CORPORATE ENERGY PLAN

2014 - 2024 | Energy Planning Working Group

Region of Waterloo

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Acknowledgements

Region of Waterloo's Energy Planning Working Group (EPWG), which is comprised from the following Regional Departments and Divisions, developed this Corporate Energy Plan:

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The plan was developed over approximately one year involving EPWG workshops, site visits at Region facilities and additional consultation with EPWG members and operational staff. The engineering consulting firm Golder Associates assisted with the development of the plan and Golder team members Klas Bockasten and Catherine Thorn worked closely with Region staff during the planning process.

In addition to EPWG members, many other individuals contributed to this plan; in particular, operations staff were consulted during a planning meeting and the staff from three site visits: Galt Wastewater Treatment Plant, Mannheim Water Treatment Plant and the Regional Operations Centre and Lab corporate facility at 100 Maple Grove Road, Cambridge.

A Message From The Regional Chair

Dear Friends,

On behalf of Regional Council, I am pleased to present the 2014 – 2024 Corporate Energy Plan (CEP) for the Regional Municipality of Waterloo.

Energy costs represent a sizeable portion of operating costs for all municipalities and the Region of Waterloo is no exception. In 2012, the Region spent approximately $14.9 million on 125 million kWh of electricity and $2.12 million on 7.08 million m3 of natural gas. This can represent from 11% to 25% of each division's operating budget.

As volatile electricity and natural gas prices rise, strategic management of our energy use and supply becomes even more important as Council strives to maintain current service levels.

Smarter energy use is not a new concept for this community. Since 2005, the Region has saved an estimated $6.5 million in energy costs by implementing various energy management projects. Without these projects, the Region would be paying about $1.1 million more in energy costs each year. We have been successful in our past efforts to better manage our energy consumption and we know there is potential for more savings over the next decade.

The CEP profiles our past achievements as well as current and planned Energy Conservation and Demand Management (CDM) initiatives that have already been included in the Region's ten-year capital budget forecast. It identifies $8.5 million of energy projects that will be implemented over the next ten years that will help the Region avoid an estimated additional 12,500,000 ekWh/year of energy consumption which represents $1.47 million in annual energy cost savings once all projects are complete.

Please take a few moments to read through our plan and learn more about these specific innovative and sustainable measures the Region will take to reduce its energy consumption over the next 10 years.

Best regards,
Ken Seiling
Regional Chair

Executive Summary

The Regional Municipality of Waterloo ("the Region") services one of the largest and fastest growing urban areas in Ontario. With population growth, comes an increased need for services. Improving energy performance will enable the Region to continue to provide excellent service by managing energy costs and supporting the Region's commitment to environmental sustainability.

In the Environmental Sustainability Strategy, the Region established the following objectives for its corporate facilities: manage energy use; reduce greenhouse gas emissions; and increase production/use of alternative and renewable energy sources. In addition to these general objectives, in 2011, the Region set a reduction target to stabilize greenhouse gas (GHG) emissions from Regional Operations at 2009 levels out through the year 2019. The Region has since outperformed expectations due to the many measures implemented, including energy efficiency and generation projects, and in 2013, revised the target to be more aggressive: achieve an absolute level of 10% below 2009 levels by the year 2019. This new target is equivalent to a 25% reduction per capita!

The Region has a long history of success in energy management: since 2005, the Region has saved an estimated total of $6.514 million in energy costs by implementing energy management projects. Had these projects not been implemented, the Region would be paying about $1.1 million more in energy costs this year alone. Even with these improvements, the Region consumes a significant amount of energy for its facilities: in 2012, the Region spent approximately $13.8 million on 133 million kWh of electricity and $2.12 million on 6.6 million m3 of natural gas.

Through this Corporate Energy Plan (CEP) and future energy planning, the Region will drive further improvements in energy performance and strive to develop a more integrated approach to energy management. The Region will work toward a future in which energy management is incorporated into everyday decision-making and the design of energy supply and distribution within Region facilities will be considered together with energy use to develop optimal energy systems.

Energy Vision: The Region of Waterloo will be an energy-conscious organization that continually seeks to conserve energy; and encourages the development and implementation of renewable and other sustainable energy infrastructure.

Energy Mission Statement: The Region of Waterloo aims to develop and implement energy plans that deliver service excellence and support current and future energy needs of the Region in a financially, socially and environmentally responsible manner.

The CEP sets out the strategy and actions planned to build on past successes and improve energy performance further, through a structured approach. It has been developed to meet the requirements of Ontario Regulation 397/11, as well as to enable the Region to meet the following corporate goals:

- Effectively manage energy use to deliver service excellence to Region of Waterloo facility users, resulting in avoided costs and cost savings.
- Sustainably manage Region of Waterloo corporate energy use to minimize environmental impacts of energy use.

The CEP identifies $8.5 million worth of energy projects to be implemented over the next ten years that are projected to avoid an additional 12,500,000 ekWh/year of energy consumption and $1,470,000/ year of energy costs.

1. Background: Celebrating Past Successes

Although this is the Region's first published energy plan, the Region has been actively engaged in energy management for the past nine years. Since 2005, the Region has recorded millions of dollars in energy savings, cost avoidance and revenue achieved by implementing energy projects.

Since 2005, the Region of Waterloo has realized an estimated total savings, cost avoidance and revenues associated with energy management projects of **$6.514 million**. Going forward about **$1.1 million per year has been freed up** and this amount continues to grow.

In 2013, energy savings, cost avoidance and revenues made up almost 6% of the annual energy cost.

In 2007, the Region of Waterloo demonstrated its commitment to improving energy performance by officially establishing the Energy Conservation Office (ECO). **Over 130 projects have been implemented by the ECO, resulting in savings of more than 7,600,000 kWh of electricity and 350,000 m³ of natural gas annually.** Projects have covered a variety of areas including the following examples:

FACILITIES

Action	Description of Representative Projects
Heater, boiler and furnace upgrades	Electrical heating, boilers and furnaces were upgraded in Regional buildings, saving over 10,000 kWh of electricity and approximately 7,400 m³ of natural gas each year.
Lighting upgrades	Interior and exterior lighting upgrades have been completed at various Region buildings to improve energy efficiency, saving over 2,700,000 kWh of electricity.
Improved controls	Better controls, including VFD's, occupancy sensors, HVAC setbacks, thermostats and stove top temperature controllers were installed in Regional buildings, saving over 200,000 kWh of electricity.
Fridge upgrades	Fridges in hundreds of Waterloo Region Housing units were replaced, saving over 360,000 kWh of electricity.
Geothermal Energy	Geothermal systems have been installed at Sunnyside Home Supportive Housing and Regional Library Headquarters.
Solar Heating	Solar domestic hot water systems were installed at Christopher Children's Centre and Cambridge Children's Centre in Cambridge. Both systems were part of major renovations in each facility.
Heat Recovery	Heat recovery has been implemented in multiple processes at Sunnyside Home, saving over 340,000 m³ of natural gas each year.
LEED® Certified Buildings	Emergency Medical Services Fleet Centre — Gold Waterloo Regional Police Service Investigative Services Building — Gold Waterloo Landfill South Workshop — Silver Waterloo Region Museum — Silver Christopher Children's Centre — Gold Region of Waterloo International Airport Operations Centre — Silver Sunnyside Supportive Housing — Silver Admin Building, Waterloo Waste Water Treatment Plant — pending Grand River Transit — Strasburg Road Facility Expansion — pending Region of Waterloo Police Services North Division — pending
Solar PV	Solar PV systems have been installed at various Region buildings, with a total installed capacity of approximately 997 kWp.

WATER

Action	Description of Representative Projects
LEED® Certified Buildings	Mannheim Water Treatment Plant Expansion — Silver Greenbrook Water Supply System — pending Middleton Water Treatment Plant — pending Biosolids Dewatering Facility - Regional Municipality of Waterloo — pending
Manheim Lighting Upgrades	Lighting in the ammonia building has been upgraded to Fluorescent T5 lighting.
Manheim HVAC Upgrades	An HVAC system upgrade was completed at Manheim water treatment plant. The new system is a variable air volume system, which can more closely match different demands in different areas, improving efficiency.
VFD's	As motor starters require replacement, VFD's have been installed.
Middleton Upgrade	Heat recovery off the raw water was implemented.
Demand Shifting	At Ayr and Greenbrook water treatment plants, energy is stored: water is pumped during the night when energy demand is lower and is fed by gravity through the plant during the day.

