03
% NATURAL GAS

71
% ELECTRICITY

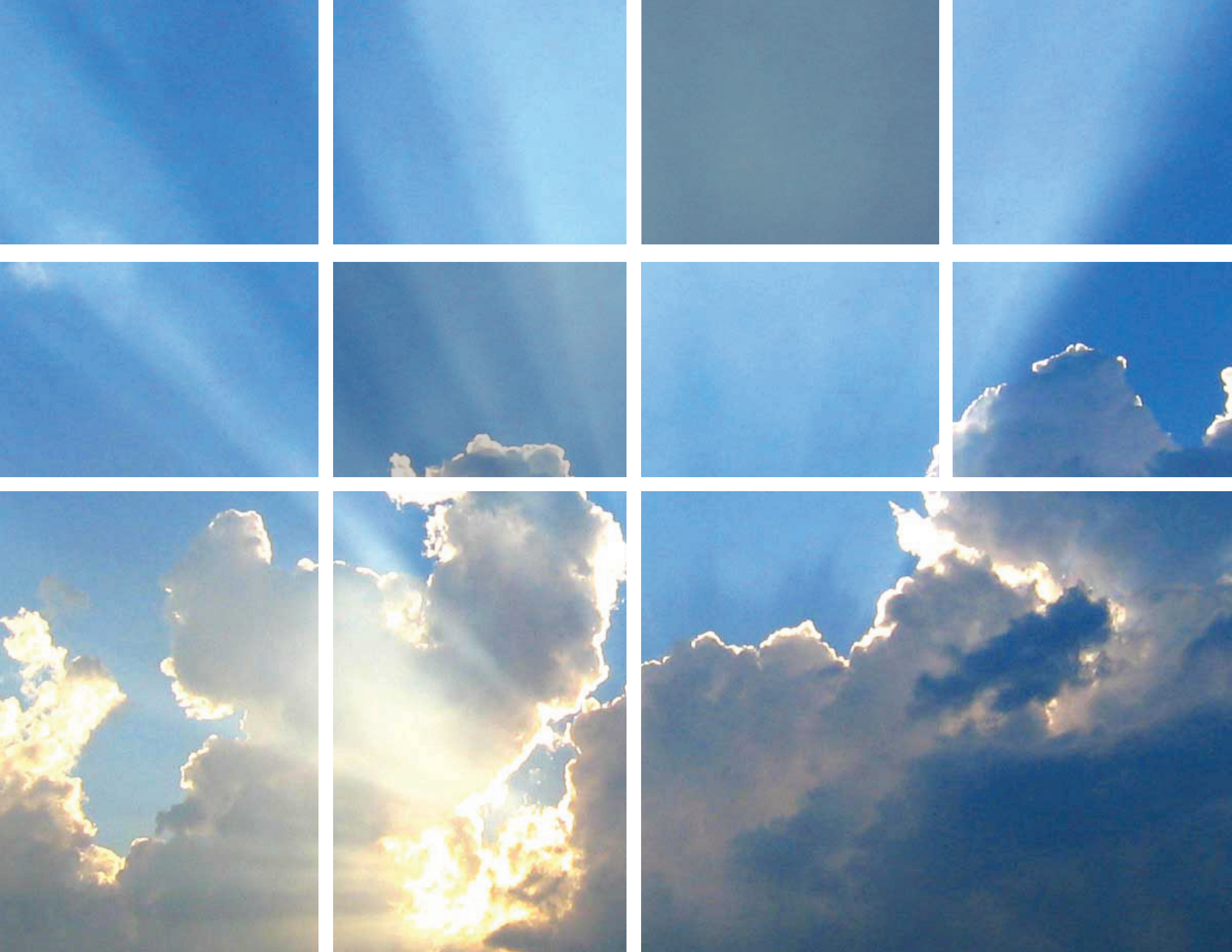
04
% UNLEADED GAS

02
% DIESEL

21
% STEAM HEAT

Opportunities for Sustainability
City of Youngstown
CARBON EMISSIONS INVENTORY

Prepared by Global Green USA



2010 CARBON EMISSIONS INVENTORY

CITY OF YOUNGSTOWN

JANUARY 2011

ACKNOWLEDGEMENTS AND CREDITS

Mayor Jay Williams and Planning Director Bill D'Avignon of the City of Youngstown thank all cooperating departments and businesses who provided the data necessary to complete this emissions inventory report. A special acknowledgement goes to Global Green USA staff members Linda Stone and Linda Morgano who provided knowledge, experience, and resources without which the report would not have been possible, and to Global Green's AmeriCorps VISTA Patrick Orr for his valuable editing skills.

The information and support of the International Council for Local Environmental Initiatives (ICLEI) was equally indispensable. Finally, the City recognizes its Climate Fellows, Jason Langer and Gina DeCarlo from Youngstown State University, who gathered and analyzed all of the data and drafted the initial report.

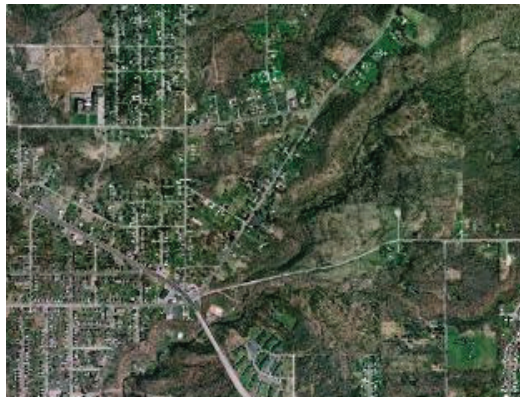
This report is the product of a year of hard work and a lot of heart. As one of the YSU Climate Fellows put it, "Our goal is not only to make Youngstown a green model for the Rust Belt, but also to make it one of the best places in America to call home."

