance.

One particular opportunity for completing a retro-commissioning process is to include it in the scope of work for any capital project scheduled in City facilities (most relevant ones are mechanical and building automation systems upgrades).

Current Status:

Currently, the utility analysis performed with the EMIS identifies opportunities for energy efficiency improvements in several city facilities.

Next Steps:

The next steps are:

- Plan a retro-commissioning process for a corporate facility
- Develop a corporate wide plan for retro-commissioning facilities that show an increasing energy consumption trend over time, in consideration of the future facility utilization plans and facility condition index (FCI)

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2014			Typically between 1 to 5 years based on facility condition and end use.		Energy team led by Corporate Strategic Initiatives staff would plan the retro commissioning process.

8. New Construction

Since January 1, 2012, new construction projects must conform to the enhanced energy efficiency requirements of Ontario's Building Code. The applicable standard is SB-10/July 1, 2011, which is referenced in the Building Code.

This Supplementary Standard indicates that the energy efficiency levels of these buildings can be achieved by exceeding the energy efficiency level of the 1997 Model National Energy Code for Buildings by 25 per cent or by exceeding ASHRAE 90.1-2010 by 5 per cent, or by meeting the prescribed modifications to ASHRAE 90.1 that are set out in the SB-10. These options are all compliance paths that meet the requirements.

The City of Burlington's Corporate Sustainable Building Policy requires a Silver LEED® rating for new corporate facilities greater than 500 m^2 or major retrofits.

As part of implementing the EMP, an Energy Team representative will be included in the project team for all new corporate facilities or major retrofits, as well as other major energy consuming assets, such as street lighting.

Current Status:

Currently, the city requires a Silver LEED® rating for new corporate facilities greater than 500 m2 or for major retrofits. LEED® rated buildings can present opportunities for energy efficiency improvements when their Energy Utilization Index (EUI) is compared with the design phase energy model, based on the utility analysis performed for the first years of operations

Next Steps:

The next steps are:

- Develop standard energy performance specifications based on ASHRAE 90.1 and ASHRAE 189.1 standards to be included in the design of all new construction

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2014					Standard specification to be developed and included in new construction projects as part of the project design process.

9. Renewable Energy

Although energy conservation and improving energy efficiency will be the main focus of the EMP, sustainable buildings can include renewable energy technologies to further reduce greenhouse gas emissions.

The following technologies are considered in the EMP:

- Passive heating and cooling technologies
- Ground source heat pumps
- Solar water heating, solar air heating, solar photovoltaic

The energy retrofit programs recommended for each of the audited facilities list opportunities for renewable technology installations. Existing renewable energy installations include:

Tansley Woods Community Centre solar pool water heating system

- Fully operational since mid-2010, the 90 solar collector panel water heating installation, with a total capacity of 325 kW, was the largest in Canada at the time of construction, based on Natural Resources Canada's data
- The system provides up to 25% of the energy required to heat the pool water
- The system contributes to avoiding approximately 67.5 tons of greenhouse gases (GHG) emissions every year.

Fire Station 8

- Designed for LEED® Silver certification and at least 25% more energy efficient than Model National Energy Code for Buildings (MNECB), the facility has implemented
  - 10 kW sun tracking electricity generating solar panels
  - Solar wall for heating incoming fresh air and avoiding natural gas use

Current Status:

The City has implemented pilot installations of solar heating and photovoltaic systems and actively supports community projects for renewable energy.

Next Steps:

The next steps are:

- Monitor available technology and market conditions to investigate the economic feasibility of renewable projects
- Report on existing pilot projects
- Investigate renewable energy measures for new construction projects

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Ongoing					Reporting on existing pilot projects to be completed by Q4 - 2014. Ongoing monitoring and investigation.

10. On-site Generation and Demand Response

Most municipal facilities require electricity and natural gas for satisfying heating, cooling and power loads. Some require power and heating or power and cooling at the same time.

In addition, several City facilities have stand-by generators for emergency power. The EMP will investigate opportunities for combined heat and power applications that result in significant increase of the overall building efficiency.

The following actions are considered in the EMP implementation:

- Micro combined heat and power (facilities with coincident requirements for power and/or heating/cooling)
- Combined heat and emergency power (stand-by generators over 50kW)
- Thermal storage (pools and arenas)
- Load shift optimized based on price signal (buildings over 150kW demand)

Current Status:

Several city facilities have diesel-fueled stand-by generators for emergency power.

