



City of Rochester
**Municipal
Operations
Climate
Action Plan**



Narrative Report • Produced by the City of Rochester
In collaboration in ICLEI-Local Governments for Sustainability USA • July, 2013

Credits and Acknowledgements



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ICLEI – Local Governments for Sustainability USA (ICLEI) is a membership association of more than 1,200 local governments worldwide – more than 600 in the United States – committed to advancing the climate protection and sustainability. Through technical expertise, direct network engagement, and the innovation and evolution of tools, ICLEI strives to empower local governments to set and achieve their emissions reduction sustainability goals.

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City of Rochester Environmental Mission

The City of Rochester will demonstrate our commitment to outstanding environmental stewardship through practice and policy. The City, while cognizant of fiscal limits, is committed to the implementation of environmental management practices that will provide a healthy and sustainable environment and enhance the quality of life for our residents.

Our Environmental Values as Citizens and employees of the City of Rochester, we practice environmental leadership and act as environmental stewards. **We are guided by the following values:**

Sustainability. We carefully consider how to best design any construction that can be maintained over time without damaging the environment, balancing near-term interests with the protection and public safety of the interest of future generations. We recognize the interdependence between environmental quality, economic growth, and social justice.

Conservation. We plan for the careful use of natural resources in order to prevent depletion, prevent pollution and to do no harm to the environment. Through action and education, we strive to reduce energy consumption, waste generation, dependence on fossil fuels and production of greenhouse gases.

Restoration. We will work to clean up environmentally impacted lands that impede a sustainable environment. We will actively seek funding for and promote restoration and development of Brownfields within the City.

Compliance. All City of Rochester facilities and operations will meet or exceed standards and regulation for compliance with state and federal environmental regulations, for the benefit of all its customers.

Leadership. We will act as community models and educators in environmental stewardship. We will always strive to “do the right thing” in environmental matters.

Continuous Improvement. We will, on a regular basis, review our environmental program, identify opportunities for improvement, and implement changes when necessary.

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List of Acronyms

Acronym	Definition
AFV	Alternative Fuel Vehicle
BBC	Better Buildings Challenge
CACP 2009	Clean Air and Climate Protection Software, 2009 Edition
CAP	Climate Action Plan
CAPPA	ILCEI Climate and Air Pollution Planning Assistant V1.5 [©]
CH ₄	Methane
CNG	Compressed Natural Gas
COR	City of Rochester
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
CDD	Cooling Degree Days
CY	Calendar Year
DOE	United States Department of Energy
ECM	Energy Conservation Measure
EECBG	Energy Efficiency and Conservation Block Grant
EECS	Energy Efficiency and Conservation Strategy
EIA	United States Energy Information Administration
EUI	Energy Use Intensity
EV	Electric Vehicle
FY	Fiscal Year
GHG	Greenhouse Gas
GWP	Global Warming Potential
HDD	Heating Degree Days
HFCs	Hydrofluorocarbons
HVAC	Heating, Ventilation and Air Conditioning
ICLEI	International Council for Local Environmental Initiatives
IEAP	International Local Government GHG Emissions Analysis Protocol
kBtu	Kilo British Thermal Units
kWh	Kilowatt-hours

LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
LGOP	Local Government Operations Protocol
MMBtu	Million British Thermal Units
Mlbs	Thousand Pounds of Steam
MTCO ₂ e	Metric Tons of Carbon Dioxide Equivalent
MSW	Municipal Solid Waste
MW	Megawatt
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
N ₂ O	Nitrous Oxide
PFCs	Perfluorocarbons
PHEV	Plug-in Hybrid Electric Vehicle
PPA	Power Purchase Agreement
PV	Photo Voltaic
RDH	Rochester District Heating (Steam)
RG&E	Rochester Gas and Electric
SEC	State Electronics Challenge
SF ₆	Sulfur Hexafluoride
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
VMT	Vehicle Miles Travelled
WQIP	Water Quality Improvement Program

Executive Summary

The City of Rochester (City) has made a commitment to address climate change by reducing energy consumption and greenhouse gas (GHG) emissions within its municipal operations. One of the foremost ways the City has recognized this commitment is to sign onto the United States Department of Energy's (U.S. DOE) Better Buildings Challenge (BBC). Under the BBC, the City has pledged to reduce energy use intensity (EUI) by 20% by 2020 from a 2009 baseline of 4,120,224 square feet of municipal building space. In addition to the BBC, the City aims to reduce absolute GHG emissions (GHG emissions without normalization for activity levels) throughout City operations by 20% by 2020 from a 2008 baseline. To support data management and future EUI analysis, the City began tracking EUI data (*i.e.*, building energy consumption and square footage), beginning with baseline year 2009, using the Energy Star Portfolio Manager® on-line tool. Since this baseline year, the City has implemented energy reduction measures in municipal buildings that have resulted in a decrease of approximately 4% in EUI through 2012.

In 2011 the City completed a baseline GHG emissions inventory for the baseline year 2008. According to this GHG emissions inventory, the City's municipal operations resulted in 33,039 metric tons of carbon dioxide equivalent emissions (MTCO_{2e}) for the 2008 baseline year, exclusive of steam consumption and Scope 3 emissions. Including the steam consumption and Scope 3 emissions the City's total GHG emissions baseline estimate changes to **35,599 MTCO_{2e}**.

Based on discussions with City officials, the size of the vehicle fleet, number of buildings, and extent of services provided by the City are projected to remain relatively flat 2008 through at least 2020. Consequently, GHG emissions and EUI associated with municipal activities are projected to remain unchanged through 2020, relative to the 2008 values (35,599 MTCO_{2e}) and 2009 values (124 kBtu/gross square foot (GSF)-year) respectively. However, it is the City's goal and commitment to reduce government-wide GHG emissions by 20% below 2008 baseline emissions by 2020. Through the end of 2011, GHG reduction measures implemented by the City have already resulted in an 8.62% reduction from 2008 baseline emissions.

The City will work towards achieving municipal EUI and GHG emissions target reductions by focusing on the following five key categories of proposed measures and policies:

- Energy Efficiency and Renewable Energy;
- Transportation and Fleet;
- Materials and Waste Management;
- Climate Change Adaptation and Green Infrastructure; and
- Employee Education and Engagement.

The City's Climate Action Plan (CAP)

- Provides background on the science and impacts of climate change;
- Presents the City's baseline GHG emissions inventory and emissions reduction target;
- Presents the City's EUI baseline and energy use reduction target;
- Outlines the policies and measures in transportation/fleet, energy efficiency and renewable energy, materials and waste management, climate change adaptation and green infrastructure, and employee education and engagement that the City will implement and/or is already implementing to achieve its target; and
- Presents next steps required to implement the CAP.

Completion of the measures and projects outlined in this CAP within the next six years is expected to contribute to progress toward the EUI and GHG emissions reduction goals such that the City will be approximately 144% and 101% of these goals, respectively, by 2020. This CAP also provides the City's plans for evaluating additional measures that may be implemented for the purpose of providing additional energy and GHG emissions reductions.

The City is committed to assessing and requesting resources required to implement measures considered to be beneficial both in terms of GHG and EUI reductions as well as cost effectiveness. The determination of these projects and accomplishments will be dependent on feasibility and funding source availability.



City Hall Green Roof.

Background: Rochester's Climate Change Initiative

The City recognizes that local governments play a leading role in reducing both GHG emissions and the potential impacts of climate change. There is growing awareness that GHG emissions from human activity are contributing to global climate change and that the City has a responsibility to act to reduce these emissions, through its municipal operations through “leading by example” and inspiring change throughout the community. The City has pledged to do its part to meet the challenge of reducing its GHG emissions in meaningful ways through the following:

- Signing the U.S. Conference of Mayors Climate Protection Agreement (2007): committing to reducing GHG emissions to meet or surpass the Kyoto Protocol targets of a seven percent reduction from 1990 levels by 2012;
- Taking the New York State Department of Environmental Conservation (NYSDEC) Climate Smart Communities Pledge (2009): a state-local partnership committed to the voluntary undertaking of climate reduction actions, saving taxpayer dollars and advancing community goals for health and safety, economic vitality, energy independence and quality of life;
- Passing a Resolution in Support of Environment and Climate Protection Actions (2009): acknowledging the many activities the City has already undertaken and paving the way for additional efforts that will position Rochester as a livable, green City;
- Completing a baseline GHG inventory (2011);
- Tracking energy and water consumption using the ENERGY STAR Portfolio Manager® online tool (2012);
- Signing the U.S. DOE BBC (2012): pledging a 20% reduction in building EUI from a 2009 baseline by 2020 incorporating 4,120,224 square feet of municipal building space
- Formally establishing the City's Office of Energy and Sustainability within the Department of Environmental Services (2012) ; and
- Developing this CAP (2013).

Since the start of these commitments, the City has undertaken many initiatives to increase sustainability efforts throughout the City and reduce GHG emissions (discussed further in Section 5). The City also continues to evaluate areas where measures can be implemented to reduce energy consumption and GHG emissions. This CAP serves both to provide a summary of the steps that the City has taken and plans to take towards meeting the following EUI and GHG emissions reduction commitments:

- A 20% reduction in absolute GHG emissions in government operations from 2008 baseline GHG emissions by 2020; and
- A 20% reduction in EUI in municipal buildings from 2009 baseline by 2020, in accordance with the BBC.

This CAP will also aid in planning for a City-wide sustainable future and paving the path for the Community as a whole. For more information on these and additional green activities and initiatives, the reader is encouraged to visit the City’s website at www.cityofrochester.gov.

About ICLEI and the Cities for Climate Protection Campaign

ICLEI’s mission is to improve the global environment through local action. The Cities for Climate Protection® (CCP) campaign is ICLEI’s flagship campaign designed to educate and empower local governments worldwide to take action on climate change. ICLEI provides resources, tools, and technical assistance to help local governments measure and reduce GHG emissions in their communities and their internal municipal operations.