WASTEWATER

Action	Description of Representative Projects
Lighting Upgrades	Exterior and interior lighting has been upgraded to LED lights at the New Hamburg and Galt Wastewater Treatment Plants (WWTP).
Biogas Utilization	Biogas produced by the digesters in the treatment process is used for the hot water boiler fuel.
Galt Influent Pumping Station VFD's	VFD's have been installed on the six pumps in the Galt influent pumping station.
Effluent Pumping Station VFDs	VFDs have been installed on five pumps at the Kitchener effluent pumping station and on four at the Waterloo effluent pumping station.
Building Design	The design of the Manitou Biosolids Dewatering Building and the Waterloo Wastewater Treatment Plant Administration Building incorporated LEED Silver energy efficient components, including building system controls and lighting.

WASTE MANAGEMENT

Action	Description of Representative Projects
Landfill Gas Utilization	The Region of Waterloo was an early adopter of using the methane in landfill gas to produce electricity, decreasing GHG emissions and decreasing demand on the grid.
Waterloo Landfill Baler Upgrade	When replacing the baler at Waterloo Landfill Materials Recycling Centre (MRC), a lifecycle analysis was completed on energy use to identify the most efficient option.
Wind Turbine	A wind turbine was installed at 1001 Erb St.

TRANSPORTATION

Action	Description of Representative Projects
LED Traffic Signals	400+ intersections converted from incandescent to LED, producing annual savings of 4,800,000 kWh
Lighting Upgrades	Lighting in the lobby of the airport was upgraded, producing annual savings of over 110,000 kWh of electricity.
Energy Audit	A comprehensive energy audit was completed on airport facilities and identified opportunities are planned for implementation within the timeframe of this Corporate Energy Plan (CEP).

2. Strategic Alignment: The Way Forward

This Corporate Energy Plan (CEP) will help formalize an energy management framework to provide the basis for delivering service excellence and support the Region's environmental and financial objectives. An implementation program plan will be developed and executed by the Energy Conservation Office (ECO), under the guidance of the Senior Management Team. The work of prioritizing projects will be the responsibility of the individual program area and establishing measurement and verification protocol will fall to the ECO.

Energy costs represent a sizeable portion of operating costs for the Region, ranging from approximately 11% to 25% of each division's operating budget. As electricity and natural gas prices rise, managing energy use and supply may enable the Region to forego otherwise necessary budget/service cuts in other areas. The Region's Asset Management strategy recognizes the need to actively manage the lifecycle costs of corporate assets and calls for energy to be responsibly managed.

The Region is committed to environmental sustainability; it is identified as a goal in the Corporate Strategic Plan, reflected by livability objectives in the Region's Official Plan (ROP) and planned for through both the Environmental Sustainability Strategy and the supporting Corporate GHG Emission Reduction Plan. Sustainably managing energy use is a key part of environmental sustainability. 2012 energy use in the Region's corporate facilities resulted in approximately 23,000 tonnes[1] of greenhouse gas (GHG) emissions. Implementing energy conservation and demand management measures in Region facilities is essential to achieving the Region's emission reduction target of a 10% absolute reduction in GHG emissions from 2009 levels by 2019. This energy plan directly supports the Region's Service First Strategy, Asset Management Plan and Corporate GHG Action Plan which in turn, further the Region's Infrastructure Master Plans, Environmental Sustainability Strategy and Corporate Strategic Plan, as shown in Figure 1.

1 Calculated using the GHG emission factors 0.0800 kg per kWh of electricity and 1.8906 kg per m^3 of natural gas, from the Ministry of Energy's reporting template for annual energy consumption and greenhouse gas emissions reports.

Region of Waterloo Corporate Strategic Plan 2011-2014 Five Focus Areas:

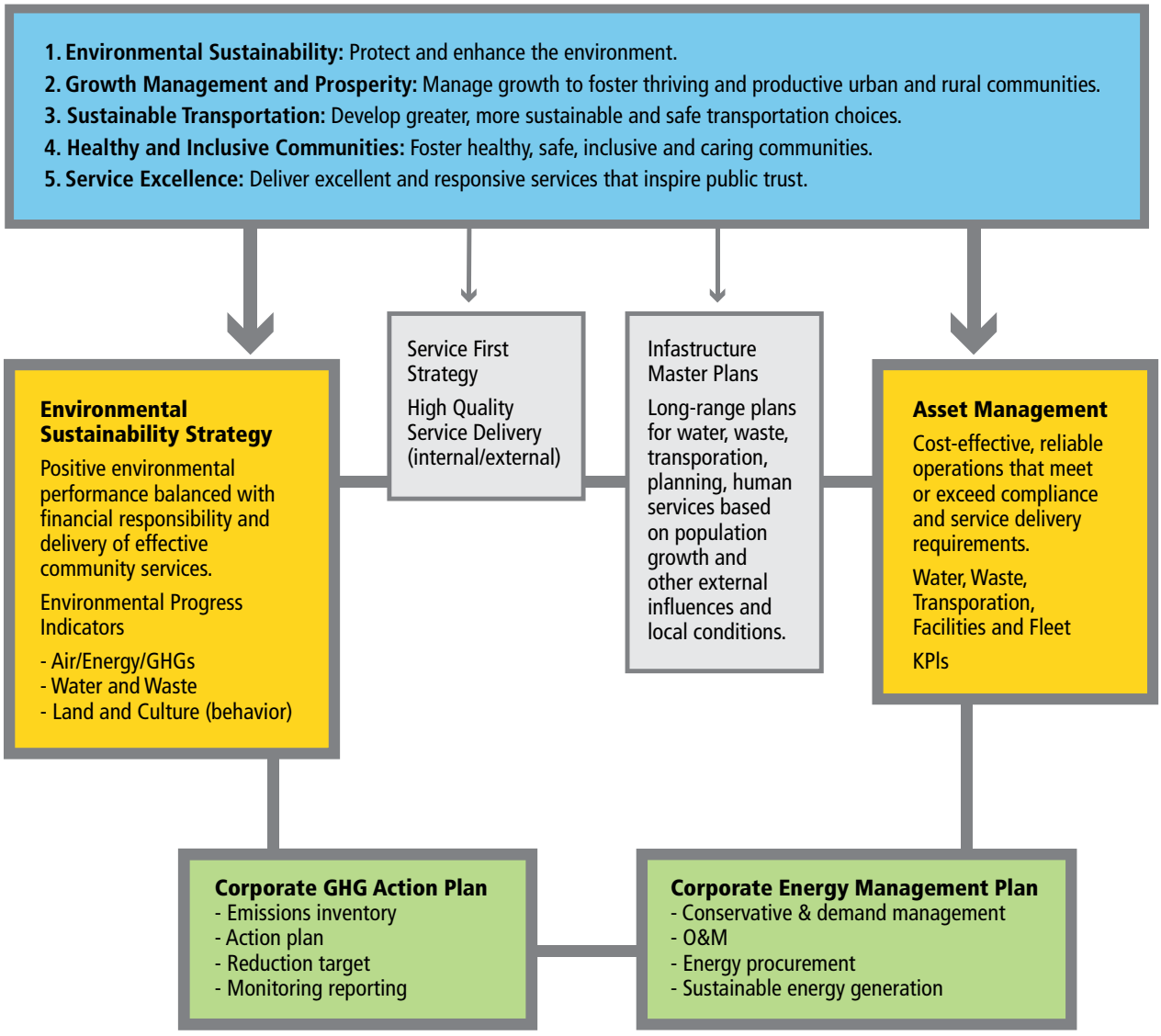


Figure 1: Integrated Diagram of Major Corporate-Wide Plans and Strategies in Relation to Internal Energy Planning

2.1. Energy Plan Guiding Principles

Energy Vision

The Region of Waterloo will be an energy-conscious organization that continually seeks to conserve energy; and encourages the development and implementation of renewable and other sustainable energy infrastructure.

Energy Mission Statement

The Region of Waterloo aims to develop and implement energy plans that deliver service excellence and support current and future energy needs of the Region in a financially, socially and environmentally responsible manner.