Next Steps:

The next steps are:

- Monitor available technology and market conditions to investigate the economic feasibility of on-site generation projects
- Investigate fuel switching to natural gas fuelled generators for new construction and generator replacement projects

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Ongoing					

11. Corporate Fleet Energy

The city approved the Corporate Green Fleet Transition Policy in 2008. This policy included actions in the following categories:

- Rightsizing fleet vehicles
- Hybrid technology
- Alternative, cleaner fuels
- Vehicle maintenance
- Driver training
- Smart commute

In order to be consistent with the EMP, it is recommended that the Green Fleet Transition Policy is updated as well.

In addition to the fleet transition policy, Idling Control By-law 27-2009 was approved by council which prohibits unnecessary idling of vehicles within the City of Burlington including city fleet vehicles.

Current Status:

As the City continues to right size fleet vehicles and utilize hybrid vehicles where feasible, the overall fuel efficiency of the fleet will increase. The target included in the EMP is 10% reduction of corporate fleet fuel consumption.

Next Steps:

- Complete existing initiatives under the Green Fleet Transition Strategy 2008
- Complete fire fleet support vehicle replacement with new energy efficient vehicles by 2013 year end
- Revise the Green Fleet Transition policy

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
TBD	Existing departmental capital funding				Green Fleet Transition policy to be revised per Council direction.

12. Burlington Transit Fleet Energy

Burlington Transit has committed to actively support the overall community impact on the environment through a number of initiatives:

- Use of ultra low sulphur diesel fuel and eco friendly refrigerant for air conditioning
- Use of recycled oil products – transmission and engine
- Reclaim/recycle oil and antifreeze
- Recycle used parts from retired buses such as tires, rims, and batteries
- Use non-asbestos friction materials
- Use graphic film for striping and decals in lieu of paint on our buses
- Dispose of oil filters through an environmental agency
- Install biodegradable garbage bags on the buses
- Convert and upgrade the fleet to dry cell batteries
- Convert and upgrade buses with LED lights
- Introduce diesel engine emission regen systems on all new buses purchased
- Reduce bus idling from 10 minutes to 5 minutes
- Installation of bike racks on buses
- Use of biodegrable cleaning products for the fleet
- Eliminate use of aerosols containing fluorocarbons or trichloroethane
- Use of radial tires and aluminum rims for increased tire life, fuel efficiencies, and reduced rubber disposal
- Pre-charge vehicle air systems prior to starting to minimize vehicle run time
- Introduce hybrid supervisory vehicles

Current Status:

Burlington Transit is currently taking measures to limit increases in fuel consumption by:

- Smart driver training program to maximize engine efficiency/fuel usage
- Anti-idle policy, along with three minute engine idle shut down
- Reduction of deadhead/non-revenue travel

Next Steps:

The next steps are:

- Continue implementation of current initiatives
- The next delivery of buses with electric cooling fans instead of hydraulic cooling fans will arrive in 2015 and the result in reduction in fuel usage will from 2016 onwards.

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2015	Existing departmental capital funding				

13. Street Lighting and Traffic Lights

Significant energy reduction in street lighting is possible through the conversion of the city's existing High Pressure Sodium (HPS) street lights to LED technology. Street lighting in the city currently consumes approximately 9,745,000 KWh of electricity annual at a cost of approximately $1.1 million. LED technology can deliver energy savings of 50 to 70% when compared with the consumption of the city's existing HPS lights. The LED fixtures also have a much longer life reducing maintenance costs on bulb replacement cycles. Total annual operating cost savings for converting to LED technology would be in the order of $550,000/yr. However, the capital cost of a replacement program is significant, likely in the order of $5 to $7.5 million, and will require additional analysis in the preparation of a business case to support the program. There are also design issues that will need to be addressed due to the different nature of the light from these two sources. The city's Engineering department is currently undertaking a review of the city's street light design standards including an assessment of LED technology. Alternative financing arrangements for implementation may also be possible through energy performance contracting and will need to be evaluated further prior to any decision to proceed.

Current Status:

Street lighting staff are in the process of inventorying our street light assets. Current street lighting fixtures power rating is between 70 - 200W, with a few 400 W fixtures as well.

City Street Lighting Design manual is being updated, including assessment of LED lighting.

All existing traffic signals have been converted to LED.

Next Steps:

- Complete inventory of street light assets
- Complete update to street light design manual
- Prepare business case including financing alternative for retrofit program

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2017	TBD				

14. Corporate Energy Conservation Culture

Higher energy costs as well as increased awareness regarding our impact on the environment resulted in increased priority for energy related decisions. The energy audits completed as part of developing the EMP identified opportunities for improving energy efficiency of building systems, and the EMP includes recommendations for capital funding allocated for implementing energy conservation measures.