CONTENTS



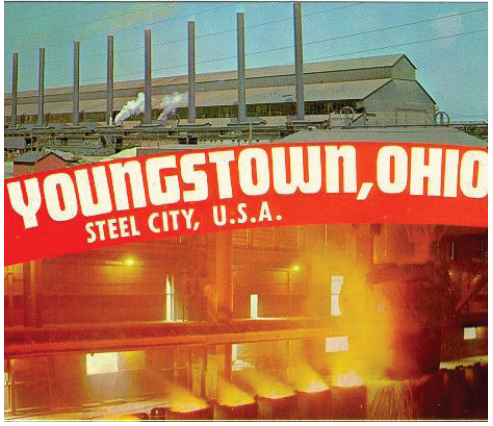




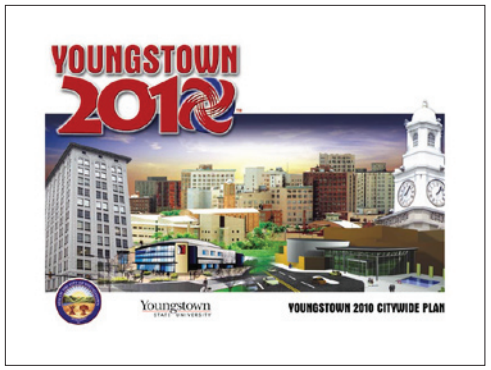
EXECUTIVE SUMMARY

Worldwide, people are beginning to accept that global climate change is a real and threatening phenomenon. The U.S. Environmental Protection Agency (EPA) projects a global temperature increase of three to seven degrees Fahrenheit by 2100.[1] Most climate scientists blame this trend on human production of certain gases that become trapped in the atmosphere, with a recent study published in Proceedings of the National Academy of Scientists showing 97% of 1,372 expert scientists agreed that human activity is "very likely" the main contributor to climate change.[2]



The "greenhouse effect" caused by the heat trapping qualities of carbon dioxide, methane, and other greenhouse gasses (GHGs) is projected to have a variety of repercussions in both global temperatures and climate stability. For instance, storms and flooding have been more numerous and intense for island nations and seaside communities in recent years, resulting in more frequent evacuations and eventual abandonment as ocean levels rise. Meanwhile, inland communities are expected to experience more servere storms, longer periods of drought, and species migration, all of which affect agricultural production and community stability.

The City of Youngstown, Ohio, in the American Midwest, was once a major industrial center, second in overall US steel production only to Pittsburgh, Pennsylvania. Youngstown's steel economy declined steadily after its heyday in the early 1970s, due to decreased access to raw materials, changes in steel manufacturing technology, and an increasingly global economy. As a result, the majority of steel production shifted to lower-cost overseas plants. By the early-1980's Youngstown had lost most of its jobs and was experiencing significant reductions in population; becoming a prime example of the term "Rust Belt."



Youngstown Mayor Jay Williams understands that his city must concurrently diversify its economy and embrace sustainability if it is to thrive once again. Where many see the area's vacant land and empty buildings as symbols of decline, Mayor Williams sees opportunity for creative land reuse and a burgeoning green economy. In 2009 Mayor Williams, local businessman Jack Scott, and Representative Tim Ryan, invited Global Green to assist in the city's transformation. Under the national nonprofit's direction, Youngstown committed to completing a greenhouse gas inventory as a key part of expanding the sustainability concepts put forward in the seminal Youngstown 2010 plan.

This report presents an in-depth analysis of both the municipal government and community-wide carbon footprints for the City of Youngstown. Taking such important steps shows that the Mayor, City Council, and other city leaders are committed to reducing greenhouse gas (GHG) emissions as part of their effort to create a sustainable economy and to provide a post-industrial model for the region.

Methods

The Greenhouse Gas (GHG) analysis presented in this report was prepared in accordance with the International Council for Local Environmental Initiatives (ICLEI) protocol under the direction of Global Green. Global Green selected ICLEI as a partner in developing Youngstown's GHG inventory because of the organization's 20 years of experience and work with nearly 1200 municipalities worldwide on reducing GHG emissions. ICLEI's roadmap for climate protection consists of five milestones: 1) the GHG inventory, 2) a reduction target, 3) a Climate Action Plan (CAP), 4) CAP implementation, and 5) monitoring and reporting.[3]

This report marks Youngstown's completion of the first two milestones and the beginning of the third, the Climate Action Plan. First, it presents 2009 baseline GHG emissions from city government and the community-at-large. There are six major greenhouse gases that primarily effect climate change and they are Carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6).

Global Green selected two Youngstown State University (YSU) students to work in the City Planning Department for a semester. These "Climate Fellows" 1) gathered information including utility bills, waste tonnage, fuel use, and employee commute data from city departments and other entities within the community; 2) input the data it into ICLEI's Clean Air and Climate Protection (CACP) software, and 3) documented the results.

The data was (Milestone 1) used to set short-, mid-, and long-term GHG reduction targets for Youngstown (Milestone 2). In addition to evaluating the data by level of emissions and cost, this report separates emission types by "scope," or direct and indirect sources. These varying analysis levels allowed the City to set specific reduction targets, and targeted long- and short-term mitigation measures. The City of Youngstown established short-term goals of a 10% reduction in government emissions and a 20% reduction in community emissions by the year 2020; mid-term goals of 20% and 30% by 2030; and long-term goals of 30% and 40% by 2050.

Findings

The Federal Environmental Protection Agency establishes criteria of priority pollutants, in the context of the Clean Air Act. Historically these pollutants have been directly harmful to either human health or the environment, but recently it was determined that CO2 could be regulated as a pollutant, even though the impacts to human and environmental health are an indirect result of changes to the global climate. Based on the data, carbon dioxide (CO2) was found to be Youngstown's largest priority pollutant. CO2 comprises 55% of the total, followed by Sulfuric Oxide (SOx) at 21%, Nitrous Oxide (NOx) at 17%, Volatile Organic Compounds (VOCs) at 6%, and Particulate Matter (PM10) at 1%.