Financial, Environmental and Social Responsibility

- Limit energy costs and exposure to market prices through conservation and generation
- Consider lifecycle costs during design and procurement
- Strive to follow the best practices outlined in recognized energy management standards
- Recognize the Region's commitment to service when evaluating energy projects
- Actively consider options to reduce emissions associated with the Region's energy consumption

Inter-Departmental and Stakeholder Engagement

- Establish energy management as a responsibility shared by every Region employee and promoted within each department
- Educate and engage staff through two-way communication
- Ensure decision makers understand how asset management decisions can affect energy performance
- Work with member municipalities, community residents, and local businesses and institutions, when appropriate, to further energy objectives

Accountability and Continual Improvement

- Make available the resources and information required to achieve energy objectives
- Develop and publish a new CEP every 5 years
- Internally review and assess progress of the CEP every year
- Review their alignment when the CEP or other strategic plans are updated
- Measure energy use at the facility level and report on it annually
- Develop internal energy performance targets at the division level and report annually on progress to the Executive Leadership
- Review energy performance during employee performance evaluations, as applicable

2.2. Goals and Objectives

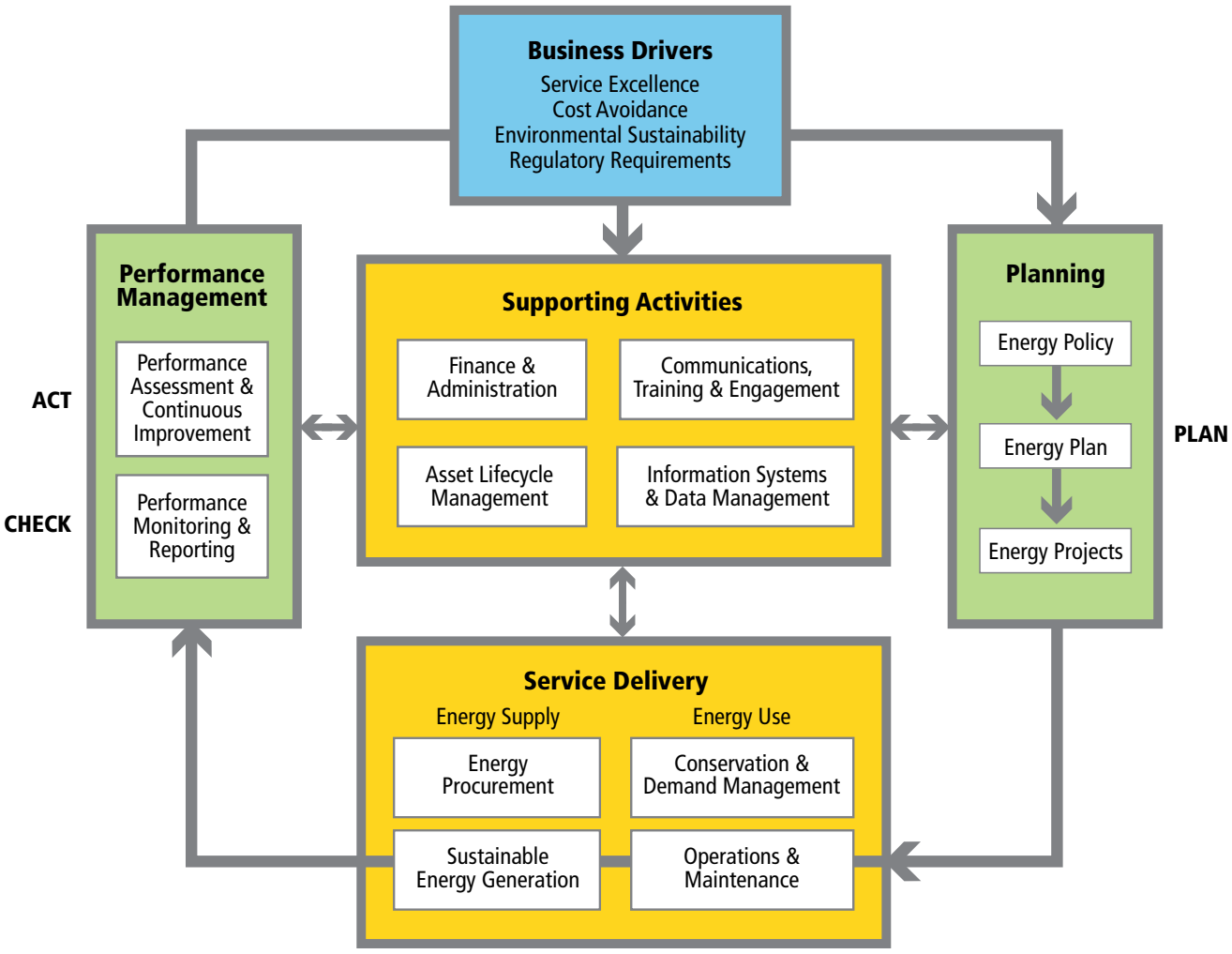
Based on the strategic direction that has been set by Region of Waterloo's corporate Strategic Plan, two main goals for energy management have been identified. The strategic objectives to achieve those goals have been developed based on the Region's priorities and best practices for energy management, including those outlined in the energy management standard ISO 50001.

Goals	Strategic Objectives
1. Effectively manage energy to deliver service excellence to Region of Waterloo facility users.	1.1. Ensure compliance with any related legislation and regulations.
	1.2. Improve energy efficiency through implementation of energy conservation and demand management.
	1.3. Manage energy costs, reliability and price volatility by investing in on-site or distributed energy generation where feasible.
	1.4. Regularly review new opportunities and oversee an energy procurement strategy.
	1.5. Optimize asset performance and minimize energy costs through incorporating energy management in building/equipment life-cycle decisions.
2. Sustainably manage Region of Waterloo corporate energy use to minimize environmental impacts of energy use.	2.1. Reduce GHG emissions by managing energy consumption.
	2.2. Reduce GHG emissions by investing in sustainable energy generation.
	2.3. Investigate renewable energy purchasing as a means to reduce GHG emissions.

2.3. Energy Management Framework

The CEP is based on the Region's Energy Management Framework below, which summarizes the drivers, planning, core services, supporting activities and performance management required to drive continual improvement in energy performance.

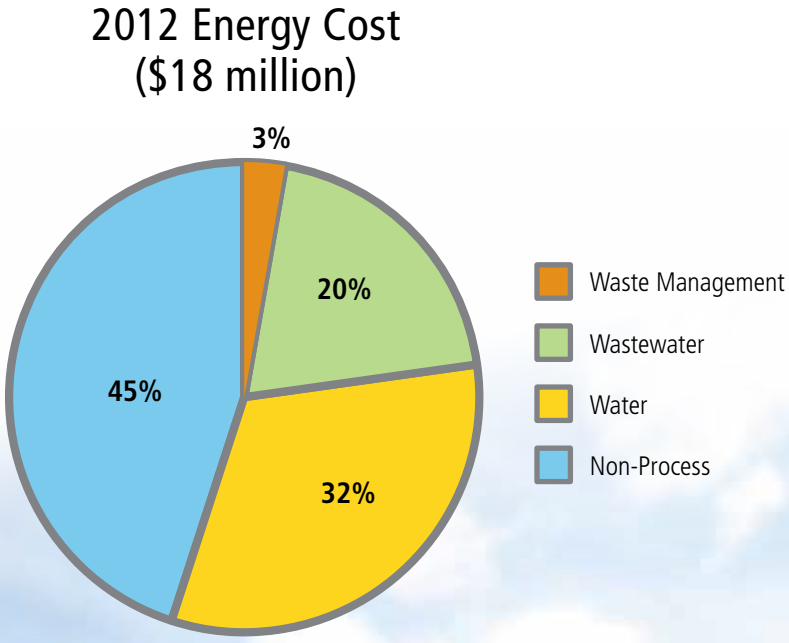
The Energy Management Framework outlines how the Region of Waterloo will manage energy as a continual business practice to deliver service excellence, support environmental sustainability and satisfy regulatory requirements. The cycle begins with understanding the business drivers that are the reason the Region has developed an energy management strategy and follows the well-established continuous improvement model of "plan-do-check-act".



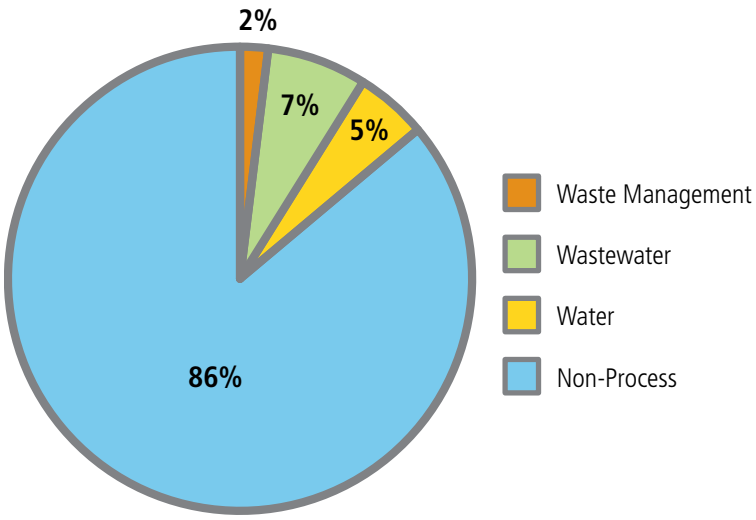
Every 5 years, energy policies, strategies and plans will be reviewed against current business drivers and lessons learned.