However, the implementation of these building upgrades is heavily dependent on the commitment to building a culture of energy conservation that will modify building occupants' behaviour towards energy conservation.

14.1 Operations Staff Training

In order to improve their energy performance, buildings today include more advanced technologies. In this context it is necessary that the building operators have a thorough understanding of mechanical and electrical systems in the building, as well as energy efficiency strategies and actions.

Continuously updating the technical knowledge of building operators is a critical component of implementing an energy retrofit program and sustaining its savings. Therefore, energy training and awareness is identified as a key area of the City of Burlington Energy Management Plan (EMP).

This component of the EMP is designed to support building operators in providing the level of indoor comfort desired for occupants and become energy champions in their building.

14.2 Energy Awareness

Although building operators are expected to take a lead role in championing energy efficiency in their building based on their technical knowledge, a successful energy retrofit program requires buy-in from other City staff and visitors.

Choosing the right communication vehicle, the following information can increase awareness towards energy efficiency:

- Energy utilization index
- Energy reduction target
- Building system upgrades
- Monitoring progress towards target
- Expectations from City staff and visitors

Current Status:

Annual energy consumption reports are prepared based on utility billing data and distributed to City departments. Building operators attend technical training related to new systems, or when deemed necessary for the City.

Next Steps:

The next steps are:

- Create an annual training program for building operators
- Include building energy performance in the annual performance review for relevant staff
- Design facility performance updates for general public and occupants

Next Steps Complete By	Cost ($)	Annual Energy Savings ($)	Payback (years)	GHG Emissions Avoided (tCO2/year)	Comments
Q4 - 2015	As required from facility operations budget	40,622		96.5	Measure is consolidated in Table 7.2 recommendation "Training and Awareness".

15. Financial Considerations

15.1 Incentives

Several external incentive programs exist to support the implementation of energy conservation and efficiency measures. The following current incentives are applicable to fund EMP actions:

- Ontario Power Authority (SaveOnEnergy)
- Union Gas (demand side management)
- NRCan (ecoENERGY)

SaveOnEnergy

	Prescriptive Measures	Engineered and Custom Measures
Lighting	Per unit incentives	The greater of either, $400/kW of demand savings or $0.05/kWh of first year electricity savings
Non-lighting Including Lighting Controls	Per unit incentives	The greater of either, $800/kW or $0.10/kWh of first year electricity savings

Union Gas

Union Gas helps fund workshops and seminars and provides newsletters and access to technical information that can help consumers improve their energy efficiency and save natural gas.

In addition, rebates and incentives are available for the following measure categories:

- Space heating programs
- Water heating programs
- Engineering projects

NRCan

At this time, NRCan does not offer any grants or incentives directly related to energy savings. However, a portfolio of information tools and training are available to further support energy efficiency efforts. This can be a useful asset for the operations staff training component.

15.2 Funding of Energy Projects

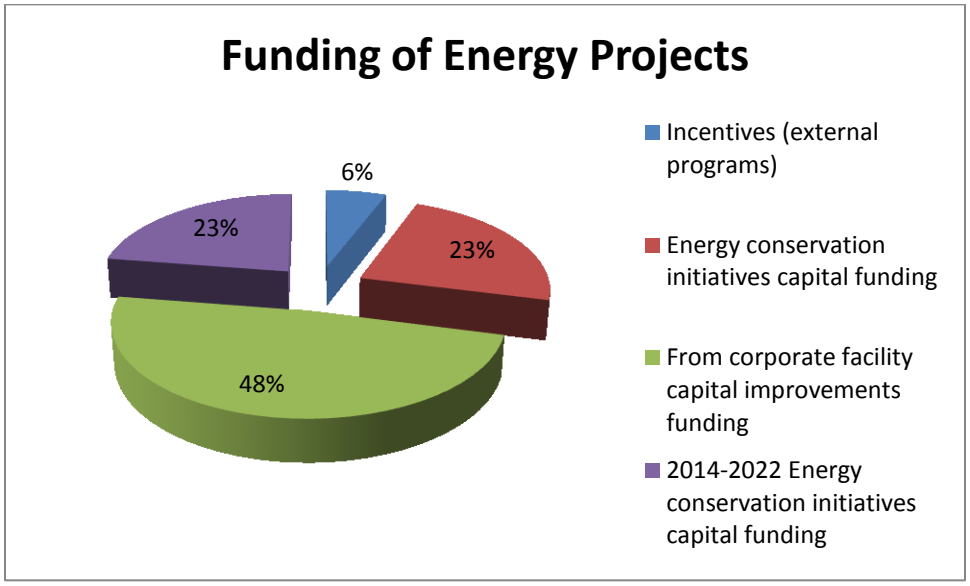
If all the energy retrofit measures identified for City facilities through the energy audit process were implemented, the total 2012 estimated cost would be $3,544,310.