The City's 2009 total energy-related CO2e emissions appear by source in Figure 1. Electricity makes up 71% of Youngstown's energy use emissions, or 30,453 tonnes of CO2e. The high emissions here are due the City's main source of electricity coming from the burning of bituminous coal. Emissions from the other energy sources are minimal in comparison, with natural gas at 1,158 tonnes CO2e or 3%, steam heat at 8,465 tonnes of CO2e or 20%, unleaded gas at 1,658 tonnes CO2e or 4% of the total, and diesel gas at 703 tonnes CO2e or 2%.

A comparison shows that electricity is by far the most expensive energy source and highest GHG emitter. This is partly because electricity is the most commonly used, but more importantly, the burning of bituminous coal is an inefficient and environmentally damaging process. The alignment of monetary savings and GHG reductions provides an important argument for green alternatives.

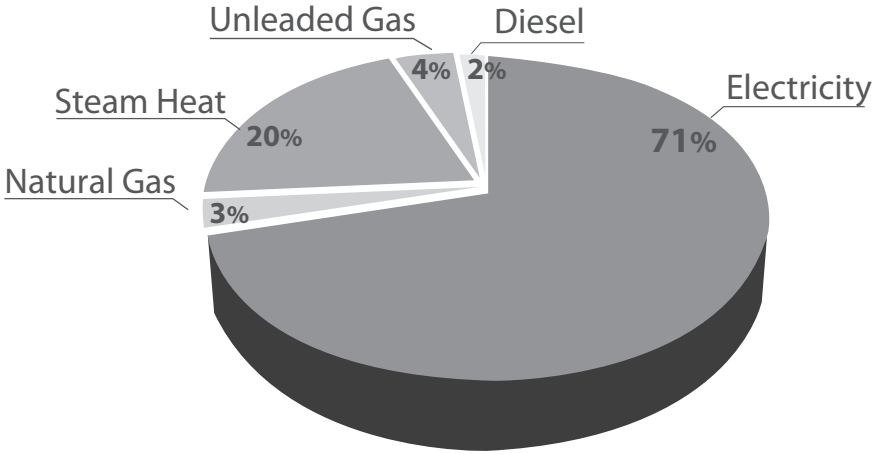


Figure 1: 2009 Municipal GHG Emissions by Source

The City's energy consumption costs taxpayers considerably: Youngstown City Government spent almost $5 million to power itself in 2009. These energy costs are broken down in Figure 2 below. Buildings and Facilities cost the most at almost $1.7 million, the Wastewater Treatment

Plant was close behind at $1.4 million, Streetlights & Traffic Signals were third at $1.2 million, the Vehicle Fleet was half a million, and Employee Commute was about $600.

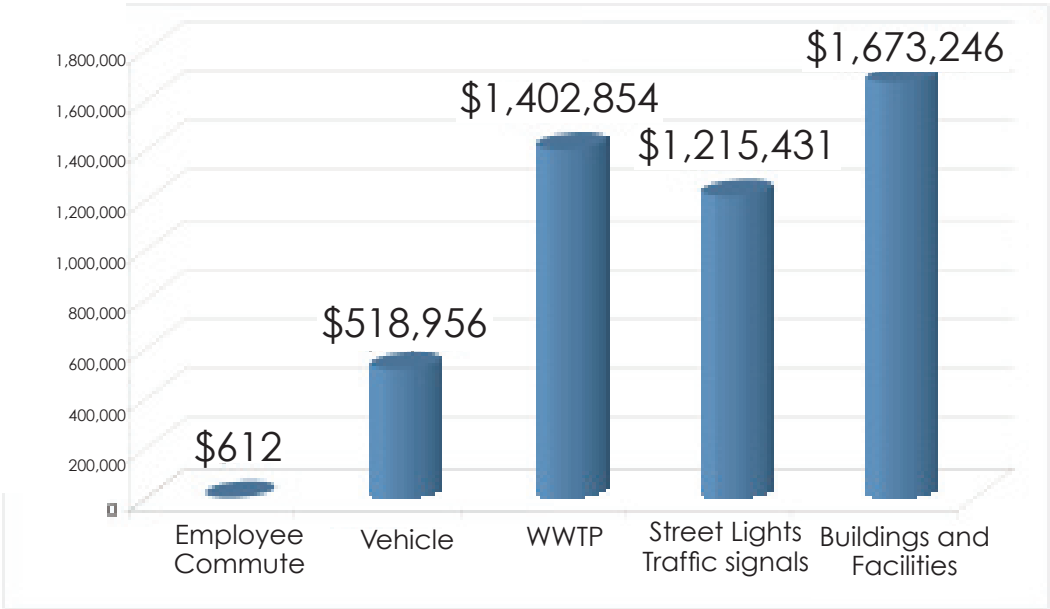


Figure 2: City of Youngstown Energy Cost for Municipal Operations

There are several ways Youngstown can reduce these costs while also decreasing greenhouse gas emissions. Based on similar improvements to other local governments, installing LED lamps in traffic signals and street lights could lead to energy savings of between 30% and 60%. An energy reduction of approximately 10% could be achieved through equipment and operations upgrades to the municipal Wastewater Treatment Plant and city buildings and facilities could undergo upgrades and modernizations to improve energy efficiency by roughly 10%. If Youngstown were to implement all of these practices savings of $700,000 to $1 million dollars could be achieved annually.

MUNICIPAL FACILITIES RECOMMENDATIONS:

Reduce Water Use and Explore New Technologies for Water Treatment

- Encourage citizens to employ water-saving techniques.

- Request a detailed report outlining options and pricing on technologies that reduce both cost and emissions for wastewater treatment.