ICLEI’s CCP campaign was launched in 1993 when municipal leaders, invited by ICLEI, met at the United Nations in New York and adopted a declaration that called for the establishment of a worldwide movement of local governments to reduce GHG emissions, improve air quality, and enhance urban sustainability. The CCP campaign achieves these results by linking climate change mitigation with actions that improve local air quality, reduce local government operating costs, and improve quality of life by addressing other local concerns. The CCP campaign seeks to achieve significant reductions in U.S. GHG emissions by assisting local governments in taking action to reduce emissions and realize multiple benefits for their communities.

ICLEI uses the performance-oriented framework and methodology of the CCP campaign’s 5-Milestones to assist U.S. local governments in developing and implementing harmonized local approaches for reducing global warming and air pollution emissions, with the additional benefit of improving community livability. The milestone process consists of the following and is presented in Figure 1:

- Milestone 1: Conduct a baseline emissions inventory and forecast;
- Milestone 2: Adopt an emissions reduction target;
- Milestone 3: Develop a CAP for reducing emissions;
- Milestone 4: Implement policies and measures; and
- Milestone 5: Monitor and verify results.



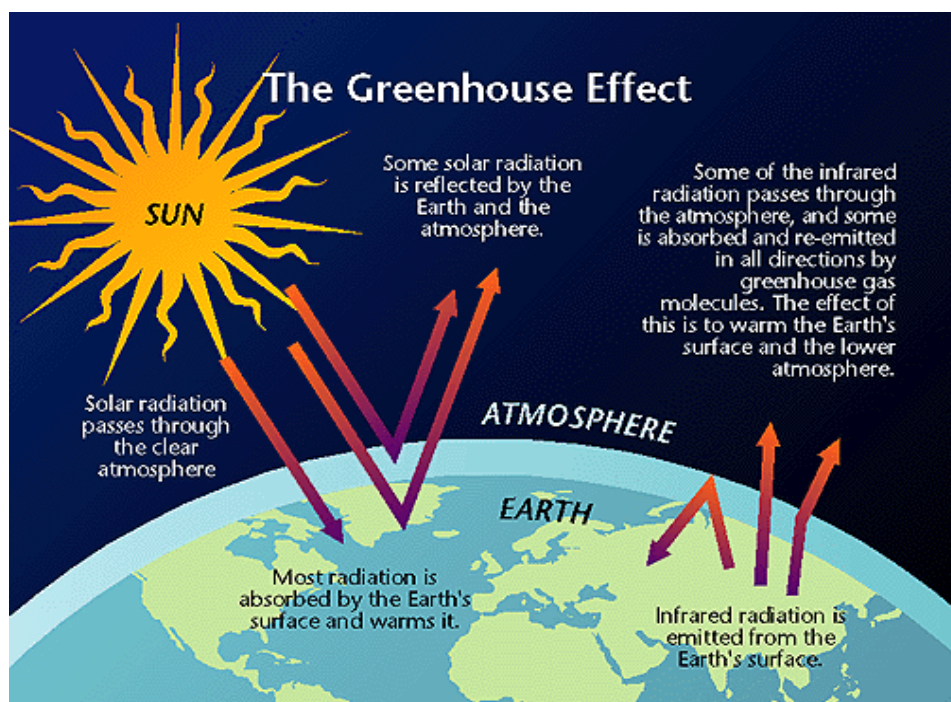
Figure 1. ICLEI 5-Milestones.

1. Introduction

1.1. Introduction to Climate Change Science

The Earth's atmosphere is naturally composed of a number of gases that act like the glass panes of a greenhouse, retaining heat to keep the temperature of the Earth stable and hospitable for life at an average temperature of 60°F. Carbon dioxide (CO₂) is the most prolific of these gases. Other contributing gases include methane (CH₄), nitrous oxide (NO₂), ozone (O₃), and halocarbons. Without the natural warming effect of these gases the average surface temperature of the Earth would be around 14°F.

Figure 2. The Greenhouse Effect.



Source: U.S. Environmental Protection Agency

However, recently elevated concentrations of these gases in the atmosphere appear to be having a de-stabilizing effect on the global climate, accelerating global climate change. The global average surface temperature increased during the 20th century by about 1°F. According to NASA scientists, the 1990s were the warmest decade of the century. Across the United States, average temperatures have increased during the past 100 years, and the rate of warming has increased over the past several decades. Increasing global temperatures and shifting precipitation patterns are also causing regional and seasonal changes to the water cycle. Nearly the entire United States has experienced increased average temperatures, with the extent of warming varying by region¹.

¹ U.S. DOE, U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather, July 2013

Scientific Facts and Projections²:

- The warmest year since record keeping began in 1895 for the contiguous United States was 2012, and the hottest month for the nation was July 2012 (NOAA 2013c).
- The average annual temperature for 2012 was 55.3°F (12.9°C), which was 3.2°F (1.7°C) above the 20th century average (NOAA 2013c).
- Since 1901 total annual precipitation in the contiguous United States has increased at a rate of about 5.9% per century (EPA 2012a), although some regions, such as the Southeast, Southwest, and Rocky Mountain states, have experienced a decrease in precipitation.
- Increasing global temperatures and shifting precipitation patterns are causing regional and seasonal changes to the water cycle (NOAA 2013b, WMO 2013, IPCC 2012, USGCRP 2009).

The climate and the atmosphere do not react in a linear fashion to increased greenhouse gases. The specific degree of warming that each ton of carbon dioxide emitted from a power plant or a vehicle's tailpipe will cause cannot be simply predicted. The Earth's climate has a number of feedback loops and tipping points that scientists fear will accelerate global warming beyond the rate at which it is currently occurring. For example, as CO₂ emissions have increased in recent human history, the oceans have been absorbing a significant portion of these gases, but as the oceans become more permeated with CO₂, scientists anticipate they will reach a saturation point, after which each ton of anthropogenically emitted CO₂ will have a more substantial impact. Another example of this compounding can be found in the polar ice caps. Ice is highly reflective and acts effectively like a giant mirror, reflecting the sun's rays back into space. As the planet warms and some of this ice melts away, a darker land or ocean surface is revealed. This darker surface tends to absorb more heat, accelerating the speed at which the planet warms with each ton of GHG emitted³.

1.2. Effects and Impacts of Climate Change

Global Impacts

In addition to causing an increase in average global surface temperature, rising levels of greenhouse gases have a destabilizing effect on a number of different micro-climates, conditions and systems. According to the Intergovernmental Panel on Climate Change, surface temperatures are on course to increase by between 2.5 and 10.5°F by the year 2100, with regions in the northern parts of North America and Asia heating by 40% above the mean increase.⁴ The increase in the temperature of the oceans is projected to accelerate the water cycle, thereby increasing the severity and rate of both storms and drought, which, along with decreased snow pack, could disrupt ecosystems, agricultural systems, and water supplies.

² U.S. DOE, U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather, July 2013

³ Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

⁴ Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

Snow cover has decreased by 10% in the last forty years. Average sea levels have raised between 1/3 and 2/3 of a foot over the course of the 20th century and are projected to rise by at least another 1/3 of a foot and up to almost three feet by the year 2100. These coastal infringements on such a large scale could lead to not only significant environmental and ecosystem disturbances, but also major population displacement and economic upheaval.⁵

Local Impacts:

While climate change is a global problem influenced by an array of interrelated factors, climate change is also a local problem with serious impacts foreseen for New York State and the City of Rochester. Over the past several decades New York State and the Rochester area have experienced the effects of climate change. The changes, though mild, have been noticed and documented. The average temperatures for the Rochester area have been steadily increasing, along with extreme heat and humidity, storms, droughts, and unhealthy air quality. The increase in heat and humidity are contributing factors to the reported higher rates of infectious diseases such as West Nile and Lyme's disease. Storms and rapidly changing weather patterns have contributed to flooding and algal blooms. Not only are these climate changes damaging to the environment but they have adverse effects on the citizens of our region and their quality of life⁶.

1.3. Action Being Taken on Climate Change

International Action

As evidence of climate change has mounted, groups at the international, federal, state and local level have responded with ways to confront the impending threat. The United Nations Framework Convention on Climate Change (UNFCCC) leads international efforts to investigate and combat climate change. Recognizing the problem of potential global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk associated with human-induced climate change, its potential impacts and options for adaptation and mitigation, releasing its most recent assessment in 2007. The IPCC has currently assembled another Working Group to prepare a fifth assessment report scheduled to be released sometime in late 2014.⁷

In 1997, 10,000 international delegates, observers and journalists gathered in Kyoto, Japan to participate in the drafting and adoption of the Kyoto Protocol, requiring industrialized nations to reduce their collective GHG emissions 5.2% below 1990 levels. As of January 2011, 192 parties have ratified the Protocol, with the United States and Australia most notably absent from the list. Additionally, since 1995 the annual United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP) has met to discuss action

⁵ Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

⁶ Natural Resources Defense Council, www.nrdc.org/health/climate/ny.asp

⁷ Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report: "Climate Change 2007", AR5

and implementation to combat climate change, with the most recent COP, scheduled to be held in Warsaw, Poland this coming November, 2013.

State and Federal Action

New York State has realized the threat of climate change and in response has set two goals:

- Executive Order No. 24 (2009): Reduce emissions of heat-trapping greenhouse gases by 80 percent from 1990 levels, by the year 2050 ("80 by 50") and preparing a CAP; and
- Climate Smart Communities Program: Improve resilience to climate change in all the state's communities.

As New York works towards minimizing the risks from climate change by planning, establishing programs, and action, the end result will be that new economic opportunities will arise and the dependence on out-of-state energy sources will diminish. The negative impacts of climate change have affected New York in the following ways:

- Winter snow cover is decreasing and spring arrives, on average, a week earlier than just a few decades ago;
- Nighttime temperatures are measurably warmer;
- Sea levels are rising thus increasing the risk of flooding;
- Summers have more record-hot days;
- Diseases typical of warmer climates are appearing; and
- Intense precipitation events are occurring on a more frequent basis.