Table 13.1 presents the possible allocation of project funding from different sources.

Table 13.1 Funding contributions for energy projects

Funding	
Incentives (external programs)	$206,710
Energy conservation initiatives capital funding	$820,000
From corporate facility capital improvements funding	$1,717,600
2014-2022 Energy conservation initiatives capital funding	$800,000
Total	$3,544,310

Figure 13.1 Funding contributions for energy projects



Funding for Burlington Transit fleet and street lighting initiatives is not included in the above. Energy conservation and efficiency measures for Transit Fleet would be funded from departmental capital allocations. Street lighting retrofit will require additional analysis and preparation of a business case including financing options.

16. Energy Management Plan Implementation

The Energy Management Plan identifies actions to support the City of Burlington towards achieving its vision, goals, objectives and targets over the next five years. Implementing the EMP requires organizational commitment, as well as responsibility regarding managing the implementation process.

The City of Burlington's Energy Team will take responsibility in the EMP implementation and revision. Appendix B presents the Action Plan Responsibility Matrix.

As a living document, the EMP will be periodically reviewed by the Energy Team to consider several external and internal factors. We propose scheduling annual periodic reviews, as well as any time when relevant changes require it, in order to effectively address development as follows:

- Policy environment
- Economic markets
- Technology advancement
- Corporate strategic planning
- Divisional organization

Appendix D presents the EMP process map.

17. Conclusions and Recommendations

Addressing the challenges posed by modern energy and environmental matters is not an easy, short-term, task. In Ontario, the energy sector has been historically shaped by low energy prices. With inexpensive costs energy efficiency and conservation were of marginal importance, providing few reasons to equip municipal operations with the tools to manage energy consumption. With prices rising to reflect the true cost of producing and delivering energy and the tightening global balance between supply and demand, long established practices are unsustainable. Changes to Ontario's energy sector will further enhance the need for municipal energy preparedness. The broader municipal sector faces a historic choice — to make a commitment to a resourceful energy plan or prepare for an unstable and high cost energy future.

Burlington's Energy Management Plan establishes a strategic framework that ensures that the wise use of energy and commitment to environmental sustainability becomes business as usual and part of the shared values and actions that reflect all corporate services. By providing a vision for energy management, the plan offers an effective and co-ordinated approach to reducing energy consumption and maintaining achieved improvements. Moreover, the plan ensures that the municipality continually passes through the cycle of holistic energy management whereby planning actions, implementing activities and checking results produce a process for continual improvement and opportunities to enhance practices as needed.

The Energy Management Plan is the roadmap to ensure that Burlington has access to reliable, affordable and clean energy to power its operations and preserve its environment. Ensuring affordable energy and adequate supplies are essential prerequisites for tackling all other policy objectives. Through concentrated and cohesive action that generates investments in a strong energy future, the City is enabling policies that will achieve real results that improve our community's health, social and economic well-being.

Energy Management Involves Everyone!