3. Energy Baseline

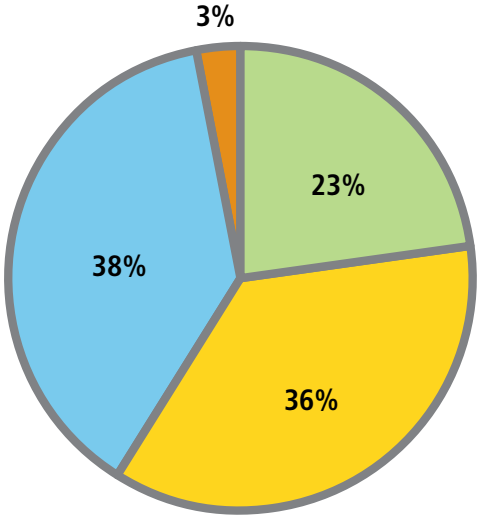
In 2012, the Region spent approximately $16 million on 133 million kWh of electricity and $2.3 million on 6.6 million m3 of natural gas for its facilities. The largest users of electricity were non-process facilities, which comprised 38% of total consumption, followed closely by water treatment facilities at 36% and wastewater at 23%. While water and wastewater treatment facilities also used a significant amount of natural gas, non-process facilities were the largest user by a substantial margin, and accounted for 86% of natural gas consumption.



2012 Natural Gas Use (6.6 million m3)



2012 Electricity Use (133 million kWh)



4. Energy Accounting and Governance

Regional Council has established energy management as a priority for the Region and directed staff to develop this Corporate Energy Plan (CEP). While Council will be sought to approve major changes in strategic energy management, the Energy Plan Steering Team provides high-level oversight on the prioritization and corporate-wide application of the energy strategy. The existing Energy Planning Working Group (EPWG) will be responsible for administering the CEP with the Energy Plan Steering Team (EPST) acting as an advisory body to that team.

While the EPWG is responsible for the CEP, energy management projects will be identified, prioritized and implemented by Region staff within the appropriate energy accounting centre. Energy accounting centres define the boundaries of business units responsible for energy performance. Each centre is accountable for its own energy use and is ultimately responsible for the decisions affecting that energy use. Five energy accounting centres have been defined for the Region of Waterloo, as shown in the Energy Governance Structure below (Figure 2). Recognizing that the majority of energy use in certain divisions (such as Water and Wastewater) is due to process equipment and there are particular process requirements unique to these operations, the individuals within these divisions are best qualified to identify, prioritize and implement projects that will improve energy performance. Energy accounting centres have been established to allow for this. The ECO will provide support through the provision of services such as facilitating business case development, feasibility analyses, measurement and verification and providing advice when requested. The ECO will also stay current with external funding programs and partnership opportunities as a value add service to its internal partners.

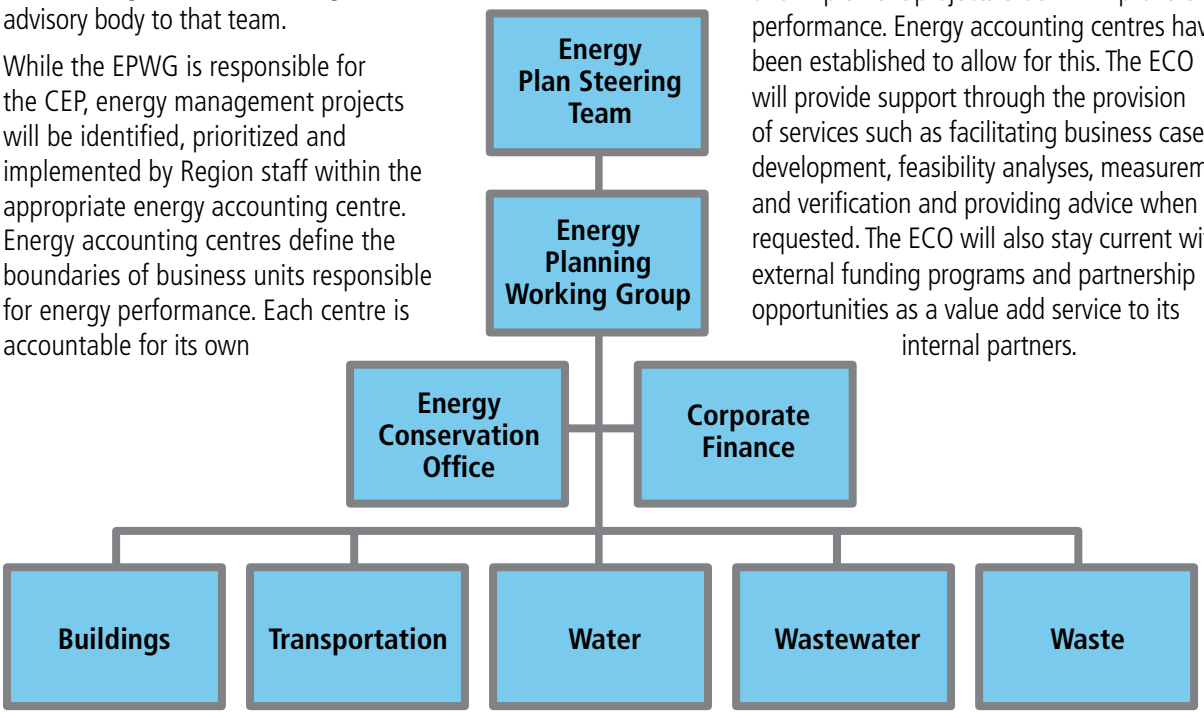


Figure 2: Energy Governance Structure

4.1. Energy Planning Working Group (Executors of the Plan)

The existing Energy Planning Working Group (EPWG) will be the primary team responsible for managing the delivery of the CEP. During plan implementation, membership will be reviewed annually and typically consist of about six to ten individuals. Suggested members include:

- Individual(s) from the Energy Conservation Office (ECO)
- Individuals from divisions that significantly impact energy management in the Region, including Water, Wastewater, Waste Management, Transportation, Housing, Facilities Management
- An individual involved in the Region's Sustainability Strategy and Corporate GHG inventory and reduction plan
- A revolving membership position from corporate Finance
- Representative from facility manager(s)/chief operator(s)

In addition to the EPWG members, a representative from Information Technology (IT) will be appointed to participate in some meetings, as necessary, to discuss energy-related software needs.

The EPWG will be responsible for administering the CEP, developing action plans for their own energy accounting centre to ensure compliance with legislative requirements, reviewing the performance of implementation and revising the CEP. As a cross-disciplinary team, the EPWG will promote involvement and action from all divisions. The EPWG will provide guidelines for energy management processes, including auditing procedures and project prioritization.

4.2. Energy Conservation Office

Value Added Services

The ECO will provide support to all energy accounting centres and the EPWG. Through the development of a formal program implementation structure, value added services will be made available where requested by energy accounting centres and could include facilitating the development of business cases, feasibility studies, project coordination, identifying funding and partnership programs, and lead data collection, reporting and tracking of KPIs across the corporation. Project implementation will be managed by specific project teams within the energy accounting centre, and the teams will report energy efficiency improvements on these projects to the ECO.

Significant energy savings can be realized through collaboration. The Region of Waterloo, City of Waterloo and University of Waterloo formed a community partnership in 2008 for a wind study.

Support Function to Address Legislative Requirements

The ECO will report on a corporate Energy Conservation and Demand Management Plan (ECDMP) that is comprised of various action plans being undertaken by energy accounting centres as required by Ontario Regulation 397/11. Goals and objectives as identified by the energy accounting centres will also be included. Affected operations include the following identified in the regulation:

- Administrative offices and related facilities
- Cultural Facilities
- Ambulance stations and associated offices and facilities
- Police stations and associated offices and facilities
- Storage facilities where equipment or vehicles are maintained, repaired or stored
- Buildings or facilities related to the treatment or pumping of water or sewage
- Parking garages

4.3. Responsibilities

The responsibility matrix below outlines the various roles of different teams for energy management activities.