Conduct Audits, Employ Incentives, Set New Building Standards, and Educate Employees

- Conduct energy audits on municipal buildings to determine most appropriate and cost effective energy efficiency measures for each.

- Assign City employees to seek and apply for rebate and incentive programs that can help the City meet its emission reduction goals.

- Take advantage of Federal Tax Deduction for new construction, which allows government to qualify for an otherwise commercial-focused program by transferring tax deduction to hired contractors or developers.

- Combine the LED retrofit as appropriate with solar-powered streetlights particularly in areas not served by the City's electric grid or where the grid needs major repairs.

Reduce Dirty Steam Heat and Introduce Combined Heat and Power (CHP)

- Replace steam heat with natural gas when upgrading existing buildings or constructing new facilities.

- Secure an Ohio Department of Development Advanced Energy Program Grant to introduce CHP to increase heating efficiency.

COMMUNITY-WIDE RECOMMENDATIONS:

Offer Alternatives to Gasoline Powered Vehicles

- Make bike lanes and alternative-fuel public transportation more available.

- Endorse parking "cash-out" programs at local companies, which offer monetary and lifestyle incentives to employees who opt not to drive to work, but rather take bikes, carpools or public transportation.

Provide Information on Financing and Incentives for Energy Efficiency

- Educate home and business owners about the importance of energy efficiency and return on investment.

- Explore creative financing methods, such as revolving loan funds designed for energy efficiency and renewable energy projects.

- Provide residents with easily accessible and understandable information on local, state and federal incentives for energy efficiency and renewable energy.

Support Renewable Energy

- Make renewable energy such as solar, geothermal, wind and hydroelectric a key part of Youngstown's GHG reduction and general sustainability strategy.

- Work with utilities to educate residents, businesses and industrial facilities about net metering.

Recognize Vacant Property as a Resource

• Explore urban agriculture as a means to reduces "food miles" and generate local jobs

• Evaluate reforestation of vacant parcels as a strategy to sequester carbon and provide a low maintaince way to increase ecological resiliance.

• Provide an openspace buffer adjacent to the Mahoning River and Crab Creek to mitigate potential flood damage from extreme weather events.

• Promote, assist, and collaborate with sustainability leaders such as Youngstown Neighborhood Development Corporation, Mahoning/ Youngstown Community Action Partnership, Grey to Green Festival, Treez Please, Mahoning Valley Organizing Collaborative. Commonwealth, Youngstown Business Incubator and Youngstown State University.

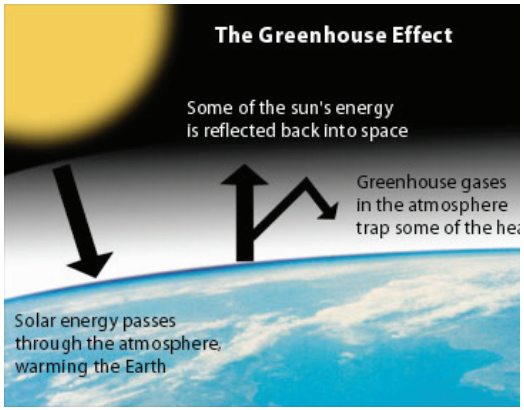
BACKGROUND

It becomes clearer each year that human activities are increasing GHG levels in the earth's atmosphere. Global warming is a key factor in the increased flooding, excess heat and drought, and species migration witnessed with growing frequency across America and the world. In the face of these often life-changing events, people are forced to consider the implications of global warming for themselves and their children. According to the U.S. Environmental Protection Agency (EPA), if the world continues business as usual, meaning no change in behavior, the overall temperature of the earth will increase three to seven degrees Fahrenheit by 2100.

Climate mitigation and adaptation are realities of the 21st Century. Forward thinking cities are considering climate change when planning, building and creating new jobs. Economic change is also a reality. After thirty years of decline, some leaders in the Rust Belt now recognize that the region may not return to its industrial prominence, and instead have chosen to be at the forefront of an emerging movement for environmentally-friendly growth. Youngstown, led by a strong and articulate mayor, is poised to become a leader in developing an ecologically-balanced economy, and to provide a model of sustainability for the Rust Belt.

The Greenhouse Effect

Energy from the sun drives the earth's climate: as the earth circles the sun, it absorbs the star's heat (radiant energy) and then radiates a portion back out of the atmosphere. Approximately 26% of this energy is immediately reflected into space in the upper levels of the atmosphere, 19% is absorbed by clouds, and 4% makes it to the earth's surface and rebounds back into space. The remaining 51% percent of that energy remains in the earth's atmosphere (see Image1). This is the greenhouse effect, a natural occurrence that supports life on earth. However, human activity, primarily the burning of fossil fuels, has increased the levels of heat-trapping greenhouse gases (GHGs), thus changing the amount of the sun's heat that remains in the earth's atmosphere.