Appendix A: Corporate Energy Audit Facility List

No	Facility/ Building Name	Facility Address	GFA sq.ft.	Consumption Electricity kWh/yr	Consumption Natural Gas m3	Consumption Water m3	Consumption Total Energy ekWh/yr	EUI kWh/ft^2/yr	Benchmark kWh/ft2/yr
101	Tansley Woods Community Centre + Library	1996 Itabashi Way	80,812	2,059,941	253,719	13,700	4,683,395	58	58
102	Mainway Arena	4015 Mainway	79,438	1,972,224	86,708	28,826	2,868,784	36	29
103	Pumphouse 1-Walkers	844 Walkers Line	650	35,659		19	35,659	55	38
104	Pumphouse 2-Appleby	789 Appleby Line	450	4,034	1,257	1	17,033	38	38
105	Brant Hills Community Centre & Library	2255 Brant Street	28,116	356,420	14,814	4,454	509,601	18	19
106	Tyandaga Golf Course-Pro shop/Restaurant	1265 Tyandaga Park Dr	9,042	159,483	15,907	1,151	323,965	36	25
107	Angela Coughlan Pool	2425 Upper Middle Road	15,034	459,214	122,712	3,828	1,728,052	115	58
108	Fire Station 4-Appleby Line	711 Appleby Line	8,321	333,652	15,982	992	498,902	60	38
109	Fire Station 7-Dundas & Berwick	4100 Dundas Street	7,196	122,779	14,660	1,087	274,362	38	26
110	Fire Station 5-Kilbride	2241 Kilbride St	4,690	29,661	11,434	300	147,889	32	26
211	414 Locust Parking Garage Offices	414 Locust Street	17,200	339,506		1,785	339,506	20	14
212	City Hall	426 Brant Street	91,986	1,511,618	78,721	4,200	2,325,593	25	24
213	Burlington Transit-Bus Terminal	430 John Street	720	24,807	1,611	303	41,469	58	35
214	Waterfront Centre-Discovery Landing	1340 Lakeshore Rd	15,300	366,781	18,840	3,849	561,581	37	38
215	Rotary Youth Centre	560 Guelph Line	12,725	67,337	4,866	245	117,652	9	7
216	Music Centre (includes #444 Drama Centre)	2311 New Street	16,170	247,216	20,271	467	456,819	28	19
217	Student Theatre Centre	2131 Prospect Street	6,395	45,508	6,442	76	112,118	18	19
218	Burlington Tennis Club (Central)	2271 New Street	2,374				-	-	
219	Burlington Art Centre	1333 Lakeshore Road	53,680	656,121	71,154	1,937	1,391,853	26	19
220	Aldershot Arena	494 Townsend Avenue	26,135	454,406	42,265	3,331	891,426	34	21
222	Nelson Arena (includes #221 Nelson Pool)	4235 New Street	40,008	389,215	91,875	6,954	1,339,203	33	25
223	Burlington Centennial Pool	5151 New Street	21,591	317,052	151,738	4,262	1,886,023	87	58
224	Nelson Youth Centre	4225 New St	2,757	28,730	4,330	170	73,502	27	19
325	Operations Centre-Main Building + Equipment St	3330 Harvester Road	67,554	613,300	98,539	5,735	1,632,193	24	21
326	Ireland House	2168 Guelph Line	5,581	28,286	4,239	17	72,117	13	19
327	Ireland House-Interpretive Centre	2168 Guelp Line	4,115	66,001	1,902	251	85,668	21	19
328	Animal Shelter	2424 Industrial Drive	6,414	70,398	33,028	1,364	411,908	64	64
329	Mountainside Pool	2205 Mount Forest	5,700	78,219	22,932	8,435	315,336	55	33
330	Sherwood Forest Community Centre	5270 Fairview Street	10,140	78,698	20,206	497	287,628	28	19
331	Appleby Tennis Club	4348 Longmoor Dr	1,734				-	-	
332	Fire Station 2-Upper Middle	2300 Upper Middle Road	8,309	93,648	8,907	377	185,746	22	21
333	Appleby Ice Centre	1201 Apply Line	130,954	3,329,969	435,896	8,364	7,837,134	60	29
434	Fire Station 1 Headquarters	1255 Fairview Street	24,190	278,775	48,516	1,173	780,430	32	21
435	LaSalle Park Pavilion	50 NorthShore Blvd East	17,800	361,475	27,890	896	649,858	37	25
436	Aldershot Pool	50 Fairwood Place	16,166	431,190	108,967	5,927	1,557,911	96	58
437	Boys' Gymnastic Club	680 Maple Avenue	16,825				-	-	
438	Girls' Gymnastic Club	710 Maple Avenue	15,668	123,854	33,505	328	470,296	30	19
439	Boating & Sailing Club	841 LaSalle Park Rd	3,513				-	-	
440	Fire Station 3-Waterdown Rd	1044 Waterdown Road	7,707	68,377	15,259	546	226,155	29	21
441	Aldershot Tennis Club	1071 Gallagher Road	2,184				-	-	
442	Joseph Brant Museum	1240 North Shore Boulevard	5,412	38,988	1,861	605	58,231	11	19
443	Drury Lane Theatre	2269 New Street	10,020				-	-	
445	Central Library	2331 New Street	62,129	1,362,997	49,829	1,163	1,878,229	30	25
446	Nelson-Braves Clubhouse & Storage	4181 New Street	3,326				-	-	
447	Lawn Bowling Club	2275 New Street	2,850				-	-	
448	Fire Station 6-Cumberland	455 Cumberland Avenue	9,996	114,817	21,575	1,143	337,903	34	21
449	Burlington Seniors' Centre	2285 New Street	16,526	356,890	31,999	920	687,760	42	19
450	Paletta Lakefront Park-Mansion + Gatehouse	4250 Lakeshore Road	14,619	237,800	25,641	544	502,928	34	19
451	Central Arena	519 Drury Lane	45,687	603,821	73,457	3,671	1,363,366	30	21

Notes:

1) The EUI presented in Appendix A is based on the selected baseline period. This is a 12 month period that is most relevant for the RETScreen Plus analysis. The baseline period could be any 12 consecutive months from the 2010-2012 period when utility data was available.
2) Utility consumption data was not available for joint venture facilities.