Defined roles include:

R = Responsible: The party responsible for successful completion or delivery

A = Accountable: The party, ultimately accountable for results, that provides oversight (and approval if necessary) to the responsible party

S = Support: The supporting individual(s) that provide information or analysis to the responsible party

C = Consulted: Individual(s) with particular knowledge that can advise the responsible party

I = Informed: Individual(s) that should be informed about the activity

	EPST	EPWG	ECO	EAC
BUSINESS DRIVERS				
Business Drivers Review	R	C	I	I
PLANNING				
Energy Plan Revisions	A	R	S	C
Energy Projects Planning		I	C	R
SERVICE DELIVERY				
Conservation & Demand Management		A	S	R
Operations & Maintenance		A	S	R
Sustainable Energy Generation		A	S	R
Energy Procurement Analysis		A	R	C
PERFORMANCE MANAGEMENT				
Annual Reporting	A	I	R	S
Measurement & Verification of Projects			I	R
Energy Monitoring			C	R
Assessment & Continuous Improvement	A	R	C	C

Figure 3: High level Responsibility Matrix

5. Core Energy Management Services

The core energy management services are those functions that directly impact energy performance through managing energy use and optimizing its supply:

SERVICES ADDRESSING ENERGY USE:	SERVICES ADDRESSING ENERGY SUPPLY:
• Conservation and demand management • Sustainable energy generation	• Operations and maintenance • Energy procurement

To formalize these services, a program approach to energy management is being carried out to develop and execute projects and non-projects. An action plan has been put in place to deliver the program over the 2014-2024 time period to align with the Region's capital planning process. Work has been identified in the following plan:

Action Description	Total Cost ($)	Forecasted Savings		Lifetime of Measure
		($/year)	(ekWh/year)	
Facility Meter Installations	198,000	Facilitates Savings in Building Management	Facilitates Savings in Building Management	10 – 15 years (for permanent meters)
Lighting Retrofits	970,000	180,000	1,500,000	8 – 15 years
HVAC Upgrades	2,876,000	481,000	4,810,000	15 – 20 years
Building Automation/Controls	1,368,000	255,000	2,550,000	10 – 15 years
Building Envelope Improvements	1,089,000	203,000	2,030,000	10 – 20 years
Wastewater Process Optimization & Equipment Upgrades	1,417,000	262,000	2,626,000	10 – 20 years
Water Process Optimization Projects*	In Development	TBD	TBD	10 – 20 years
Solid Waste Process Optimization Projects	In Development	TBD	TBD	10 – 20 years
New Construction Projects	In Development	TBD	TBD	20 – 50 years
Sustainable Energy Generation	549,000	89,000	890,000	20 – 50 years

The services required to support this plan are further developed in the next sections with some specific project examples.

* Studies to optimize water distribution are being implemented based on specific pressure zones (distribution area)

45%

the amount of natural gas saved annually at Sunnyside Home after implementing the heat recovery project.

Region of Waterloo

5.1 Energy Use

5.1.1 CONSERVATION AND DEMAND MANAGEMENT

Driving Corporate Strategic Objectives

1.2 Improve energy efficiency through implementation of energy conservation and demand management.

2.1 Reduce GHG emissions by managing energy consumption.

Each energy accounting center will proactively identify CDM opportunities, evaluate those opportunities and execute selected measures, along with the appropriate measurement and verification (M&V). The ECO will be available to support when requested. Currently, CDM opportunities are identified from a variety of sources and implemented on a case-by-case basis. As part of this plan's implementation over the next five years, the EPWG will establish the processes and tools used to track, evaluate and report on CDM opportunities and projects. The EPWG will work with IT and other stakeholders to develop the supporting software requirements and proposed solution, as discussed in more detail under the Information Systems & Data Management section of this plan.

Systematic Approach to Energy Program Management: The ECO will develop various collaborative initiatives that will for example integrate preventive maintenance with energy efficient building operations. Work underway will include building portfolio "tune-ups", re-commissioning and retro-commissioning services, and long term integration of planning with building condition assessments.

IDENTIFYING CDM OPPORTUNITIES

In the past five years, many successful CDM projects have originated from operator suggestions and energy audits. Input from operators, as well as other staff, will continue to be actively encouraged, and energy audits will be used as one of the tools to identify energy opportunities.

Energy Audits and Studies:

Energy audits will be planned by each department during the corresponding division's budgeting process each fiscal year, according to the Region's standard auditing process. To ensure that energy audits result in actionable projects that include energy supply improvements, include the following in audit RFP's:

Lighting Retrofits: The Region has completed many successful lighting retrofits with funding support and will continue to assess and upgrade lighting throughout its facilities. The majority of upgraded lighting consists of fluorescent T8 fixtures and LED technology. In addition, occupancy sensors will be installed as part of some retrofits to decrease energy use when lighting is not needed.

1. Auditors shall provide an execution model for realizing identified viable energy opportunities and incentive funding available for their implementation (such as federal or provincial funding programs).
2. Auditors shall identify any innovative sustainable generation opportunities that are particularly suited to the site.

Energy studies and audits shall be tracked and if the evaluated measures are not feasible, the results will be retained to inform future decision-making. Once developed, these reports will be saved in the energy project software solution discussed in the Information Systems & Data Management section of this plan.

Existing Facility Meter Installations: 25 permanent meters are to be installed in various Region facilities and connected to reporting systems to provide better data that is automatically integrated into the systems used to inform decision making. In addition, temporary metering will be installed to measure the energy use of particular systems for specific projects.

Projects and Implementation:

In addition to staff suggestions and energy audits, CDM opportunities should arise from the evaluation process for projects involving modifications, upgrades or replacements of mechanical, electrical and/or controls equipment in existing and new facilities. These projects often present a good opportunity to improve energy performance at a lower cost than standalone energy retrofits. The incremental capital cost of installing an energy efficient solution when a system is designed is typically far less than upgrading to such a solution after a conventional system has been installed. The costs for services such as design, construction management and installation are generally similar for a conventional system and an energy efficient one, while the energy efficient equipment itself is often less expensive to purchase as an option on new equipment rather than as a standalone product to be added to existing equipment. To achieve this, a formal process is needed to incorporate energy performance into the decision-making process for capital projects:

HVAC Upgrades: Various HVAC upgrades will be completed at different facilities in the Region. Upgrades include solutions that better match heating, cooling and ventilation operation to demand, such as improving controls, balancing the HVAC system, adjusting temperature set-points and installing VFDs on air handling units. Other upgrades involve replacing equipment, such as boilers and chillers, with more efficient options or implementing heat recovery.

1. For new buildings that will be occupied and over 500m^2, design to the LEED Silver or similar green building standards. From 2014 and on, the LEED rating system now has a much stricter energy conservation component with implications for better energy performing buildings.
2. For existing buildings and operations, when modifying, upgrading or replacing mechanical, electrical and/or

The Region's solar electric system generates 1.1 million kWh/year of energy. This is equivalent to meeting the typical electricity needs of 115 homes.

New Construction Projects: Various buildings have been LEED certified or are pending certification, including recently Waterloo Region Police Services North Division, Grand River Transit at 85 Chandler and the current 20 Weber St renovations.

controls equipment, include energy performance as one of the selection criterion listed in the RFP's for equipment and design services. Request that vendors of equipment provide lifecycle costs, including capital cost, maintenance and operating costs (such as energy and water costs).

3. When major replacements of boilers or central chiller plants are required, initiate a discussion on the potential for developing a district energy node to begin development of a thermal grid (a hot and chilled water distribution system).

CDM PROJECT IMPLEMENTATION

CDM opportunities will be evaluated as they arise and either prioritized for implementation, recorded for later review or dismissed. Once a project is approved, a project manager will be assigned from within the energy accounting center that is responsible for that project. The ECO will either take on or agree to designate responsibility for projects that affect facilities across multiple energy accounting centers. When implementing CDM projects, a measurement and verification (M&V) plan is to be developed, according to the guidelines provided in the Performance Management section of this plan. It is important to complete this M&V plan early in the process because it may require installing meters (either permanent or temporary) before the measure is implemented to develop a baseline.

Process Optimization Projects: Various projects will be completed within the process-oriented wastewater treatment, water treatment and waste operations, to optimize those processes and improve energy performance. In particular, energy-intensive processes, such as aeration, will be analyzed.

5.1.2 OPERATIONS AND MAINTENANCE

Driving Corporate Strategic Objectives

1.5 Optimize asset performance and minimize energy costs through incorporating energy management in building/equipment life-cycle decisions.

2.1 Reduce GHG emissions by managing energy consumption.

Energy Performance Standards: Facilities Management will review, compile and oversee a database of energy performance standards for building equipment and building materials in collaboration with the energy accounting centers.

To help train new operators and share successful strategies among current operators, the Region will work toward incorporating identified energy management best practices into its standard operations and maintenance (O&M) procedures.

Over the next two years, the Region is developing a comprehensive Asset Management Plan, which provides the framework for Facility Assets to be operated and maintained according to appropriate, planned regimes. Under the Asset Lifecycle Management component of this plan, O&M strategies will be documented based on each Division's asset management principles and framework. These O&M strategies shall incorporate the energy management best practices outlined by this Energy Plan.