Scientists and economists indicate that as the earth gets warmer, undesirable climate change effects will significantly outweigh apparent benefits, both in economic cost and in damage to our way of life. Today, New York faces energy and climate choices that can reduce the climate risk to future generations with new and powerful opportunities for economic development and diversification. Such opportunities include:

- **Emission reduction choices:** Limiting the GHG emissions from businesses, institutions, homes, transportation, waste disposal, and electric power generation can help to stabilize atmospheric greenhouse gases at manageable levels and avoid severe climatic changes. A burgeoning "green" economy can meet the demand for energy-efficient products and employ thousands in weatherizing buildings.
- **Climate change adaptation choices:** Protecting against unavoidable climatic changes over the longer term may require alterations to the built and natural environments. Positioning our communities, institutions and businesses for stability in the face of significant climate change will initiate local jobs and economic activity, helping to buffer the state's economy against high costs from a changing climate⁸.

⁸ New York State Department of Environmental Conservation, Energy and Climate, Climate Change

The Federal government has developed standards and proposed actions for reducing GHG emissions and combating climate change by the following:

- On September 20, 2013, EPA published the proposed *Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units* which will serve to limit carbon pollution from new power plants. These standards reflect the ongoing trend to build cleaner power generation plants that take advantage of American-made technologies. This rule would apply only to new fossil-fuel fired electricity utility generating units, ensuring progress towards cleaner, safer, and more modern power production⁹; and
- The White House, on June 25, 2013, released a President Obama's CAP to cut carbon pollution, move the U.S. economy toward American-made clean energy sources, create jobs, and lower home energy bills.

The President's plan:

- Directs the EPA to work with states and industry to establish carbon pollution standards for new and existing power plants;
- Provides \$8 billion in loans for fossil energy and efficiency projects;
- Promotes new renewable energy projects such as solar and wind on public lands by 2020 to power more than 6 million homes;
- Expands upon the Better Building Challenge;
- Sets a goal to reduce carbon pollution by at least 3 billion MTCO₂e by 2030;
- Partners with industry and stakeholders to develop fuel economy standards for heavy-duty vehicles; and
- Leverages new opportunities to reduce GHG pollution¹⁰.

Local Action

Climate Smart Communities

In 2009, the City became a participant of the NYSDEC Climate Smart Communities. Climate Smart Communities is a state-local partnership committed to the voluntary reduction of GHG emissions, saving taxpayer dollars and advancing community goals for health and safety, economic vitality, energy independence, and quality of life. As a Climate Smart Communities, the City pledges to:

- Set Goals, Inventory Emissions, Move to Action - Steps for communities as they assess their emissions and choose actions:
 - ◆ Develop local GHG Inventories
 - ◆ Develop a local CAP - Policies and measures, planning goals, actions, funding, responsibility and schedules

⁹ USEPA, Carbon Pollution Standards

¹⁰ White House Press Office, www.whitehouse.gov/the-press-office/2013/06/25/fact-sheet-president-obama-s-climate-action-plan

- Decrease Energy Demand for Local Government Operations - Reducing greenhouse gases and taxpayer cost for electricity and fossil fuel:
 - ◆ Municipal Facilities and Operations - Buildings and local services, such as water treatment and street lighting
 - ◆ Municipal Transportation - Reducing miles traveled by municipal governments; making government fleets more efficient
 - ◆ Municipal Low-Energy Policies - Green purchasing and other policies that save energy and reduce GHG emissions
- Encourage Renewable Energy for Local Government Operations.

U.S. Department of Energy Better Buildings Challenge

In June 2012 the City partnered with the U.S. DOE Better Buildings Challenge. By becoming a part of the BBC, the City pledged a 20% reduction in energy use intensity (EUI) by 2020 in 4,120,224 square feet of municipal building space. EUI is a unit that represents the energy consumed by a building relative to its size. EUI is calculated by taking the annual energy consumed and dividing it by the total floor area¹¹. (For instance if a 25,000 square foot building consumed 4,250,000 kBtu in one year its EUI would be 170 kBtu/SF-year. EUI can be calculated in two ways: using site or source energy. Site energy is the amount of heat and electricity consumed by a building as reflected in the utility bills. Source energy takes into account the total amount of electricity and fuel consumed by the building as well as incorporating transmission, delivery, and production losses from the external sources of supply. The EPA recommends using the source energy methodology because it takes into account all energy utilized, providing a more complete assessment of energy efficiency in a building¹².

The City recognizes that sustainable practices are critical to its future economic development and long-term financial stability. Through its BBC partnership, the City has committed to reduce energy intensity 20% by the year 2020 across a building portfolio of just over four million square feet. In conjunction with City operations, the City's Office of Energy and Sustainability is using its recently-completed GHG inventory, this municipal operations CAP, and City facility energy audits data to identify opportunities for energy efficiency improvements. The City plans to implement projects such as lighting upgrades, heating ventilation and air conditioning (HVAC) improvements, and renewable energy installations. By demonstrating leadership in energy efficiency and through outreach to potential stakeholders, the City will encourage local businesses and institutions to commit to reducing energy use across the community. It is noted that the BBC covers City buildings only and does not include fleet, streetlights, parking lot lights, and bus shelters.

¹¹ U.S. Energy Information Administration (EIA)

¹² EnergyStar.gov, How Portfolio Manager Calculates Metrics

2. GHG Emissions Inventory

2.1. Reasoning, Methodology and Model

The 2008 baseline GHG inventory was completed by the City in 2011. This inventory measured government operations and community-wide GHG emissions.

The first step towards achieving tangible GHG emissions reductions requires identifying baseline levels and sources of emissions. As local governments continue to join the climate protection movement, the need for a standardized approach to quantify these emissions is essential. Considering this, the City used the Local Government Operations Protocol (LGOP; Version 1.1, May 2010) to inventory GHG emissions from government operations and buildings and the International Local Government GHG Emissions Analysis Protocol (IEAP) to inventory the City's community emissions. There are two reasons for completing separate emissions inventories for community and municipal operations:

1. The government is committed to action on climate change, and has a higher degree of control to achieve reductions in its own municipal emissions than those created by the community at large.
2. By proactively reducing emissions generated by its own activities, the City government takes a visible leadership role in the effort to address climate change. This is important for inspiring local action in Rochester, as well as for inspiring other surrounding communities.

The LGOP serves as a method of accounting and reporting GHG emissions within government operations as well as establishing a baseline from which to reduce emissions a defined percentage by a certain future date. The purpose of the LGOP is to:

- Enable local governments to develop emissions inventories following internationally recognized GHG accounting and reporting principles;
- Advance the consistent, comparable, and relevant quantification of emissions and appropriate, transparent, and policy-relevant reporting;
- Enable measurement toward climate goals;
- Promote the understanding of the role of government operations in combating climate change; and
- Help to create harmonization between GHG inventories developed and reported to multiple programs.

While the State of New York does not currently require local governments to inventory and report their emissions, an emissions inventory is a critical first step for the City to develop internal emissions reduction strategies and track future progress.

2.2. ICLEI Emissions Analysis Software

To facilitate local government efforts to identify and reduce GHG emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package. This software measures emissions derived from energy consumption and waste generation both within a community and municipal operations. The CACP software calculates emissions using specific factors (or coefficients) according to the type of fuel used. Emissions are aggregated and reported in terms of carbon dioxide equivalent units, or CO₂e. Converting emissions to carbon dioxide equivalent units allows for the consideration of different greenhouse gases in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide in its capacity to trap heat, so the model converts one ton of methane emissions to 21 tons of CO₂e.

The CACP software has been and continues to be used by over 250 U.S. local governments to track their GHG emissions. However, it is noted that, although the software provides Rochester with a sophisticated and useful tool, calculating emissions from energy use with precision is difficult. The model depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the model as an approximation rather than an exact value.

2.3. Inventory Sources and Data Collection Process

The inventory of GHG emissions for the City's municipal operations required the collection of information from a variety of sectors and sources including the following:

1. For municipal electricity, natural gas, and steam data, the City consulted Rochester Gas & Electric Company (RG&E) and Rochester District Heating (RDH). Fuel oil and propane consumption were provided by the City. Stationary combustion emissions for the local government inventory were calculated according to the usage of natural gas, fuel oil, and propane. The comprehensive data was based on metered amounts delivered, and reported in therms for natural gas and U.S. gallons for fuel oil and propane.
2. Mobile source GHG emissions for the local government inventory were calculated based on actual fuel consumption (gasoline and diesel, in U.S. gallons) provided by the City.
3. Municipal solid waste for the City was accounted for by gathering data on waste volumes (in cubic yards) on a facility basis. This quantity was first converted to annual U.S. tons of solid waste to estimate the corresponding methane emissions from landfilling, and subsequently converted to MTCO₂e.
4. Wastewater discharge quantities for the City were calculated by obtaining the water delivery quantities from the City's Water Bureau (in U.S. gallons) per facility as the charges are based on the amount delivered rather than the amount discharged to the municipal sewer. The formula for calculating MTCO₂e corresponding to one gallon of wastewater is derived from USEPA (2008).

Data were entered into the software to create a community emissions inventory and a municipal emissions inventory. The CACP 2009 software program was only used to estimate emissions from electricity, natural gas, fuel oil and vehicle fleet gasoline and diesel. The software does not have a specific field for purchased steam emissions, and so these were not included in the reported total. The municipal inventory is a subset of the community inventory, and includes emissions derived from internal government operations. This CAP is based on the municipal inventory and municipal operations only.