Appendix B: Action Plan Responsibility Matrix

Action	Manager of Fleet - RPM (liaison for Parks Bldgs)	Supervisor of Traffic Operations	Manager / P&R	Supervisor of Operations Pools	Supervisor of Operations Arenas	Supervisor of Operations Specialty Facilities	Supervisor of Operations Community Centres	Supervisor of Operations Joint Ventures / City Hall	Transit Manager	Manager of Purchasing	Manager of IT Infrastructure & Operations	Deputy Chief – Fire	Director Facilities – Libraries	Manager – BAC	BPAC - Operation & Facility Sales Manager	CSI - Coordinator Project Management – Energy
EMIS software											■					■
Energy metering											■					■
Smart building integration											■					■
Monitoring and Targeting																■
Energy awareness	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Energy competion				■	■							■				
Best practices database																■
Energy training	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Staff perfomance evaluation on energy	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Measurement and Verification																■
Reporting																■
Building manuals	■		■	■	■	■	■	■	■			■	■	■	■	
Builing operationg procedures	■		■	■	■	■	■	■	■			■	■	■	■	
Maintenance program	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
ENERGY STAR® Portfolio Manager																■
Energy conservation measures	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
IT asset management											■					
Retro-commissioning			■													
New construction																■
Renewable energy																■
Demand response				■	■			■								■
Fleet energy	■								■			■				
Street Lighting and Traffic Lights		■														

Appendix C: EMP Organizational Self-Assessment by Key Stakeholders

The city staff stakeholders group (members listed in Section 2.6.3) used a matrix-based self-assessment tool presented by Natural Resources Canada's Office of Energy Efficiency. The matrices were adapted from Good Practice Guide 306: Energy Management Priorities – a self-assessment tool produced by the Building Research Energy Conservation Support Unit (BRESCU) as part of the U.K. government's Energy Efficiency Best Practice Program. The matrices have various categories rated on a scale of 0-4. Zero is the lowest score and means there is plenty of room for improvement, while a score of four means that your operations are very energy efficient.

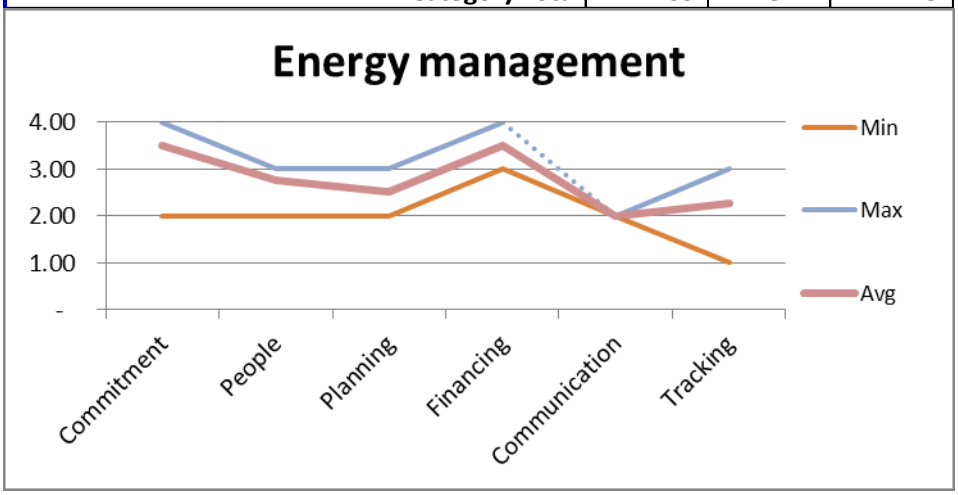
The following four high-level matrices were considered:

- The Energy Management Matrix
- The Technical Matrix
- The Monitoring and Targeting Matrix
- The Awareness and Information Matrix