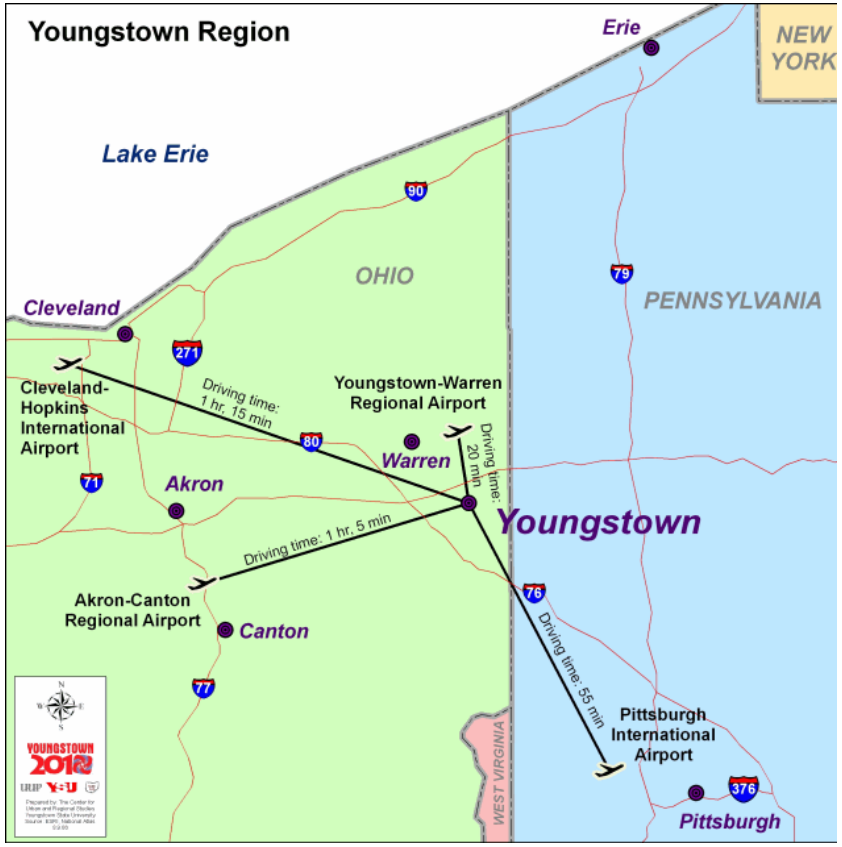


Human amplification of the greenhouse effect is considered responsible for significant long-term changes to the world's climate and weather patterns. The National Aeronautics and Space Administration (NASA)'s Surface Temperature Analysis indicates the average temperature of the Earth's surface has increased by 1.2° to 1.4° F since 1900, and other studies show this trend continuing. Climate change has subtle impacts on precipitation patterns and storm frequency. Places already vulnerable to storms like the northern and eastern portions of the U.S. are seeing increased precipitation, while alternately areas far from storm tracks are experiencing less precipitation and increased risk of drought. Heavy, more dangerous storms are hitting with increased intensity and frequency across America despite these regional variations in yearly precipitation levels.

There are six major GHGs contributing to global warming, all of which are primarily introduced through anthropogenic (human) means.[1] These are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Carbon dioxide (CO_2) and methane (CH_4) have the highest atmospheric concentrations.[2] Common human sources of CO_2 emissions include deforestation, transportation and energy generation. Methane emissions mainly come from livestock, agriculture, changes in land use, and landfills. Since CO_2 is the most prevalent and commonly known GHG, CO_2 equivalent or CO_2e is used in many instances to refer to all GHG's.

The City of Youngstown

The City of Youngstown, nestled in Ohio's lush Mahoning Valley, encompasses 34 square miles midway between Cleveland, 65 miles to the northwest, and Pittsburgh, 61 miles to the southeast.[3] Thirty years ago, Youngstown was a thriving steel center. It became an industrial hub because of large natural deposits of coal and iron, and the old growth hardwood forests used for charcoal production. The first blast furnace was put to work in 1803, and by the 1920's Youngstown was second only to Pittsburgh in total steel production in the U.S.[4] The industry thrived until the mid-1970's, when more stringent EPA regulations combined with overseas competition and changing industrial demands led to a slow but steady economic collapse mirrored in many of America's industrial cities. By 1982, nearly all of Youngstown's steel mills had closed and 50,000 jobs were lost.[5]



[1] *ibid.*
[2] U.S. EPA. 2009. Frequently Asked Questions.
[3] City of Youngstown [website]. 2008. Maps and Weather. Available at http://www.cityofyoungstownoh.org/about_youngstown/maps/maps.aspx
[4] Blue, Frederick J.; Jenkins, William D.; Lawson, William H.; Reedy, Joan M., 1995. Mahoning Memories: A History of Youngstown and Mahoning County. Virginia Beach, VA: The Donning Company. p. 20.
[5] *Ibid.*

Youngstown's economy, built on the success of steel production, never truly diversified; the only other major employers were (and still are) the university and hospital. There was no safety net for laid-off steel mill Methodsorkers, forcing many to migrate to find employment. In 1970 the city's population was 139,788,[6] but by 2008 it was estimated to be only 72,925—about 28,369 households--a 47.8% population loss in 38 years.[7]

Youngstown and Climate Change

At the national level, the climate change conversation has focused on coastal cities, due to the threat of hurricanes and rising sea levels. However, impacts are being felt in diverse cities and towns throughout the United States. Ohio has experienced rising temperatures, an increase in precipitation, more extreme weather events, and decreased water resources in recent years.[8] In the southern Great Lakes Region, average annual temperatures have risen 1.3°F since 1895,[9] the summer months have seen an increase in heavy precipitation while winter snowfall has decreased.[10] Since 1900, precipitation has increased by 10% in northern Ohio, and decreased 10% in southern Ohio.[11] The water level of Lake Erie has dropped 3.5 feet since 1997 with similar decreases taking place throughout Ohio's surface water resources.[12] Clearly, global warming is impacting Youngstown and its environs regardless of the City's distance from the sea.

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[14] City of Youngstown- Youngstown 2010 Plan

[6] U.S. Census Bureau. 2005. Ohio - Race and Hispanic Origin for Selected Large Cities and Other Places: Earliest Census to 1990. Available at http://www.census.gov/population/www/documentation/twps0076/OHtab.pdf

[7] U.S. Census Bureau. 2010. State and County Quick Facts. Available at http://quickfacts.census.gov/qfd/states/39000.html

[8] National Conference of State Legislators. 2008. Climate Change and the Economy; Addressing the Costs of Climate Change, Ohio. p.1. Available at http://www.cier.umd.edu/climateadaptation/Climate%20change--OHIO.pdf

[9] U.S. Environmental Protection Agency. 1998. Climate Change and Ohio. Washington D.C.