Building Envelope Improvements:
The Region has initiated building condition assessments for many of its facilities and will upgrade building components such as windows or insulation to improve energy performance.

5.2 Energy Supply

5.2.1 ENERGY PROCUREMENT

Driving Corporate Strategic Objectives

1.4 Implement an energy procurement strategy.

2.3 Investigate renewable energy purchasing as a means to reduce GHG emissions.

In 2008, the Region completed a study on energy procurement to develop their energy purchasing strategy. As there have been many changes in the market since then, the Region plans to update this strategy. A review of current market dynamics, costs, risks and benefits will provide a better understanding in the development of options. These options will be provided to senior leadership for approval of a strategy moving forward. The ECO will be collaborating with Finance on this study of energy procurement options for Region facilities, considering the following:

- Evaluate risks and benefits for various options
- Perform an environmental scan of what other municipalities are doing in Ontario
- Electricity options (time-of-use, market price, retail contract, green energy)
- Natural gas options (regulated price from local distribution company, retail contract)
- District energy (chilled water, hot water)
- Biomass and energy from waste (in the future)
- The trade-off between risk and predictability of energy prices

It is important that the operations group responsible for each facility understands the electricity and natural gas rate structures for that facility so that the costs can be managed accordingly. Electricity rates in particular impact the optimal way to operate a facility for managing energy costs. For time-of-use billing, for example, significant cost savings can be achieved by shifting demand to off-peak hours, when the electricity rates are lower. When paying the market price though, shaving the peak demand of the facility is usually more effective because there are significant demand charges. Since the planned energy procurement study will begin with a review of existing energy rates, the existing rates will be communicated to each operations department once the review is complete. Going forward, whenever rates are to be changed, the operations division in charge of the facility will be given the opportunity to provide input on the rate structure and will be notified of new rates once effective.

ELECTRICITY

Electricity rates consist of the commodity price, delivery charges, the debt retirement charge, the global adjustment and regulatory components determined by the Ontario Energy Board (OEB). The commodity portion can be purchased either from the local distribution company (LDC) or under a retail contract from an electricity marketer, while the other components are regulated and must be paid to the LDC. The commodity price charged by the LDC is regulated through the OEB and fluctuates according to market prices; whereas, retail contract prices are unregulated and set by the electricity marketer. Regardless

The current revenue on 16 solar electric sites will net $2.9 million over 20 years.

of any purchasing agreements made, the Region will be billed through the LDC and the LDC will deliver the electricity to Region facilities. Certain electricity marketers also offer contracts for green energy, which will reduce overall GHG emissions if purchased.

NATURAL GAS

Natural gas rates consist of the commodity price and delivery charges. Similar to electricity, the commodity portion can be purchased from either the LDC or a natural gas marketer under a retail contract. Natural gas prices have fluctuated drastically in the past ten years and can be difficult to predict. Retail contracts can provide price stability and can be beneficial if market prices increase more than the contracted price, but they also present the risk that regulated prices will decrease and the Region will be locked into a contract with prices higher than the market.

DISTRICT ENERGY

While opportunities to purchase district energy are not common today, they are expected to increase as the concept becomes more popular in Canada. If there is a particular grouping of facilities being developed by one of the Region's member municipalities, for example, a city may put in a district energy system to which a nearby Region facility could be connected. Another possible source would be an industrial facility that has excess heat to reject from one of their processes and that is located near to a Region facility.

OTHER ENERGY

Other energy supplies are likely to be explored in the future and should be reviewed as they are added to the list of potential energy purchase options for use by the Region. These energy supplies could include biogas, biomass, energy from waste and other renewable fuels considered in the future.

5.2.2 SUSTAINABLE ENERGY GENERATION

Driving Corporate Strategic Objectives

1.3 Manage energy costs, reliability and price volatility by investing in on-site or distributed energy generation where feasible.

2.2 Reduce GHG emissions by investing in sustainable energy generation.

Currently, most municipalities in Ontario buy the bulk of their electricity from the transmission grid managed by Hydro One; however, in the not-too-distant future, local governments will likely take a more proactive role in managing their electrical and thermal energy consumption. Municipalities will develop more sustainable energy systems that include both the electrical and thermal generation and potentially incorporate developing new district energy distribution systems (distribution of hot and chilled water from central energy plants). Ontario Power Authority encourages such developments by the local governments, particularly because as large energy consumers and often partial owners in their local electrical distribution companies, municipalities are in a good position to develop such systems and cost effectively manage their energy and operating costs for public facilities.

1 Since 2003, the Henry Hub spot price has varied from over $18/MMBTU to under $2/MMBTU according to data from the US Energy Information Administration

Installing energy generation systems on-site will reduce the Region's exposure to increasing market prices and enable the Region to predict energy budgets more accurately. Installing new Combined Heat and Power (CHP) generators connected to Region facilities reduces the Region's reliance on the regulated electrical distribution network, increasing energy reliability and flexibility. On-site generation using back-up electrical generators (or combined heat and power units) is particularly beneficial during power outages, which may increase in frequency, considering the aging infrastructure and capacity constraints of the grid. Such CHP systems typically consist of natural gas fired-reciprocating engine generators that are linked to the natural gas distribution grid and can be designed to operate in island mode (supply electricity and hot water to a single building or number of buildings while disconnected from the electrical grid) or in parallel mode with the electrical grid.

Further, installing renewable electricity systems that connect to the grid under the FIT and microFIT programs provides income to offset energy costs. In addition to financial benefits, sustainable energy generation reduces the GHG emissions resulting from energy consumption by either using a technology that does not involve combustion or increasing the efficiency of generation and distribution so that more useful energy can be generated from the same amount of fuel (i.e. CHP).

Each energy accounting centre will consider sustainable energy generation opportunities for their facilities and in the case of district energy, surrounding facilities as well. Sustainable energy generation systems include:

- Solar energy, including photovoltaic, thermal and solar walls;
- Wind energy;
- Hydroelectric energy that is low impact;
- Geothermal exchange systems using ground source heat pumps;
- Biomass combustion, including energy from waste, landfill gas and digester gas;
- Combined heat and power (CHP) with a combined efficiency of over 75%; and
- District energy (heating and cooling distribution system)

IDENTIFYING INNOVATIVE GENERATION OPTIONS

As energy costs rise and environmental sustainability is increasingly valued, more organizations are investing in sustainable energy generation and technologies are advancing. To take advantage of these developments, the Region will investigate the use of innovative generation options that are market-ready, including those listed above. The ECO will be responsible for providing information on new and emerging generation technologies, gathered through the following means:

- Initiate new partnerships with the cities and organizations in the area, including the private sector,
- Research publications,
- Conferences,
- Cross-learning from other municipalities through programs, and
- Energy audits.

PROJECT IMPLEMENTATION

As they arise, sustainable energy generation opportunities will be evaluated and either prioritized for implementation, recorded for later review or dismissed. Once a sustainable energy generation project is approved, a project manager will be assigned from within the energy accounting center where the project is to be installed. The ECO will either take on or agree to designate responsibility for projects that affect facilities across multiple energy accounting centers. When planning the implementation of these projects,

Sustainable Energy Generation: The Region will install sustainable energy generation and distribution systems, such as on-site solar PV, at Region facilities.

develop a measurement and verification plan to track and report on the amount of energy the system actually generates each year. Suppliers of generation technology often offer metering as an option for a small incremental cost compared to the equipment cost. Specify in the procurement documentation that such monitoring equipment be included as an option.

6. Supporting Activities

6.1. Communications, Training & Engagement

People are at the core of energy management and in the long term, people's actions account for a much larger portion of energy savings than technology upgrades. To support the implementation of this CEP, the EPWG will

- Communicate energy management successes, best practices and new initiatives;
- Develop training to further improve the energy knowledge of operations staff and help all staff understand their role in energy management; and
- Engage staff in energy management through encouraging their actions as well as their suggestions for improvement.

COMMUNICATIONS

Relevant, ongoing communication and recognition of achievements is one of the keys to engaging people and sustaining their commitment to a strategy. The ECO will work with various groups who have completed energy projects to showcase those successes and will provide updates on the Region's energy management strategy through the following media:

- Intranet
- Internal newsletters
- Information packages for new employees
- External website
- Social media
- Press releases

TRAINING AND ENGAGEMENT

Various training and engagement programs have been implemented over the past five years, including energy management workshops for operators and an employee staff suggestion program. Over the next five years, the following actions will be taken:

- Staff will receive training on an ongoing basis through workshops, seminars and other forms of training. These staff members will then bring back the knowledge gained and present learnings to the EPWG during meetings.
- An energy awareness campaign will be run to help staff recognize and reduce energy consumption.
- An operator recognition program will be investigated to reward operators for outstanding performance in energy management each quarter. Recognition may include staff announcements, portal news stories, conduct a lunch-and-learn on the successful measure they have implemented and awards.
- An energy champion program will be investigated with champions selected from each division to educate and encourage colleagues to manage their impact on energy consumption.