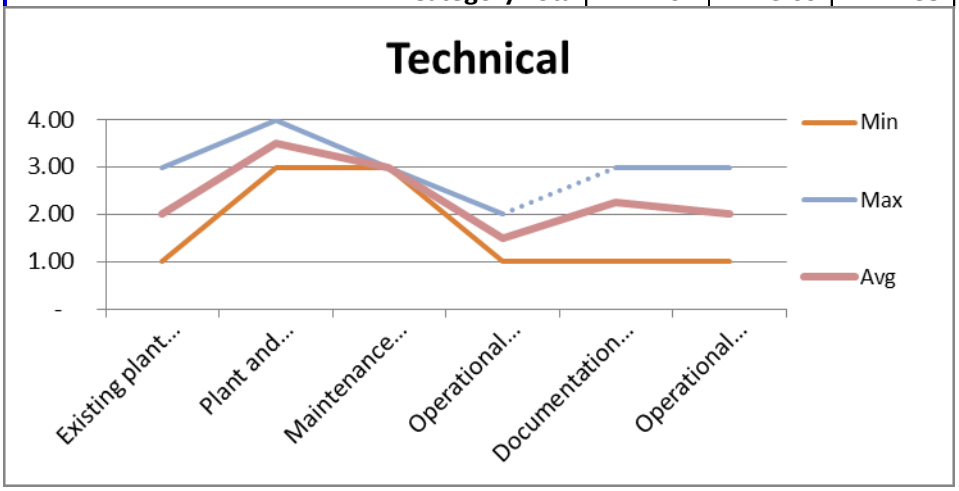
The responses were gathered during the self-assessment exercise completed at the key stakeholders meeting on Nov 7, 2012, as part of the EMP development process.

The overall charts indicate that there is room for improvement in creating a culture of conservation including communications on operational energy conservation procedures.

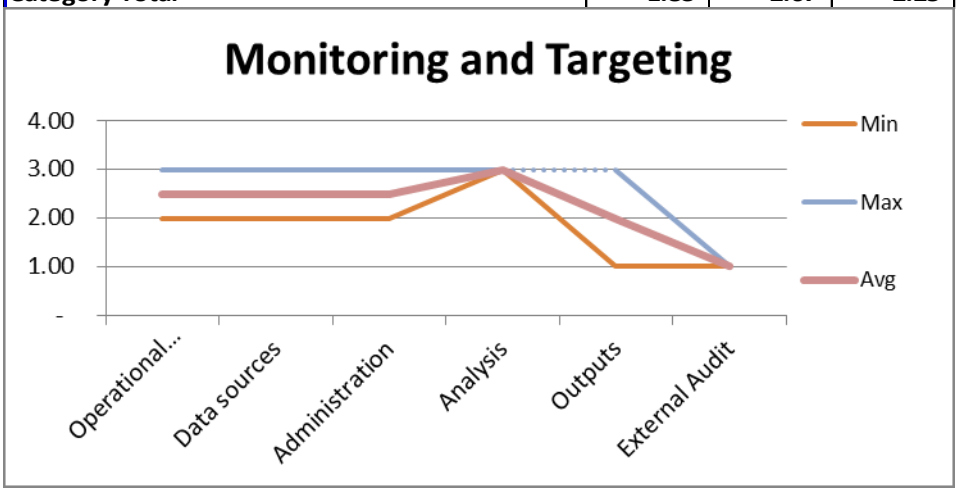
High-Level Matrix - Energy Management	Min	Max	Avg
Commitment	2.00	4.00	3.50
People	2.00	3.00	2.75
Planning	2.00	3.00	2.50
Financing	3.00	4.00	3.50
Communication	2.00	2.00	2.00
Tracking	1.00	3.00	2.25
Category Total	**2.00**	**3.17**	**2.75**



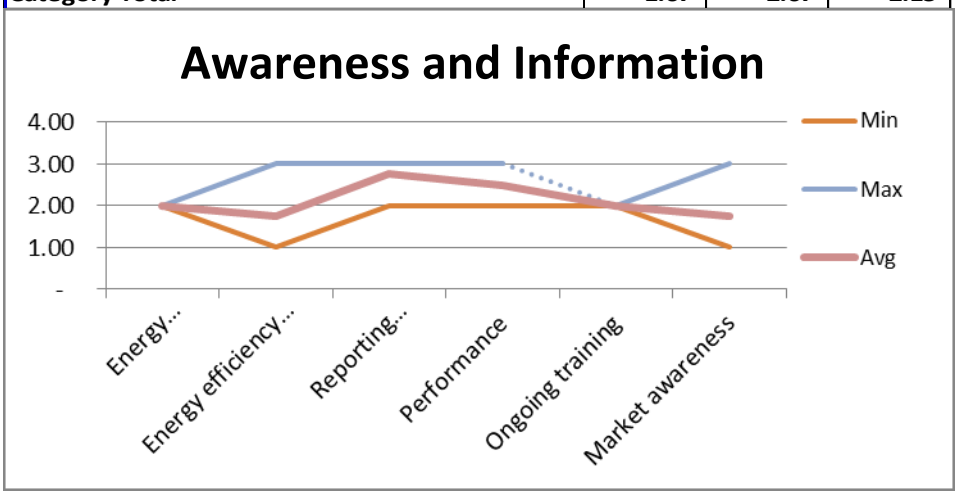
High Level Matrix - Technical	Min	Max	Avg
Existing plant and equipment	1.00	3.00	2.00
Plant and equipment replacement	3.00	4.00	3.50
Maintenance procedures	3.00	3.00	3.00
Operational knowledge	1.00	2.00	1.50
Documentation and record keeping	1.00	3.00	2.25
Operational methods	1.00	3.00	2.00
Category Total	**1.67**	**3.00**	**2.38**