[10] Great Lakes Water Quality Board. 2003. Climate Change and Water Quality in the Great Lakes Basin. Ontario, Canada: International Joint Commission of the United States and Canada. P. 3-12

[11] U.S. EPA. Climate Change and Ohio.

[12] U.S. Environmental Protection Agency. 2006. Lake Erie Lake-wide Management Plan. Washington D.C.

Climate change has the potential to affect the economy and quality of life for all Ohio residents. Heat waves may become more frequent and intense, adversely impacting the population's health. Meanwhile, more frequent heavy rainstorms will cause flooding, overload the city's drainage systems and water treatment facilities, threaten infrastructure, and increase the risk of water-borne disease.[13] An increase in pests, pathogens, soil runoff, and weather extremes will affect agricultural production.[14] The receding water in Lake Erie will necessitate more frequent dredging due to concentration of pollutants and impairment of commercial shipping, with estimated costs of compensating for a 1.25 to 2.5 meter drop along the Illinois shoreline reaching $251 to $515 million.[15] Habitat for animals and plants will change with the increases in air and water temperatures, which will impact hunting, fishing, and other industries dependent on natural resources. Additionally, many of the main contributors to climate change such as automobiles and power plants also create ozone buildup, increasing smog to dangerous levels. The resulting respiratory issues will include coughing fits and rising asthma levels and may lead to deaths.[16]

Global warming will continue to intensify unless GHG emissions are cut considerably. The City of Youngstown is committed to developing local climate mitigation strategies and using the baseline data provided in this report to target emission reduction activities. Youngstown's plans do not stop at solely mitigating this damage, for the city is using the climate change issue as a chance to grow stronger, cleaner, healthier and better. It is anticipated that changes will be made in City policy and planning documents governing land-use, zoning, building codes, permitting processes, infrastructure investment, municipal service delivery, and management of schools, parks, and recreation areas.

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[13] Great Lakes Water Quality Board. Climate Change and Water Quality. p. 64

[14] Wander, Michelle and Clemmer, Steve. 2003. Impacts on Agriculture, Our Region's Vital Economic Sector. (Selected findings from *Confronting Climate Change in the Great Lakes Region: Impacts on our Communities and Ecosystems* [Kling et al. 2003])Union of Concerned Scientists. p. 2. Available at: http://www.ucsusa.org/assets/documents/global_warming/ag _factsheet-fnl.pdf

[15] Great Lakes Water Quality Board. Climate Change and Water Quality. p. 73

[16] Ohio EPA. Fact Sheet: Ozone Mapping Project. Division of Air Quality Control. Available at http://www.epa.ohio.gov/Default.aspx?tabid=2850

The Baseline Inventory

The City of Youngstown has made some progress toward its goal of limiting its environmental impact. There are numerous local programs and community organizations engaged in climate-friendly activities. On the strength of existing efforts and a committed Mayor and business community, Youngstown attracted Global Green USA as a partner in its sustainability efforts.

One of the first steps in the GHG analysis effort was for Youngstown to join the International Council for Local Environmental Initiatives (ICLEI) and thereby gain access to its useful tools for helping local governments measure and reduce GHG emissions. Global Green then selected two Climate Fellows from Youngstown State University (YSU) who worked within Youngstown's Department of Community Development & Planning under the direction of Bill D'Avignon and auspices of Mayor Williams. These interns did the bulk of the work in gathering and analyzing the emissions data and drafting this baseline GHG inventory report.

The Climate Fellows compiled data on electricity and natural gas consumption, landfill waste, traffic counts, wastewater treatment emissions, employee commute, and vehicle fleet gas consumption. They entered these data into specially designed software to come up with a baseline GHG inventory and forecasts for 10, 20 and 40 years. This report, a precursor to the local Climate Action Plan (CAP), examines the GHG inventory, makes recommendations for further mitigation activities, and describes Youngstown's existing climate-friendly programs.

METHODOLOGY

This section summarizes the application of ICELI's Five Milestones to Youngstown.

Milestone 1—Conduct the GHG emissions analysis
The analysis in this report was done in accordance with ICLEI's Local Government Operations Protocol (LGOP) utilizing the organization's Clean Air and Climate Protection (CACP) software, which calculates the raw data and expresses them in carbon dioxide equivalents, energy consumption, cost, and many other environmental factors.

Milestone 2—Set reduction targets
The City has set challenging yet achievable GHG reduction goals for Youngstown. For city government they are: a 10% reduction by 2020; 20% by 2030; and 30% by 2050. Goals for the community-at-large are more aggressive: a 20% reduction by 2020; 30% by 2030; and 40% by 2050. Since the level of emissions for the community is so much greater (97% compared to 3%), the community reduction goals are more critical and thus more formidable.

City Of Youngstown GHG Reduction Goals

YEAR	2020	2030	2050
City Government	10%	20%	30%
Traffic lights	20%	30%	40%

Milestone 3—Develop a Climate Action Plan (CAP)
In the next step, the City must develop a CAP that sets specific directives and goals in response to the findings of this Greenhouse Gas Report. The City of Youngstown will work with Global Green and selected stakeholders to create a document that can serve as a user-friendly guide to transforming the city. The ÇAP will then be presented to the Mayor and City Council for adoption.

Milestone 4—Implement the CAP
A stakeholder working group will be formed to facilitate plan implementation. The group will include representatives from government, business, industry, academic, nonprofit and community sectors, and each will be responsible for insuring completion of appropriate components of the plan. For example, public works components such as replacing incandescent traffic lights with LEDs might have citizen oversight, while community activities such as tree planting may be sponsored and supported by local businesses.

Milestone 5—Monitor and report
Follow-up inventories every three to five years will demonstrate whether the measures undertaken are resulting in significant GHG reductions, and where further work is required.

Inventory Collection Process

The YSU Climate Fellows working with the City of Youngstown collected data from 2009, the most recent year from which all necessary records were available. The information came from City departments, utility companies, community businesses and institutions. Table 2 shows the contacts and organizations that provided data.