6.2. Finance & Administration

Finance has a critical role to fulfill for the successful implementation of this CEP. Since cost avoidance is a primary driver of the Region's energy management strategy, cost data is essential to measure performance and inform decision-making. The finance department, as the body that receives and processes all electricity and natural gas bills for the Region, is the keeper of this data.

To provide each division with timely information for tracking their energy costs, when a staff member in Accounts Payable pays an electricity or natural gas invoice, that staff member will also email a copy of the invoice to the ECO and appropriate division representative. With the implementation of the Asset Management Strategy and related system upgrades, this process can be improved. Under the Asset Management

Strategy, each facility will have its own account to which energy costs are charged. When developing the system and process changes that allow this a level of tracking, the EPWG will facilitate the development of a corresponding, automated method of collecting and communicating consumption / cost data for individual divisions and facilities.

6.3. Asset Lifecycle Management

The Asset Management Strategy and this CEP are closely linked through Asset Lifecycle Management (ALM): the creation, acquisition, maintenance, renewal and disposal of assets. ALM dictates that when decisions are made regarding asset creation and acquisition, the lifecycle costs, of which energy costs are usually a large component will be a key consideration. This will help to incorporate energy performance into the decision-making process for the procurement of buildings, systems, products, equipment and design services.

While this CEP provides direction, implementation will be taken under the Asset Management Strategy.

The Region leverages funding for energy projects with grants from external agencies. The Operations Centre solar electric project received $500,000 each from the Provincial and Federal governments towards the $1,500,000 project.

6.4. Information Systems & Data Management

Effective management of energy can only be accomplished if energy use is understood and that requires timely, comprehensive and accurate data. The Region does currently collect a significant amount of data and tracks it using a SCADA system or in the Energy and Environmental Management System (EEMS). The Region has been collecting energy data within EEMS since 2003 and is ready to take the next step toward more advanced systems that allow better analysis capabilities and integration with sub-metered data. To improve the systems that enable effective energy management, support from the Region's IT division will be essential.

In addition to updating EEMS, the EPWG will work with IT and other stakeholders to establish a software solution to be used for tracking, evaluating and reporting on CDM and sustainable energy generation opportunities, from identification through to implementation. This will enable the Region to encourage more suggestions from staff, track measures that should be reconsidered at a later date and generate automatic reports on the results of these measures, for both public and internal purposes.

High-level requirements of this software solution include:

- Online access with different security levels for different users
- Energy management suggestion tool on employee portal
- Automatic and customized reporting capability
- Status tracking for energy management initiatives
- Analysis tools to assist with lifecycle cost avoidance calculations and project evaluation of new opportunities
- Tie-in to the overall revenue meters and sub-meter data for implemented projects
- Energy data normalization for weather
- Tracking of project costs, projected and actual savings, key performance indicators
- A database of learnings from different projects and reports from energy studies with the capability to notify a user that is entering a new project or study of results from similar projects or studies
- Documentation database for relevant policies/procedures

7. Performance Management

The purpose of performance management is to check that the Region's energy management strategy and related activities are producing the desired results and if not, adjust the strategy and/or supporting activities to improve performance. Activities under this service category are focused on establishing processes for continuous improvement of the Region's energy management.

ENERGY MONITORING

To enable effective performance management, the Region shall collect, organize and communicate energy data, as necessary both to effectively plan, implement and assess energy management initiatives and to consider energy costs in strategic decision-making. Currently, metering in Region facilities includes real-time meters, meters connected to building automation systems, interval meters with Utilismart software capability and regular utility meters. Monthly utility data is currently entered and tracked in EEMS once it has been received and processed by Accounts Payable.

Two areas for improvement in energy monitoring have been identified as priorities for this plan:

1. Make energy cost and consumption data available for each division in a more timely fashion.
2. Increase the amount of real-time energy use data available from revenue meters and sub-metering of significant energy-using equipment.

The first of these items will be addressed through a new process for utility invoices that will include sending out the invoice information to the appropriate division representative, as discussed in the Finance & Administration section of this Plan. The second item will be addressed by installing sub-meters gradually, both as part of the measurement and verification plans for specific energy management measures and as part of metering initiatives planned for particular facilities. In water and wastewater operations, the sub-meters installed will be tied into the operational SCADA system to allow operators to easily track energy consumption and adjust operating procedures when appropriate. Information on energy use of the entire operation will then be communicated to EEMS. In other facilities, sub-meters will be specified to include the capability to directly convey data to EEMS.

MEASUREMENT AND VERIFICATION (M&V) OF ENERGY PROJECTS

An M&V strategy shall be selected and reported on for each planned energy management project. If implemented projects fall significantly short of projections, the project shall be investigated and the learnings entered into the software system (used to track and evaluate projects) to inform future decision-making. For sustainable energy generation projects, the M&V can be based on modeling simulations and compared to actual energy generated, measured by energy monitors installed along with the system. The M&V methodology for CDM projects shall be selected from the International Performance Measurement and Verification Protocol (IPMVP) options.

REPORTING

Each quarter, the EPWG will meet to discuss planned and current projects. On an annual basis, each energy accounting centre will provide a summary of the projects completed that year and the projects planned for future implementation, as well as any causes for adjustments in baseline energy consumption. An example of such an adjustment is a regulation change that increases the water treatment levels and requires a more energy-intensive treatment technology to be used.

The ECO will compile this information, the energy key performance indicators (KPIs) outlined below, and the energy consumption report required by Ontario Regulation 397/11 into an annual summary report for the Senior Management Team (SMT).

Energy Accounting Centre	Key Performance Indicator
Buildings	ekWh / ft^2
Water	ekWh / ML treated water, adjusted for new standards
Wastewater removed	ekWh / ML treated water, adjusted for new standards, and kWh / cBOD
Waste	ekWh / tonne of waste processed
Transportation – airport	ekWh / ft^2

Energy performance data will be reviewed annually by the EPWG with recommendations to optimize performance, and the plan will be reviewed, updated and published every five years, or earlier as needed.

8. Glossary

Asset Management: The integrated set of processes that minimize the lifecycle costs of owning, operating, and maintaining assets, at an acceptable level of risk, while continuously delivering established levels of service

Asset Management Team (AMT): The existing Region of Waterloo team that is developing the Asset Management Plan

Combined Heat & Power (CHP): Cogeneration of electricity and heat by a single engine or power station

Community Housing: A range of affordable housing and housing programs that is overseen or funded by the Region of Waterloo

Corporate Energy Plan (CEP): The plan that sets out a framework for energy management at the Region of Waterloo facilities and operations

Corporate Finance: The existing Region of Waterloo corporate finance group

Council: Region of Waterloo Council

Equivalent kilowatt hour (ekWh): Conversion of other forms of energy into a common kWh value

Energy & Environmental Management System (EEMS): A versatile online database designed to track consumption, expenses and environmental effects of energy usage

Energy Accounting Centre (EAC): Business units responsible for energy performance. Each centre is accountable for its own energy use and is given control over the decisions affecting that energy use

Energy Conservation Office (ECO): Team (within Facilities Management Division) responsible for overseeing the development and implementation of the Plan

Energy Plan Steering team (EPST): The Directors of divisions that account for the bulk of the region's energy consumption. Responsible for providing oversight and guidance. This team is comprised of three directors: Director, Water Services; Director, Facilities Management; Director, Waste Management

Energy Planning Working Group (EPWG): The team charged with developing this Corporate Energy Plan and the team that will be responsible for its implementation

Facility Assets: Assets to be managed under the Asset Management Plan

Greenhouse Gas (GHG): Various atmospheric gases whose densities affect the temperature of the earth

Heating, ventilating & air conditioning (HVAC): Industry term relating to mechanical equipment required to service buildings.

Key performance indicators (KPI): Performance measurements that have been selected to evaluate progress and success of an organization, project, system or program

Kilowatt hour (kWh): A unit of energy equivalent to one kilowatt of power expended for one hour of time.