During the creation of the GHG inventory, for the City's municipal operations, there were uncertainties in calculating several areas of the government emissions. In other words, the information is not a qualitative judgment of the credibility of the numbers presented. Rather, it is a quantitative measure of the ranges within which these numbers lie. It can be thought of as the "error bars" often seen on scientific charts. The areas of uncertainty include the following:

- Scope 2 Government Emissions – Purchased Steam
 - ◆ The City purchased a total of 294,688 therms of steam in calendar year 2008. The CACP 2009 software program does not have a specific field for purchased steam emissions, and so these were not included in the reported total. Using an emission factor of 86.845 kg CO₂e per MMBtu (DOE, 2007), and applying the conversion from MMBtu to therms, we obtain GHG emissions of 2,559 MTCO₂e. This corresponds to 7.7% of the reported Scope 1 + Scope 2 emissions (33,039 MTCO₂e).
- Scope 3 Government Emissions – Solid Waste and Wastewater
 - ◆ Reporting of Scope 3 emissions is optional under the LGOP and is not specifically covered by the CACP 2009 software used to calculate the City's Scope 1 and Scope 2 GHG inventory. However, reporting of Scope 3 emissions is useful in that it provides insight into additional contributors to real GHG emissions to the atmosphere.
 - ◆ The City decided to report Scope 3 government emissions from the following sources:
 - › Municipal Solid Waste – For calendar year 2008, the City reported the disposal of 15,934 cubic yards of municipal solid waste from 53 facilities, corresponding to 996 U.S. tons of waste and generating GHG emissions of 418 MTCO₂e.
 - › Wastewater Discharge – Total water consumption was used as a proxy for wastewater discharge. The total water consumption for calendar year 2008 by City facilities was 51,926,000 U.S. gallons, all of which was assumed to be released to wastewater streams. Assuming emission factors of methane and nitrous oxide to be 3.336×10^{-4} kg/gal and 1.63×10^{-6} kg/gal respectively (USEPA 2008) and applying the appropriate global warming potential (GWPs) for these GHGs. GHG emissions were estimated to be 393 MTCO₂e.

- › Taken together, these two sources of emissions correspond to 2.5% of the reported Scope 1 + Scope 2 emissions (33,039 MTCO₂e). Other Scope 3 sources, such as employee commuting and business travel, were not reported due to a lack of availability of reliable data.

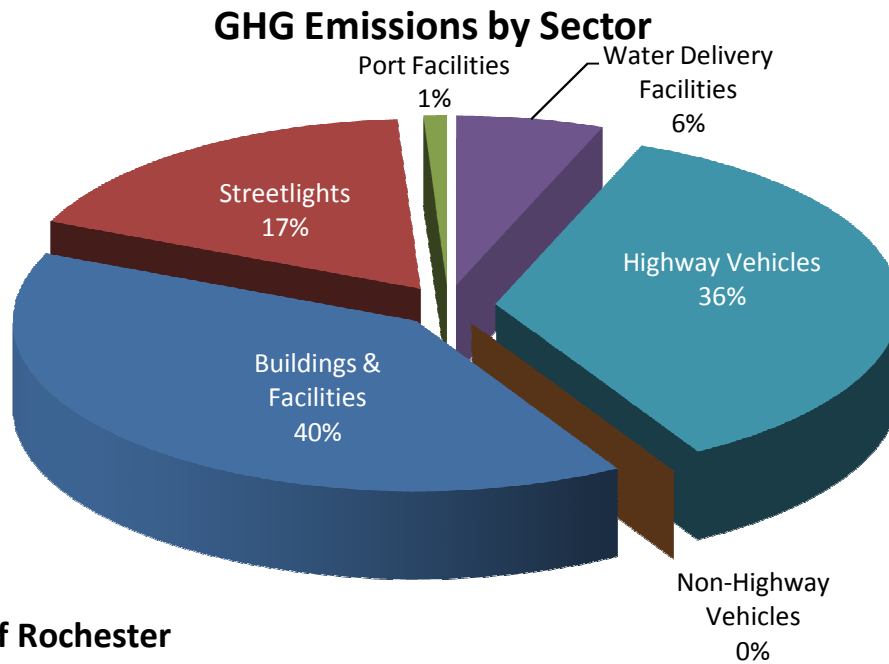
2.4. Inventory Results

In order to maintain consistency in the City's energy consumption tracking going forward, the emissions for the 2008 GHG inventory were revised to reflect the following:

- Removal of energy consumption from City buildings that are not included or tracked in Portfolio Manager®;
- Inclusion of revised gasoline and diesel consumption for government fleet vehicles. Since 2008, the City has begun the use of a new fuel tracking system that has resulted in more accurate fuel usage data for the vehicle fleet; and
- Assumption that government fleet vehicles consist of highway vehicles.

The revised total GHG emissions baseline from City municipal facilities for calendar year 2008, including GHG emissions from steam consumption, municipal solid waste disposal, and wastewater discharge were estimated at **35,599 MTCO₂e**. Figure 3 below and Table 1 on the next page show the breakdown of government emissions by sector as calculated in the original GHG baseline inventory (without the steam consumption and Scope 3 emissions). It is observed that the Buildings & Facilities sector is the largest contributor (40%), followed by Highway Vehicles (36%) and Streetlights (17%). Other sector contributions are in the single digit percentages.

Figure 3. City of Rochester Government GHG Emissions by Sector.



**City of Rochester
Government Emissions - CY2008
Total = 33,039 MTCO₂E**

Table 1. 2008 Government GHG Emissions by Sector and Scope¹

Sector	Scope		Totals ²	
	Scope 1 Direct Emissions	Scope 2 Indirect Emissions	MTCO ₂ e	%
Buildings & Facilities	4,488	8,673	13,161	40%
Highway Vehicles	11,819	–	11,819	36%
Streetlights	–	5,808	5,808	17%
Water Delivery Facilities	673	1,271	1,944	6%
Port Facilities	139	168	307	1%
Subtotal²	MTCO₂e	17,119	33,039	100%
	%	51%		

1: Scope 1 and Scope 2 only; Scope 3 emissions were not estimated for government operations.

2: Subtotals may not add up exactly due to rounding.

Figure 4 shows a breakdown of government emissions by energy source as calculated in the original GHG baseline inventory. It is observed that emissions from the generation of electricity are the largest contributor by a significant margin, accounting for 48% of total government emissions. They are followed by emissions from the combustion of gasoline (21%), natural gas (15%), and diesel (15%). In terms of emission scopes, note that purchased electricity is the sole contributor to Scope 2 emissions; all other displayed source categories fall under Scope 1.

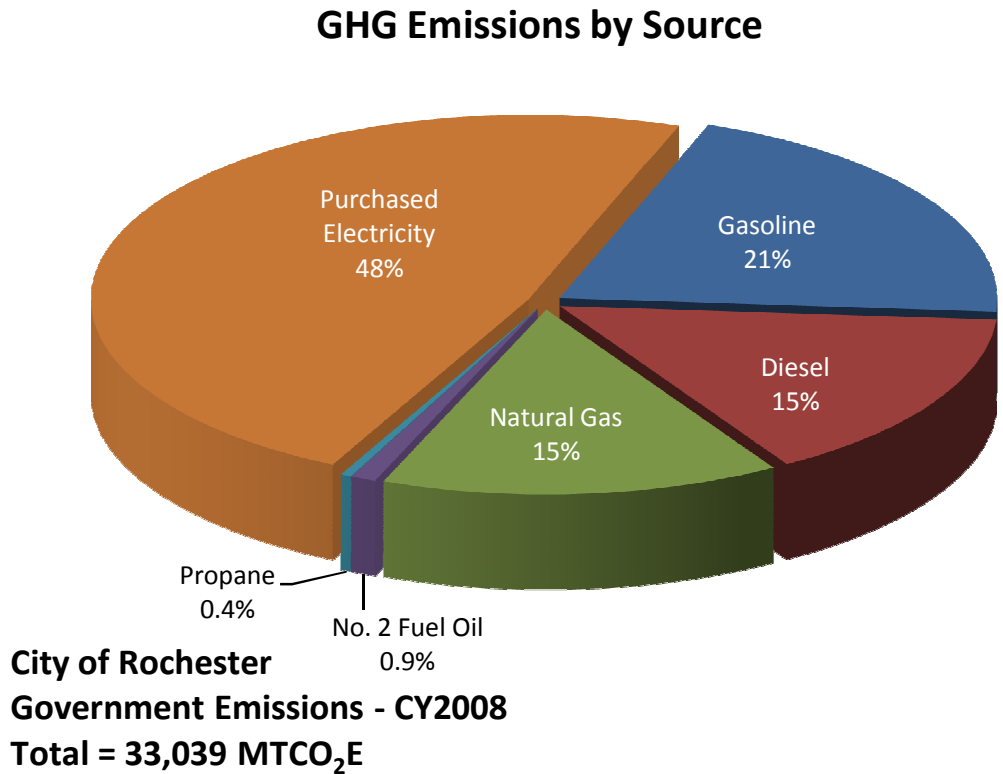


Figure 4. City of Rochester Government GHG Emissions by Source.

3. Forecast for Energy Use Intensity and Greenhouse Gas Emissions

The first step toward reducing GHG emissions and EUI towards targeted levels is to estimate the City’s projected business-as-usual (BAU) GHG emissions and EUI. BAU calculations aid the City in predicting how GHG emissions and EUI may change over the projected goal date horizon if no actions are taken. Based on discussions with the City, building space growth, size of the vehicle fleet, number of buildings, and extent of services provided by the City are projected to remain flat through at least 2020. Consequently, the GHG emissions and EUI associated with government activities are projected to remain stable through 2020, relative to their 2008 and 2009 values, respectively. Measures identified to reduce GHG emissions and EUI with respect to the BAU are discussed in greater detail in Section 6.



Photovoltaic cells on Arnett Library.

4. Energy Use Intensity and Greenhouse Gas Emissions Reduction Goals

4.1. EUI and GHG Emissions Reduction Goals

A reduction target provides a tangible goal for the City's energy consumption and GHG emissions reduction efforts. Local factors considered in selecting the target reduction percentage included estimation of the effects of implemented and planned programs and policies, an approximate assessment of future opportunities to reduce emissions, targets adopted by peer communities, and emissions reductions expected to be achieved by state-level climate policy. In accordance with the BBC commitment, the City has adopted an EUI reduction target of 20 percent below 2009 baseline EUI by the year 2020. The estimated 2009 EUI is 124 kBtu/GSF-year. A 20% reduction results in a target EUI of approximately 99 kBtu/GSF-year by 2020.

In alignment with the BBC's EUI reduction goal, the City has also committed to reducing absolute GHG emissions by 20% from a 2008 baseline year by 2020. Based on estimated GHG emissions of 35,599 MTCO_{2e} for 2008, this commitment requires that the City reduce GHG emissions by approximately 7,119 MTCO_{2e} to 28,480 MTCO_{2e} by 2020.