Inventory Structure

The GHG inventory is divided into two distinct areas: municipal operations and the community-at-large. Municipal operations include all public buildings and facilities, street and traffic lights, the Wastewater Treatment Plant, solid waste facilities, vehicle fleet, and employee commute. The community-at-large includes energy use from all residential, commercial, and industrial buildings, plus waste and transportation related emissions.

Contact List

Data Collected	Data Source	Contact	Phone/Email
Wastewater emissions data	Waste Water Treatment Plant	Dave Paul & Denise Seman	330-742-8820; dseman@ cityofyoungstownoh.com
Traffic lights	Sign Shop	Bill Glenelen	330-743-1494
Street lights	Public Works	Janet Thompson	330-742-8804
City building utility bills	Finance Dept.	Jeanne Rostan	330-742-8724
Fuel purchases	Purchasing	Anna Marie Frease	330-742-8988; amfrease@ cityofyoungstownoh.com
Steam heating	Youngstown Thermal	Rich Burns	330-743-7712
Community electric information	FirstEnergy/Ohio Edison Electric Co	David Turner	330-740-7721 dturner@firstenergycorp.com
Community gas information	Dominion East Ohio-Gas Co	Tracy Stevens	866-478-5778 tracy.w.stevens@dom.com
Bus emission information	WRTA	Thomas Nugen	330-744-8431 tnugen@wrtaonline.com
Community recycling	Litter/Recycling	Jennifer Jones	330-744-7526

Scopes

GHG emissions can be direct or indirect and these distinctions are generally referred to as "Scopes". They provide a framework for managing and reducing direct and indirect emissions.

Scope 1: All direct GHG emissions with the exception of emissions from biogenic sources, which are fuels created from renewable organic feedstock, such as algae or switch grass. These biogenic sources of fuel are not considered in a particular scope, because they actually recycle and sometimes even sequester CO_2 emissions.

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

Scope 3: All other indirect emissions not in scope 2, such as emissions resulting from extraction and production of purchased materials and fuels or transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel, outsourced activities, waste disposal, etc).[17]

Inventory Process Reliability

It should be noted that this report is not an exact calculation of Youngstown's GHG emissions but rather a fairly accurate estimate. The results are based on an analysis of real data, but include some assumptions due to certain information being unobtainable. Assumptions on the percentage of types of waste going to landfills were made using CACP defaults, as Youngstown uses multiple landfills to dispose of its trash and does not track the waste streams. Other information that was not available includes fugitive emissions from Freon-containing items such as city cars, air conditioning units, and vending machines. In the community sector, many large emissions producers such as Youngstown State University (YSU) were not analyzed in detail because the existing software limits community analysis. The writers of this report believe that larger producers such as YSU should be examined in more depth, or that a separate GHG inventory should be done for those entities. Nevertheless, the constraints described above in no way prevent the report from serving as a reliable tool for developing a strong local action plan.

[17] WRI/WBCSD, "GHG Protocol Corporate Standard." 2004.

FINDINGS

Youngstown's total air pollution for 2009, including GHG emissions, is shown in Table 1 below. Emissions included 25 million pounds of Carbon Dioxide (CO_2), 10 million pounds of Sulfuric Dioxide (SOx), close to 8 million pounds of Nitrous Oxide (NOx), 2.5 million pounds of Volatile Organic Compounds (VOCs), and 350 thousand pounds of Particulate Matter (PM_{10}). While this report focuses on CO_2, it should be noted that measures put in place to reduce CO_2 will also help reduce the other pollutants.

Standard procedure is to report GHG's in CO_2 equivalent (CO_2e). The common unit used to express CO_2e is tonnes and the conversion factor from pounds to tonnes is 0.00045359237 or 2204 pounds in one metric tonne. CO_2e includes all of the GHG's found in Table 3 converted into a concentration of CO_2 that would have the same negative impact on the upper levels of the atmosphere. This conversion is made to ease reporting and comprehension.

Pollutants Emitted by Type

Type	NOx (lbs)	SOx (lbs)	CO2 (lbs)	VOCs (lbs)
Government Emissions	182,276.00	420,642.00	115,543.00	12,097.00
Community Emissions	7,758,547.00	8,934,630.00	25,150,337.00	2,574,105.00
Total Emissions	7,944,823.00	9,775,914.00	25,265,880.00	2,586,202.00

Municipal Inventory

Municipal (city government) GHG emissions were calculated for five sectors: 1) City Buildings and Facilities, 2) Streetlights and Traffic Signals, 3) Wastewater Treatment Plant (WWTP), 4) City Vehicle Fleet, and 5) Employee Commute. These are broken out in the Summary Report of 2009 Government GHG Emissions table below.

The City of Youngstown's municipal operations released almost 45,000 tonnes CO_2e in 2009. The highest emissions were from the WWTP, which emitted 23,047 tonnes CO_2e or 51.6% of total emissions. This was followed by Buildings and Facilities, releasing 10,120 tonnes CO_2e, 22.7% of the 2009 total. Close behind were Streetlights and Traffic Signals at 9,142 tonnes CO_2e, 20.5%, followed by the city's Vehicle Fleet at 2,359 tonnes CO_2e, 5.3%, and Employee Commute at 2 tonnes CO_2e, 9.9 e-4%.