(kWp): The peak power available under optimum conditions

LED lamp: a light emitting diode that is assembled into a lamp for use in lighting fixtures

m3: volume measurement, cubic meters

Materials recycling centre (MRC): Facility where recyclables are processed

Measurement and Verification (M&V): The processes by which energy savings are measured and verified

Megawatt hours (MWh): common energy unit in 1000 x kWh

(MMBTU): common thermal energy unit in 1 million x British Thermal Units

Request for proposal (RFP): A document that invites potential suppliers to present proposals on a product or service of interest

Supervisory Control and Data Acquisition (SCADA): An industrial computer system that monitors and controls water and wastewater treatment process

Sustainable Energy Generation: A comprehensive term for alternative energy supply systems and generation, including renewable energy, geothermal, biomass, combined heat and power and district energy

Variable frequency drives (VFD): An electronics control centre that adjusts electric motor speeds and torque to match the load demand

Appendix A: Project Evaluation Criteria

When evaluating and prioritizing projects for implementation, consider the following criteria:

Time sensitivity: Energy efficient options on existing capital projects or equipment purchases often require a decision to be made within a short timeframe to prevent delaying the project. In these cases, if this timeframe is missed, the energy efficient option is not feasible to implement at a later date, so if the measure meets other criteria, then time sensitivity makes it high priority for implementation.

Direct project financials: For capital cost < $50,000 Evaluate capital cost, forecasted avoided costs and simple payback. Assign projects with lower simple payback a higher priority.

For capital cost > $50,000 Evaluate capital cost, forecasted avoided costs over the lifecycle of the measure and net present value considering debenture costs. Assign projects with higher net present value a higher priority.

Indirect cost avoidance: Energy management projects often improve the operation of equipment and may prevent premature and/or critical equipment failure. Some indirect cost avoidances may be greater than the energy cost avoided by the project, so this criterion can significantly impact priority.

Environmental benefit: The avoided GHG emissions from a reduction in energy consumption or via the use of renewable/alternative sources should be calculated and considered as well as the financials. Marginal abatement cost curves can be used to factor in both considerations.

Service Level: In addition to cost, measures that improve service levels will be prioritized higher and overall service level should be maintained or increased after measure implementation.

Leadership potential: Certain projects, such as thermal and pumped energy storage, can demonstrate leadership in energy management and promote development in the field. These may be demonstration initiatives where newer technology applications are being implemented and scrutinized against claimed benefits. While this is not the most important criterion, it should be recognized if the project already meets other criteria.

Appendix B: Audit Process

1. Review the existing CDM measure list and the measures planned for implementation by that energy accounting centre. If more savings opportunities than those already identified are required to meet the Region's goals, proceed with additional energy audits.

2. Rank facilities by their energy consumption and compare the largest energy-users against benchmarks for similar facilities. Based on the analysis, plan energy audits for the building(s) or operation(s) in which energy performance can likely be improved. Use the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) level system (summarized below) for classifying audits or another method of standardizing energy audit processes:

Level 1: Walk-through audit

- Includes a brief inspection of the facility
- Identifies low-cost CDM measures
- Provides a rough estimate of costs and savings

Level 2: Energy Survey & Analysis

- Includes a more detailed inspection of the facility
- Provides a refined analysis of energy use
- Includes detailed analysis of CDM opportunities and more accurate estimates of the costs and savings than Level 1
- Identifies both low cost and more capital intensive CDM measures improvements

Level 3: Detailed Survey & Analysis

- Completed for specific, major capital investments
- Includes a refined analysis of costs and savings based on monitored data and in-depth analysis

3. For facilities that have not previously been audited and in which opportunities are completely unknown, plan an ASHRAE Level 1 audit (a walk-through audit) to identify simple CDM measures for immediate implementation and more complicated measures for additional investigation. This level of audit will determine whether a Level 2 or 3 audit would be productive and if so, establishes the scope of work for that audit.

4. For facilities in which opportunities are known to exist and the scope of work is well-defined, plan a Level 2 audit (an energy survey and analysis) to identify measures for implementation.

5. For facilities in which the opportunities to be investigated are for a particular system that consumes a significant portion of overall energy use, plan a Level 3 audit (detailed survey and analysis).

6. To ensure that identified measures are actionable, in the audit RFP, specify that the audit report shall include an execution model for realizing identified viable energy opportunities and incentive funding available for their implementation (such as Federal, Provincial, OPA and local distribution company funding).

7. For Level 1 and 2 audits, in the RFP, specify that the audit report shall identify, for further investigation, any innovative sustainable generation opportunities that are particularly suited to the site.

Appendix C: Reporting CDM Opportunities

Source of CDM Opportunity	Responsibility for Ensuring CDM Opportunity is Tracked
Internally initiated	
Operator suggestions	The operator that provided the suggestion
General staff suggestions	The staff that provided the suggestion
Chief building operator meetings	An Energy Conservation Office representative that attended the meeting
Energy audits and studies	The Region's project manager for that energy audit or study
Existing capital or asset management projects for which there is an energy efficient option. This includes scheduled replacements of equipment, systems, aspects of building envelope, etc.	The Region's project manager for that project
Externally initiated	
Engineering, Contractors and Equipment Vendors, member municipalities	The Region staff that receives outside input for innovative energy solutions within the Region, which may include collaboration opportunities with the City of Kitchener, Waterloo, Cambridge

Appendix D: Operations and Maintenance Reference

The following table outlines a few key operations and maintenance best practices that improve energy performance:

Operations	Maintenance
Establish appropriate setbacks	Carry out preventative maintenance
Control operations to match, not exceed, needs	Clean / change equipment components as appropriate
Use the appropriate utilities for applications	Detect and repair leaks

Table 1. Examples of typical problems that cause higher energy costs

Typical Problems	Monitoring Frequency*
Process Operations	
• incorrect set-points	hourly
• fouled heat exchangeers	daily
• advanced controls switched off	hourly
• poor control timing	hourly
Boilers	
• poor air-fuel ratio	hourly
• fouled exchangers	daily
• excessive blow-down	hourly
• incorrect boiler selection	hourly
Refrigeration	
• fouled condenser	daily
• air in condenser	daily
• incorrect superheat settings	daily
• high head pressure settings	daily
• incorrect compressor selection	hourly
Compressed Air	
• leaks	daily
• poor compressor control	daily/hourly
• incorrect pressure	hourly

Typical Problems	Monitoring Frequency*
Steam	
• leaks	hourly
• failed traps	hourly
• poor isolation	hourly
• incorrect set-points	hourly
• low condensate return	hourly
Space Heating/Cooling	
• excessive space temperature	hourly
• excessive fan power use	hourly
• overcooling	hourly
• heating and cooling	hourly
• high chilled water termperature	hourly
Power Generation	
• poor engine performance	hourly
• incorrect control settings	hourly
• poor cooling tower operation	hourly
• fouled heat exchangers	hourly

Figure 4 Source: "Canadian Industry Program for Energy Conservation, Energy Management Information Systems: Achieving Improved Energy Efficiency, a Handbook for managers, engineers and operational staff, Natural Resources Canada 2004"

Appendix E: Measurement & Verification Options

The following provides a summary of measurement and verification options outlined by the International Performance Measurement and Verification Protocol:

Option A – Retrofit Isolation: Key Parameter Measurement

This is the simplest option and does not require baseline measurements because reference data is well-documented and the baseline can be determined from engineering calculations. The energy use after implementation can be determined from a measured key parameter and estimated values that are based on historical data, equipment specifications or engineering judgment.

Option B – Retrofit Isolation: All Parameter Measurement

This option requires that both the baseline energy and energy use after implementation are measured directly or are calculated based on a related parameter that is measured directly.

Option C – Whole Facility

This option should be selected when there are multiple CDM measures implemented that are significant enough to impact overall energy use. It requires that the baseline energy and energy use after implementation be based on data available for the facility's energy use. A year's worth of monthly utility data can be used for this option. Other factors affecting consumption can be adjusted for using analysis techniques such as regression.

Option D – Calibrated Simulation

This option can also be used when multiple CDM measures are implemented, but it is an option when no historical data is available and implementation is complete. A computer model is used to simulate the baseline energy use and the energy use after implementation. Collected energy data is used to calibrate the model.

Appendix F: Annual Reporting

Energy Accounting Centre Reporting Template

YEAR: _____

DATE SUBMITTED: _____

ENERGY ACCOUNTING CENTRE: _____

AVERAGE KEY PERFORMANCE INDICATOR VALUE: _____

PROJECT PROGRESS

Project No.	Status	Completion Date	M&V	Capital Cost, $	Incentive Funding	Annual Electricity Savings, kWh	Annual Natural Gas Savings, m^3	Comments

BASELINE ADJUSTMENTS (ONLY FILL OUT IF NECESSARY)

Adjustment Cause	Explanation of Adjustment	Effective Date

Region of Waterloo
Corporate Resources,
Facilities Management and Fleet Services
50 Queen St., 7th Floor
Kitchener, ON N2H 6P4