4.2. Progress in Meeting Goals

In the baseline year 2009, the City began tracking EUI data (*i.e.*, building energy consumption and square footage) using the Energy Star Portfolio Manager® on-line tool. Since this baseline year, the City has implemented energy reduction measures in government buildings that have resulted in a decrease of approximately 4% in EUI through 2012.

Since the 2008 baseline GHG inventory, the City has implemented reduction and energy conservation measures which have resulted in an 8.6% decrease in total GHG emissions (including steam consumption and Scope 3 emissions) through 2011. Emissions were reduced in all sectors with the exception of the Port Facility which was vacant during 2008 and has since been occupied thus generating higher energy consumption. Table 2, on the following page, shows the GHG reductions achieved by sector through 2011.

Table 2. GHG Reductions Achieved from Baseline Year to 2011.

Sector	2008 GHG Emissions	2011 GHG Emissions	% Reductions
Buildings & Facilities	15,720	14,294	9.1
Vehicle Fleet	11,819	11,767	0.4
Water Delivery Facilities	1,946	1,713	12.0
Streetlights	5,808	4,203	27.6
Port Facilities	307	555	-80.8
Overall¹	35,599	32,532	8.6

1: Totals may not add up exactly due to rounding.



City of Rochester Alternative Fuel Vehicle.

5. Existing Measures and Policies

5.1. Municipal Operations and Measures

The City has completed multiple projects and implemented reduction initiatives to reduce energy consumption and GHG emissions throughout municipal operations. These include:

- Performing energy audits at City-owned facilities in order to identify potential energy reduction opportunities;
- Development of the Energy Efficiency Project Fund;
- Construction of a LEED Gold Certified Water Operations Facility;
- Integration of alternative energy at City facilities, including geothermal energy at Riverside Cemetery and solar photovoltaic energy systems at the Arnett Branch Library (44kW) and the Rochester Public Market (15kW);
- Use of energy management systems in select City buildings;
- Implementation of lighting upgrades identified during the NYSERDA FlexTech parking garage audits for Court Street Garage, High Falls Garage, Washington Square Garage, and Sister Cities Garage;
- Implementation of lighting improvements (controls and fixture replacement) at facilities including City Hall, Riverside Convention Center, Rundel Library and Genesee Valley Park Recreation Center;
- Purchasing and maintaining a City vehicle fleet that includes over 300 alternative fuel vehicles (E-85, compressed natural gas (CNG), hybrid, and electric vehicles);
- Design and construction of a new Green Fuel Facility to provide biodiesel, E85 and CNG for its alternative vehicle fleet;
- Green roof installation at City Hall;
- Installation of a permeable pavement parking lot at City Hall (planned for spring 2014);
- Permeable pavement parking lot and rain gardens installations at Turning Point Park;
- Port of Rochester parking lot bioretention areas;
- Construction of a new Emerson and Locust Green Connector Street;
- Durand Eastman Park Smart Sponge project;
- Cornerstone Park Green Infrastructure retrofits such as porous pavement and rain gardens (out for bid July, 2013) ; and
- Installation of porous tree pits in Center City.

6. Proposed Measures and Policies

The City has evaluated measures for possible implementation for the purpose of reducing energy consumption and GHG emissions and meeting the target reduction goals of 20% in GHG and EUI by 2020. These measures are outlined in the following sections as well as in Appendix A. The proposed energy conservation measures (ECMs) were identified through discussions and input from City Staff Stakeholders and benchmarking research. A complete table of identified GHG reduction measures and proposed projects can be found in Appendix A. Assumptions and calculations using the ILCEI Climate and Air Pollution Planning Assistant V1.5[©] (CAPP) outlined later in this section can be found in Appendix B. CAPP is designed to assist local governments in identifying emissions reduction projects and policies to implement meeting their own climate and air pollution reduction goals. Subsections 6.1 through 6.5 summarize the five key categories of proposed measures and policies. The final subsection (6.6) graphically illustrates those measures and their impacts into two wedge diagrams.

6.1. Energy Efficiency and Renewable Energy

Increasing energy efficiency throughout City facilities offers the greatest potential to both reduce GHG emissions, EUI, and save tax payers money. A wealth of resources exist to assist municipalities in this regard such as funding and grant incentives towards energy products and tools for improving energy management through NYSERDA, the State, and ENERGY STAR.

Renewable energy sources provide a clean, decentralized energy source that can significantly impact the municipality's GHG emissions. The City will work to build on current efforts to integrate alternative energy into its energy portfolio. Currently available sources of renewable energy include solar, wind, biomass, and geothermal. Consideration for implementation will be based according to project feasibility, energy and cost savings associated with each measure, and funding availability.

The City will also apply measures to improve water conservation in order to increase the reduction of energy use and associated emissions. As water consumption is reduced, emissions are reduced as less electricity is required to pump and treat the water and less domestic water heating energy is required. Installation of water saving faucets and water saving toilets during their regular replacement periods will aid the City in water conservation efforts.

The tables highlighted further in this section provide summaries of the energy conservation measures (ECMs) that the City is considering for implementation to meet the target reduction goals. Table 3, on the following page, summarizes the proposed ECMs from the NYSERDA FlexTech City Facility Energy Audit, completed in June 2012. This audit analyzed the energy consumption and identified energy conservation opportunities at 25 City facilities. These 25 facilities were selected based on annual energy consumption, facility uses (current and anticipated), and completed previous studies. The table shows potential energy and annual reductions for each proposed measure,

site and source energy compared to gross square footage (GSF), and GHG reductions. Site energy is calculated by comparing an individual building's energy consumption to its square footage. Source energy uses site energy plus incorporates transmission, delivery, and production losses from the external sources of supply. The emissions factors associated with both site and source energy are shown in Appendix B. Table 4, on the following page, summarizes the proposed ECMs from the NYSERDA FlexTech Parking Garage Assessment, which was completed in October 2010.

Table 3. Summary of Proposed ECMs from NYSERDA City Facility Energy Audit, June 27, 2012

ECMs	Annual Electrical Energy Reduction (kWh) ¹	Annual Fossil Fuel Energy Reduction (MMBtu) ²	Annual Steam Energy Reduction (Mlbs) ³	Total Annual Site Energy Reduction (kBtu) ⁴	Total Annual Source Energy Reduction (kBtu) ⁴	Annual GHG Emissions Reduction (MTCO ₂ e)
City Hall: replace HVAC heat pump loop heat exchanger with inline steam injection heater			204	197,880	237,456	21.30
Rundel Library: replace HVAC heat pump loop exchanger with inline steam injection heater			805	780,850	819,893	84.03
Bausch & Lomb Library: replace HVAC heat pump loop exchanger with inline steam injection heater			265	275,050	308,460	27.66
Genesee Valley Pool & Rink: infrared heaters	8,952	1,596		1,626,546	1,770,796	87.69
Genesee Valley Pool & Rink: Replace domestic hot water heater and storage tank with staged on-demand wall mounted water heaters		1,804		1,804,000	1,894,200	95.97
Totals for Genesee Valley Pool & Rink				3,430,545	5,030,805	183.66
Port Terminal/Gate: demand controlled ventilation	10,095	337		371,446	460,976	21.07
Port Terminal/Gate: VSDs on AAON RTUs and fans	40,305			137,526	427,707	12.53
Totals for Port Terminal				508,972	888,683	33.60
Wheatley Branch Library: RTU Replacement	2,096	238		245,152	272,142	13.31
Wheatley Branch Library: HVAC distribution smart pump	3,049	15		25,404	48,105	1.75
Totals for Wheatley Branch Library				270,556	320,247	15.06
Edgerton Rec. Center: HVAC distribution smart pump	2,969	5		15,131	36,756	1.19
Edgerton Rec. Center: radiant hot water HVAC upgrade	16,894			57,645	179,275	5.25
Edgerton Rec. Center: increased roof insulation		265		265,000	278,250	14.10
Totals for Edgerton Rec. Center				337,775	494,281	20.54
RPD – Tactical K9: HVAC distribution smart pump	5,678	12		31,374	72,854	2.40
RPD – Tactical K9: HVAC system upgrade	-129,870	8,651		8,207,865	7,705,401	419.84
RPD – Tactical K9: condensing boiler	-480	181		179,533	185,487	9.50
Totals for RPD – Tactical K9				8,418,772	7,963,742	431.74
Overall Totals⁵:	90,038	13,104	1,274	14,220,400	16,063,567	817.60

- 1: kWh: kilowatt hours of electricity
- 2: MMBtu: million British thermal units of fossil fuel
- 3: Mlbs: 1000 pounds of steam
- 4: kBtu: thousand British thermal units
- 5: Totals may not add up exactly due to rounding.