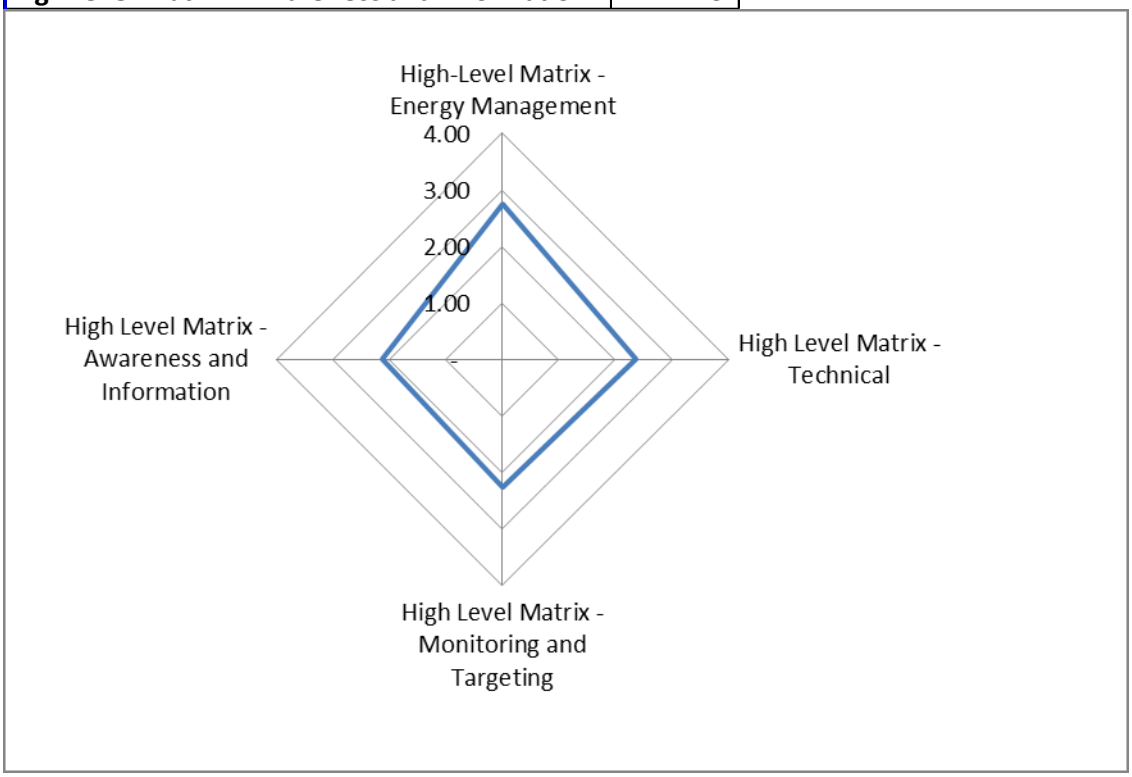
High Level Matrix - Monitoring and Targeting	Min	Max	Avg
Operational requirements	2.00	3.00	2.50
Data sources	2.00	3.00	2.50
Administration	2.00	3.00	2.50
Analysis	3.00	3.00	3.00
Outputs	1.00	3.00	2.00
External Audit	1.00	1.00	1.00
Category Total	**1.83**	**2.67**	**2.25**



High Level Matrix - Awareness and Information	Min	Max	Avg
Energy management responsibilities	2.00	2.00	2.00
Energy efficiency awareness	1.00	3.00	1.75
Reporting procedures review of energy	2.00	3.00	2.75
Performance	2.00	3.00	2.50
Ongoing training	2.00	2.00	2.00
Market awareness	1.00	3.00	1.75
Category Total	**1.67**	**2.67**	**2.13**



Overall	
High-Level Matrix - Energy Management	2.75
High Level Matrix - Technical	2.38
High Level Matrix - Monitoring and Targeting	2.25
High Level Matrix - Awareness and Information	2.13



Appendix D: EMP Process Map