Table 4. Summary of Proposed ECMs from NYSERDA FlexTech Parking Garage Energy Assessment, October 28, 2010

ECMs	Annual Electrical Energy Reduction (kWh) ¹	Total Annual Site Energy Reduction (kBtu) ⁴	Total Annual Source Energy Reduction (kBtu) ⁴	Annual GHG Emissions Reduction (MTCO ₂ e)
Court Street Garage: temperature setbacks	26,000	88,715	275,906	8.09
Court Street Garage: lighting controls	200,000	682,428	2,122,352	62.2
Court Street Garage: lighting fixture replacement (LED)	441,000	1,504,754	4,679,787	137
Court Street Garage: lighting fixture replacement (induction)	309,000	1,054,351	3,279,034	96.1
Court Street Garage: lighting fixture replacement (T5HO)	202,000	689,252	2,143,576	62.8
Court Street Garage: lighting fixture replacement (T8)	396,000	1,351,208	4,202,258	123
Court Street Garage: elevator replacement	4,200	14,331	44,569	1.31
Court Street Garage: HVAC motor efficiency replacements	4,040	13,785	42,872	1.26
Totals for Court Street Garage⁶	675,240	2,304,015	7,165,486	210
High Falls Garage: lighting controls	46,700	159,347	495,569	14.5
High Falls Garage: lighting fixture replacement (LED)	142,100	484,865	1,507,931	44.2
High Falls Garage: lighting fixture replacement (Induction)	85,300	291,056	905,183	26.5
High Falls Garage: lighting fixture replacement (T5HO)	15,200	51,865	161,299	4.7
High Falls Garage: lighting fixture replacement (T8)	113,000	385,572	1,199,129	35.1
High Falls Garage: elevator replacement	2,800	9,554	29,713	0.87
High Falls Garage: temperature setbacks	18,700	63,807	198,440	5.82
Totals for High Falls Garage⁶	210,300	717,573	2,231,653	275
Sister Cities Garage: lighting controls	84,700	289,008	898,816	26.3
Sister Cities Garage: lighting fixture replacement (LED)	170,800	582,794	1,812,489	53.1
Sister Cities Garage: lighting fixture replacement (Induction)	143,000	487,936	1,517,482	44.5
Sister Cities Garage: lighting fixture replacement (T8)	122,000	416,281	1,294,635	37.9
Sister Cities Garage: elevator replacement	5,200	17,743	55,181	1.6
Sister Cities Garage: HVAC motor efficiency replacement	1,220	4,163	12,946	0.4
Sister Cities Garage: HVAC variable speed drives	15,400	52,547	163,421	4.8
Sister Cities Garage: temperature setbacks	8,250	28,150	87,547	2.6
Totals for Sister Cities Garage⁶	285,570	974,405	3,030,401	88.8
Washington Square Garage: lighting controls	97,700	333,366	1,036,769	30.4
Washington Square Garage: lighting fixture replacement (LED)	180,000	614,186	1,910,117	56.0
Washington Square Garage: lighting fixture replacement (Induction)	105,000	358,275	1,114,235	32.7
Washington Square Garage: lighting fixture replacement (T5HO)	44,400	151,499	471,162	13.8
Washington Square Garage: lighting fixture replacement (T8)	154,000	525,470	1,634,211	47.9
Washington Square Garage: temperature setbacks	53,800	183,573	570,913	16.7
Totals for Washington Square Garage⁶	331,500	1,131,125	3,517,799	103
South Ave. Garage: lighting controls	226,000	771,144	2,398,258	70.29
South Ave. Garage: lighting fixture replacement (LED)	571,000	1,948,333	6,059,316	177.58
South Ave. Garage: lighting fixture replacement (Induction)	334,000	1,139,655	3,544,328	103.87
South Ave. Garage: lighting fixture replacement (T5HO)	141,000	481,112	1,496,258	43.85
South Ave. Garage: lighting fixture replacement (T8)	490,000	1,671,950	5,199,763	152.39
South Ave. Garage: elevator replacement	2,400	8,189	25,468	0.75
South Ave. Garage: escalator PIR update	44,300	151,158	470,101	13.78
South Ave. Garage: temperature setbacks	13,400	45,723	142,198	4.17
Totals for South Ave. Garage⁶	857,100	2,924,547	9,095,341	267
Overall Totals⁵:	2,359,710	8,051,665	25,040,680	943.8

1: kWh: kilowatt hours of electricity

2: MMBtu: million British thermal units of fossil fuel

3: Mlbs: 1000 pounds of steam

4: kBtu: thousand British thermal units

5: Totals may not add up exactly due to rounding

6: Totals include only LED lighting fixture replacement (omit Induction, T5HO, and T8).

Table 5 through 8, summarize additional proposed energy efficiency, water conservation, streelight, and renewable energy ECMs for municipal facilities and operations. The reductions highlighted in further sections of this report, specifically in Tables 5 through 11, were calculated by using the CAPP tool.

Table 5. Summary of Proposed Additional Energy Efficiency ECMs

Energy Efficiency/Conservation Proposed ECMs	Annual Electrical Energy Reduction (kWh) ¹	Annual Natural Gas Reduction (therms)	Total Annual Site Energy Reduction (kBtu)	Total Annual Source Energy Reduction (kBtu)	Annual GHG Emissions Reductions (MTCO ₂ e)
Install Reflective Roofing (approx. 10,000 ft ²)	7,740	(133)	13,110	68,170	3
Energy Efficiency Retrofits at Existing Facilities (approx. 500,000 ft ²)	779,000	17,500	80,558,059	90,061,562	367
Totals²:	786,740	17,367	80,571,169	90,129,732	370

1: kWh: kilowatt hours of electricity
 2: Totals may not add up exactly due to rounding.

Table 6. Summary of Proposed Water Conservation ECMs

Water Conservation Proposed ECMs	Annual Electrical Energy Reduction (kWh) ¹	Annual Natural Gas Reduction (therms)	Total Annual Site Energy Reduction (kBtu)	Total Annual Source Energy Reduction (kBtu)	Annual GHG Emissions Reductions (MTCO ₂ e)
Water Saving Faucets	73	93	9,510	10,498	1
Water Saving Toilets	1,549		5,284	16,434	1
Totals²:	1,622	93	14,794	26,932	2

1: kWh: kilowatt hours of electricity
 2: Totals may not add up exactly due to rounding.

Table 7 shows a 15% reduction in kWh from 2012 electricity use levels, or the conversion of approximately 7,220 streetlights to LED lighting.

Table 7. Summary of Proposed Streetlight ECM

Streetlight Proposed ECMs	Annual Electrical Energy Reduction (kWh) ¹	Total Annual Site Energy Reduction (kBtu)	Annual GHG Emissions Reductions (MTCO ₂ e)
Streetlights LED Conversion (25% of lights)	2,743,453	9,361,050	947
Totals²:	2,743,453	9,361,050	947

1: kWh: kilowatt hours of electricity
 2: Totals may not add up exactly due to rounding.

Table 8 below shows two proposed renewable energy ECMs that the City will consider implementing in order to achieve its reduction goal by 2020.

Table 8. Summary of Proposed Renewable Energy ECMs

Renewable Energy Proposed ECMs	Annual Electrical Energy Generation (kWh) ¹	Total Annual Reduction (kBtu)	Annual GHG Emissions Reductions (MTCO ₂ e)
Install PV 2000 kW (2MW) System	2,920,000	9,963,455	1,008
Install 15 kW Wind Turbine	22,800	77,797	8
Totals²:	2,312,800	10,041,252	1,016

1: kWh: kilowatt hours of electricity

2: Totals may not add up exactly due to rounding.

Specific efficiency and renewable energy projects and measures partially or wholly integrated in the tables above include:

- LED lighting technology for streetlights; and
- Hemlock Filtration Plant: install high reflective roof to reduce heat.

Additional efficiency and renewable energy projects and measures not outlined in the table above but to be considered include:

- Hemlock Operations Center: Install T8 or T5 light fixtures;
- Hemlock Filtration Plant: Install T8 or T5 light fixtures;
- City Hall: Install LED light fixtures;
- Mortimer Garage: Upgrade lighting;
- Water Bureau Operation Center: perform retrocommissioning to reduce electrical demands for heating and cooling;
- 42 South Ave., 250 State St., and 80 Commercial St.: evaluate office spaces to correct insulation, cooling and heating issues;
- Hemlock Filtration Plant: install building envelope insulation on the roof;
- Hemlock Filtration Plant: install high efficiency fuel oil boilers and a heat recovery system;
- Hemlock Filtration Plant: install a ground source geothermal heat pump;
- Holly Pump Station: install variable speed drive controllers on the electric fire system pump;
- Genesee Valley Park Ice Rink: install high efficiency hot water boilers for Zambonis;
- Implement retrocommissioning study recommendations at the Public Safety Building;
- Increase the purchase of green power from supplier to 30%;
- Participate in the State Electronics Challenge (SEC); and
- Install power saving software for computers and monitors (all City facilities).

6.2. Transportation and Fleet

There are two primary approaches to reduce GHG emissions from the transportation sector. One approach is to implement policies that reduce dependence on personal motor vehicles and encourage alternative modes of transportation, such as public transit, cycling, and walking. Another approach is to utilize vehicles that release fewer greenhouse gases, such as hybrids, more fuel efficient vehicles, and vehicles that run on alternative fuels. Table 9 shows proposed ECMs in the transportation and fleet sector that will be considered to achieve its reduction goals.

Table 9. Summary of Proposed Transportation/Fleet ECMs

Transportation/Fleet Proposed ECMs	Annual Diesel Savings (gallons)	Annual Gasoline Savings (gallons)	Total Annual Reduction (kBtu)	Annual GHG Emissions Reductions (MTCO ₂ e)
Fleet Conversion to Biodiesel (200 vehicles converted to B20)	100,000		13,900,000	761
Fleet Conversion - Diesel to CNG (25 CNG vehicles)	30,105		4,184,595	76
Fleet Conversion to Gasoline - CNG (15 CNG vehicles)		9,169	1,136,960	23
Fleet Conversion to Electric (15 electric vehicles)		9,169	1,136,960	86
Fleet conversion to E85 (300 vehicles)		106,599	13,218,274	853
Police on Bicycles (5 Bicycle Patrols)		3,763	466,628	35
Reduce Municipal Fleet Mileage (150,000 vehicle miles travelled eliminated)		7,614	944,162	72
Reduce Idling of Heavy Duty Vehicles (50 diesel vehicles, 1 hour less idling daily/240 days)	12,000		1,668,000	114
Reduce Idling of Light Duty Vehicles (50 gasoline vehicles, 10 minutes less idling daily/240 days)		636	78,864	6
Totals¹:			36,734,443	2,026

1: Totals may not add up exactly due to rounding.

Specific proposed transportation and fleet projects and measures partially or wholly integrated in the table above include:

- Purchase new CNG vehicles;
- Purchase new Flex-Fuel vehicles;
- Convert entire refuse fleet to CNG (partially included in table above);
- Auto Vehicle Locator (AVL) to reduce vehicle miles travelled; and
- Expand use of police bicycle patrols.

Additionally proposed transportation and fleet projects and measures not outlined in the table above but to be considered include:

- Install electric car charging stations (EVSE);
- Replace old propane forklift with new electric forklift;
- City car-sharing program (using hybrid vehicles);

- Smart parking meters;
- Bike-share for City employees; and
- Solar sidewalk demonstration project (reduces the need for sidewalk plows).

6.3. Materials and Waste Management

Strategies to achieve keeping waste out of landfills can include measures such as expanding existing municipal recycling and composting programs, and expanding employee education and engagement initiatives. Table 10 shows a proposed ECM in the materials and waste management sector that the City will consider implementing in order to achieve its reduction goals.

Table 10. Summary of Proposed Material and Waste Management ECMs

Material and Waste Management Proposed ECMs	Annual GHG Emissions Reductions (MTCO ₂ e)
Organics Composting (100 lbs/person ¹ /year)	1
Totals²:	1

1: Based on 500 City Employees.

Additional proposed materials and waste management projects not outlined in the table above but to be considered include:

- Zero waste facility demonstration project;
- Track and report recycling rates for City facilities;
- Collect recyclable materials from work spaces;
- Expand number of smart boards in conference rooms (reduce printing);
- Municipal pilot composting program (Public Market, City Hall);
- Purchase biodegradable cleaning supplies;
- Purchase materials with “eco-friendly designation; and
- Solar trash compactor curbside garbage receptacles.

6.4. Climate Change Adaptation and Green Infrastructure

Addressing climate change by adapting projects that promote carbon sequestration and stormwater management, by using natural processes, provides multiple environmental benefits and supports a sustainable community. Green infrastructure projects include stormwater management systems that imitate natural areas which provide habitat, flood protection, and cleaner water by soaking and storing stormwater rather than draining it to the municipal sewer systems. Increasing the implementation of green infrastructure can lower GHG emissions by reducing the energy required to run water pumping equipment, reducing the energy required to treat stormwater at a water treatment facility, and potentially reducing heating/cooling requirements for buildings. Table 11 shows

proposed ECMs in the climate change adaptation and green infrastructure sector that the City will consider implementing in order to achieve its reduction goals.

Table 11. Summary of Proposed Climate Change Adaptation and Green Infrastructure ECM

Climate Change Adaptation and Green Infrastructure ECM	Annual GHG Emissions Reductions (MTCO ₂ e)
Install Green Roof (5,000 ft ²)	1
Totals:	1

Additional proposed climate change adaptation and green infrastructure projects and measures not outlined in the tables above but to be considered include:

- Evaluate the inclusion of porous pavement in new construction projects;
- Evaluate the inclusion of bioswales in new construction projects;
- Use of rain barrel collection systems for landscape watering in select City facilities; and
- Evaluate the inclusion of bioretention areas in new construction projects.

6.5. Employee Education and Engagement

Encouraging City personnel to participate in energy conservation and reduction behavioral measures will not only increase efficiency in City facilities but will promote a sense of stewardship within the municipal employee population. These savings tracked and calculated financially can be used as incentives for such examples as reduced bus passes or bicycle storage improvements. The City is proposing measures involving employee behavior to encourage and promote reductions in energy consumption through employee education, flier distribution, and various signages throughout City facilities. Specific proposed employee education and engagement projects and measures to assist the City in meeting its target reduction goals include:

- Turning off lights when leaving work area;
- Turning off computers and monitors at the end of the work day;
- Turning down thermostats in unoccupied areas or at the end of the work day;
- Encouraging double-sided printing;
- Employee energy awareness program to promote energy conservation;
- Encourage employees to walk for trips ½ mile or less;
- Encourage telecommuting or conference/video calls to reduce need for off-site meetings;
- Encourage/incentivize employees to utilize public transportation for commuting;
- Provide training for City employees on fuel efficient driving techniques; and
- Improve/provide bicycle storage/bicycle racks at City locations.

For the purposes of this report, the aforementioned behavioral changes are estimated to bring an approximate savings of 5% reduction in electricity and natural gas consumption if there is 100% compliance and participation with these measures.

6.6. Wedge Diagrams Identifying Strategies and Potential Impacts

A wedge diagram serves as a useful aid in visualizing the relative magnitudes of business-as-usual EUI and GHG emissions, along with the impact of ECMs on the EUI and these emissions. The wedge diagram developed for the City's government EUI is shown in Figure 5 below. The top edge of the diagram, (*i.e.*, the flat line remaining stable at 124 kBtu/GSF-year through 2020), represents the trajectory of emissions under a business-as-usual scenario (*i.e.*, no growth in government operations). It is noted that each wedge depicted in the diagram represents the sum of EUI reductions for Tables 3 through 6 and 8 through 11 outlined previously in this section. (Table 7, Summary of Streetlight ECM, is not included since streetlights do not contribute to buildings' EUI). Next, the cumulative impact of all ECMs is identified for the target year 2020, and is represented by the difference between this business-as-usual value (124 kBtu/GSF-year) and the point value at the intersection of the blue and brown areas for 2020. This difference is numerically equal to 36 kBtu/GSF-year. In other words, if all ECMs were to be fully implemented by 2020, the City government EUI would be approximately 88 kBtu/GSF-year. It is assumed that ECMs would be implemented in a linear manner from 2014 to 2020, giving the ECMs the triangular or "wedge" shape from which this type of diagram gets its name. If the ECMs for the areas depicted in the wedge diagram are fully implemented, the City is expected to be at approximately 144% of its goal of reducing the source EUI by 20% by 2020.

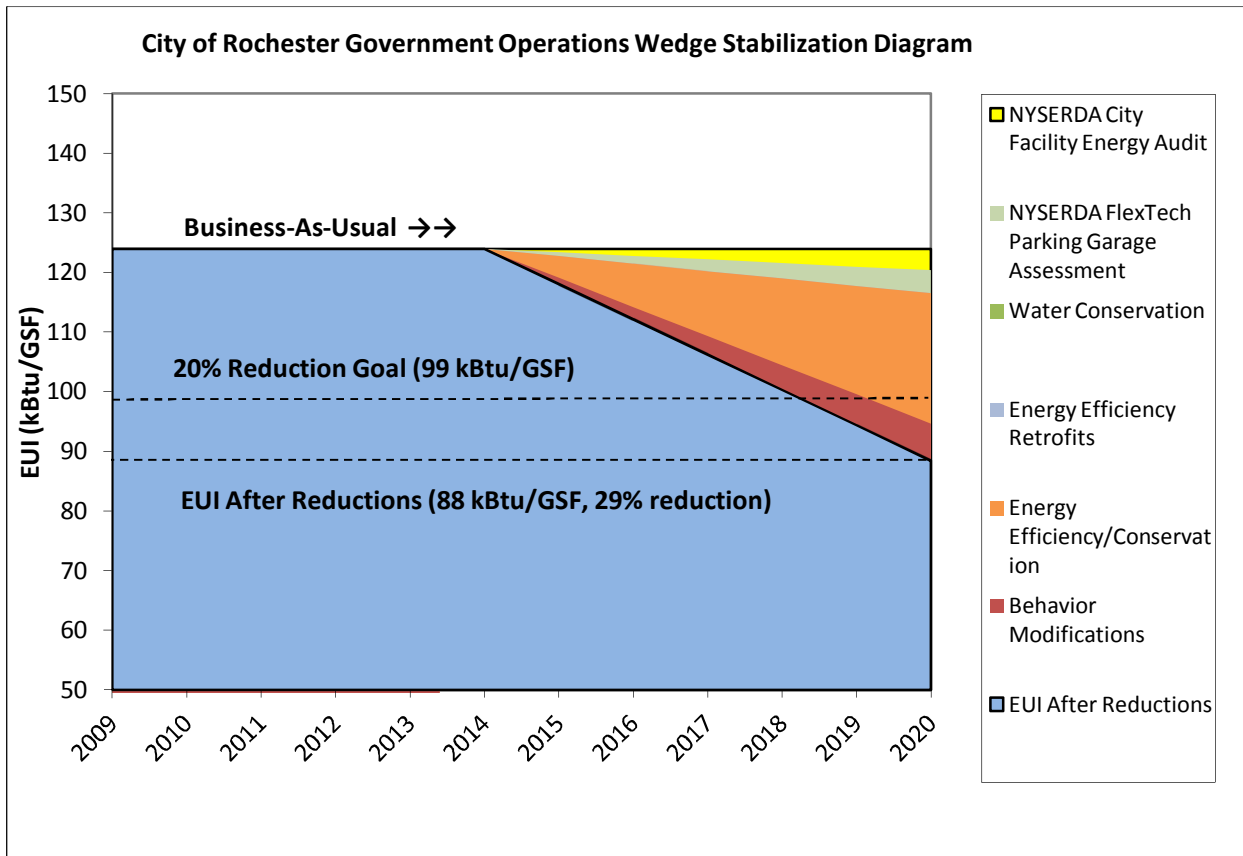


Figure 5. City of Rochester Government Operations EUI Wedge Stabilization Diagram

The wedge diagram developed for the City’s GHG emissions is shown in Figure 6 below. The top edge of the diagram, (*i.e.*, the flat line remaining stable at 35,599 MTCO₂e through 2020), represents the trajectory of emissions under a business-as-usual scenario (*i.e.*, no growth in government operations). It is noted that each wedge depicted in the diagram represents an ECM category City building and includes the sum of GHG emissions reductions for that category. The GHG emissions reductions associated with each ECM were provided in Tables 3 through 11 previously in this section. Next, the cumulative impact of all ECMs is identified for the target year 2020, and is represented by the difference between this business-as-usual value (35,599 MTCO₂e) and the point value at the intersection of the blue and brown areas for 2020. This difference is numerically equal to 7,164 MTCO₂e. In other words, if these ECMs were to be fully implemented by 2020, the City government GHG emissions would be approximately 28,435 MTCO₂e. It is assumed that these ECMs would be implemented in a linear manner from 2014 to 2020. If the ECMs depicted in the wedge diagram are fully implemented, the City will be at approximately 101% of its goal of reducing absolute emissions by 20% by 2020.

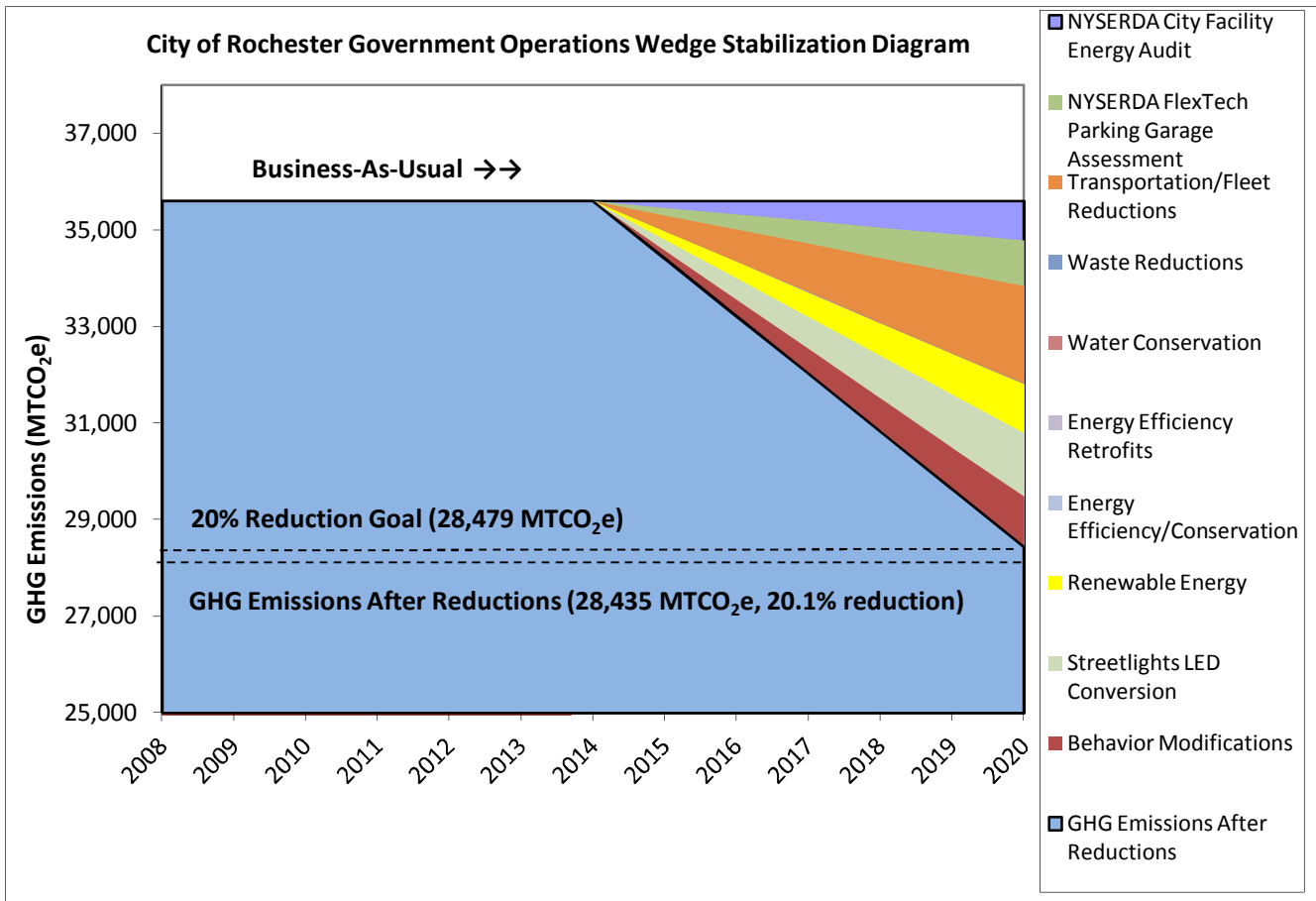


Figure 6. City of Rochester Government Operation GHG Emissions Wedge Stabilization Diagram



Alternative Fuel Vehicle.

7. Measures Implemented External to the City of Rochester

While the City is taking proactive steps towards reducing GHG emissions from its municipally operated facilities without relying on externally imposed policies, it is important to highlight the initiatives created by New York State and Monroe County which have indirectly influenced the sustainable path Rochester has chosen.

New York State has adopted several policies into legislation during the last two Governors' terms that are directed at reducing the GHG emissions consumed by the State.

On April 25, 2008 Governor David Paterson issued Executive Order Number 4 establishing a Green Procurement and Agency Sustainability Program to promote policies within State Agencies that reduce consumption of materials and energy and reduce potential impacts on public health and the environment by purchasing environmentally friendly commodities, services and technologies.

In 2011 Governor Andrew Cuomo and New York State Energy Research and Development Authority (NYSERDA) created the Cleaner, Greener Communities Program. This program provides \$100 million in grants awarded in two phases to New York's 10 regions to encourage the creation of more sustainable communities by funding smart growth in land use, housing, transportation, infrastructure, environmental practices, and energy. On June 27, 2013 Governor Cuomo announced \$30 million towards the first round of grants for the implementation of regional sustainability plans under the Cleaner, Greener Communities Program.

On April 26, 2012 Governor Cuomo announced Clean Energy and Environmental Initiatives:

- \$450 million commitment for energy efficiency in State Buildings (a.k.a. Build Smart NY – Executive Order No. 88). New York Power Authority (NYPA) is slated to finance approximately \$450 million towards cost-effective energy efficiency projects over the next 4 years with a goal to reduce energy consumption in State buildings by 20% by the year 2020; and
- NY-Sun Initiative: Expansion of solar PV deployment incentive programs administered by NYSERDA, Long Island Power Authority (LIPA), and NYPA to \$432 million through 2016.

Most recently, on December 28, 2012, Governor Cuomo signed Executive Order Number 88 directing state agencies and authorities to improve the energy efficiency of state buildings.

Monroe County has also implemented several sustainability measures, expanding its contribution towards regional sustainability. These contributions include the following:

- On June 14, 2007 County Executive Maggie Brooks announced the Green Building Initiative. This initiative ensures that construction projects for County facilities use green building design in accordance with U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standards. LEED standards will be used where practically feasible for any new building construction or renovations on buildings greater than 5,000 square feet. The County Executive has also requested that the County of Monroe Industrial Development Agency (COMIDA) adopt a Green Building incentive to implement LEED standards as well;
- On August 21, 2008 Monroe County unveiled a "Green" Alternative Fueling Station including hydrogen fuel cells, ethanol and biodiesel pumps to accommodate the County's Green Fleet. This Fleet consists of more than six dozen flex-fuel and hybrid vehicles. The intent for this initiative was to convert the entire County fleet to alternative fuel vehicles and phase out traditional gasoline vehicles by 2012 and significant progress has been made;
- County Crime Lab – A LEED Platinum facility constructed utilizing green building design practices in accordance with U.S. Green Building Council's Leadership in Energy and Environmental design (LEED) standards; and
- Installation of a green roof at the County Civic Center Garage.

8. Guide for Future Steps

8.1. Administration and Staffing

This CAP is a road map created to guide the City in the climate protection process and change towards sustainability. The City's next steps will be to adopt and implement this CAP within their municipal facilities and operations, and to create and approve a community-wide CAP addressing City-wide emissions.

The City Office of Energy and Sustainability, with the assistance from staff from all City departments, will be responsible for oversight of implementation of this CAP, tracking and monitoring progress towards meeting emission reduction goals, identifying proposed changes in policy, and employee education and engagement training.

8.2. Financing and Budgeting

Many of the GHG reduction projects outlined in this CAP will produce cost savings for the City. The City is prepared to set up a fund created from these savings to utilize for new GHG reduction projects.

The City will also continue to seek out State and Federal Grant programs, partnering with NYSERDA on various energy reduction measures, taking advantage of available tools, guidance documents and software provided by the USEPA and USDOE to evaluate and reduce energy, as well as take advantage of grants such as Green Innovation Grant Program (GIGP), Water Quality Improvement Program (WQIP), and RGE/NYSERDA Energy Efficiency Rebate Program to assist in financing the reduction projects identified herein.

8.3. Developing a Timeline

A schedule for implementing this CAP should be established to ensure the reduction measures proposed are implemented and the reduction goal of 20% is reached by 2020. This schedule will take into practical account City budgeting, administrative and staffing involved in getting the projects put into action. Stakeholder input and involvement, as well as financial and budget implications, will also be taken into consideration during each phase of the projects as appropriate.

8.4. Community-wide Sustainability

The City is currently in the process of applying for a planning grant through NYSERDA's Cleaner, Greener Communities Program. This Program promotes sustainable growth and development practices at the regional level addressing community-wide areas such as land use, housing, transportation, infrastructure, energy and environmental practices. Through this grant the City will update its comprehensive plan to include a City Energy and Sustainability Plan, to include Community GHG reduction measures.

8.5. Re-Inventory and Monitoring Progress

Due to the difficulty in estimating each energy reduction measure with 100% accuracy, it is important that the City closely monitor the progress of each measure and record or report the results on a regular basis. The success of energy reduction measures will be evaluated not only by the effort of participation but the level of detail to which the results are maintained.

For the municipally-operated facilities, the City has been using the Portfolio Manager® to monitor the energy consumption and cost by fuel type since 2009. Portfolio Manager® is an online tool which allows secure means to measure and track energy and water consumption as well as GHG emissions. It can also be used to benchmark select building performance or a portfolio of buildings. The City plans on continuing the use of Portfolio Manager® to track building energy use. This data will be utilized to assist the City in conducting another GHG inventory in 2015. This second GHG inventory will be used to measure progress against the 2008 GHG baseline and determine where further energy reductions can be made.

8.6. CAP Updates

The City will update this CAP periodically to reflect the following:

- Results of ongoing energy assessments and evaluations of GHG emission reductions opportunities;
- identification of new measures that will be proposed/planned;
- Savings accrued as a result of measures already implemented; and
- Summaries of new policies that are created within government operations.

The City expects that future CAP updates will include updated ECMs, wedge diagrams, and discussion relative to the City's current EUI and GHG emissions in comparison to the respective goals and commitments. The City will report the progress realized as a result of implementing this CAP in reducing its EUI and absolute GHG emissions via its website on a recurrent basis to be scheduled by the City.

9. Appendices

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