Summary Report of Government GHG Emissions

	CO2 (tonnes)	(kg)	CH4 (kg)	Equiv C02 (tonnes)	(%)	Energy (MMBtu)	Cost ($)
Buildings and Facilities	10,068.00	153.00	213.00	10,120.00	22.70	65,382.00	1,673,246.00
Streetlights & Traffic Signals	9,092.00	154.00	106.00	9,142.00	20.50	44,486.00	1,215,431.00
Wastewater Treatment Plant	20,746.00	7,412.00	144.00	23,047.00	51.60	60,097.00	1,402,854.00
Vehicle Fleet	2,322.00	113.00	83.00	2,359.00	5.30	32,451.00	518,956.00
Employee Commute	2.00	-	-	2.00	9.9 e-4	30.00	612.00
Total	**42,230.00**	**7,832.00**	**547.00**	**44,670.00**	**100.00**	**202,447.00**	**4,811,099.00**

GHG emissions are also separated into component gases CO_2, Nitrous Oxide (N_2O), and Methane (CH_4) for each municipal sector. The WWTP's N_2O emissions, at 7,412 kg, were significantly higher than the other sectors because the water treatment process produces high levels of N_2O. The WWTP also emitted the most CO_2e at 51.6% of the total, followed by Buildings and Facilities at 22.7% and Streetlights and Traffic Signals at 20.5%. Interestingly, Buildings and Facilities emitted the most Methane, due to the large amount of fossil fuels burned for electricity and heat. The City's Vehicle Fleet emitted 5.3% total CO_2e while Employee Commute accounted for less than 1%. The total cost of energy, at $4,822,099, shows that the City needs to cut its emissions for financial reasons, while the total emissions of 44,670 tonnes CO_2e exhibit the great impact the City has on the environment.

Figure 3 again makes it clear that Youngstown's WWTP is responsible for the majority of city government emissions, followed by Buildings and Facilities. However, the WWTP only used 30% of the City's energy, while City Buildings and Facilities used 32%.

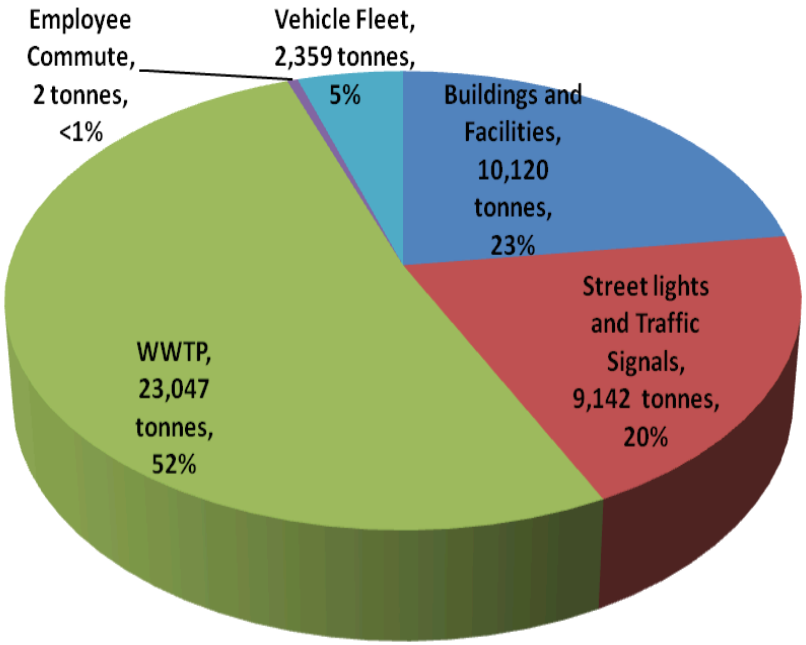

Figure 3: Government GHG Emissions by Sector (tonnes)

Energy consumption data for 2009 appears in Figure 4 measured in MMBtu. The percentage of energy use was more evenly distributed between the sectors than GHG emissions. Buildings and Facilities comprised 65,382 MMBtu or 32% of total energy use, while the WWTP was at 60,097 MMBtu or 30%, Streetlights & Traffic Signals at 44,486 MMBtu or 22%, the Vehicle Fleet at 32,451 MMBtu or 16%, and Employee Commute at 30 MMBtu or less than 1%.

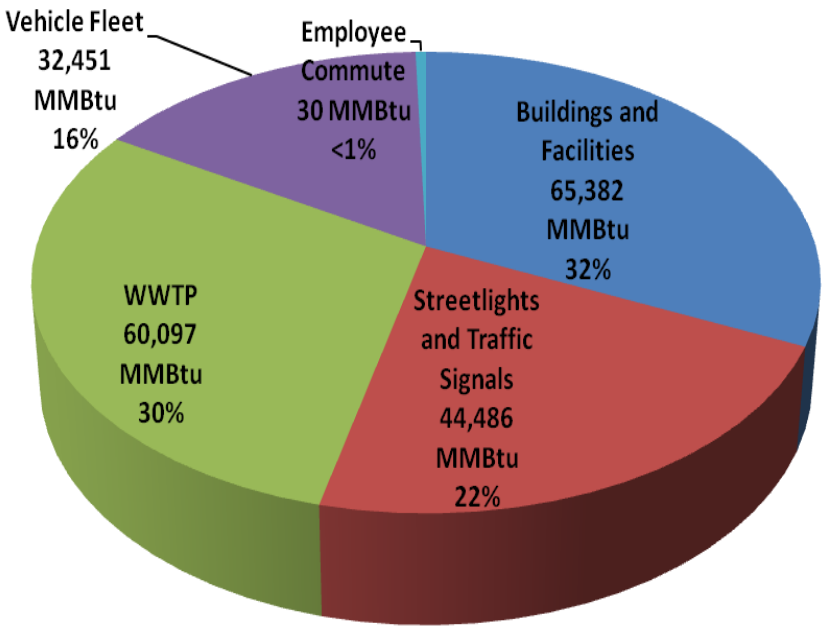

Figure 4: Government Energy Use by Sector (MMBtu)

Energy Source and Cost Analysis

The City's energy consumption costs taxpayers considerably: Youngstown City Government spent almost $5 million to power itself in 2009. These energy costs are broken down in Table 4 (page 13) and Figure 5. Buildings and Facilities cost the most at almost $1.7 million, the Wastewater Treatment Plant was close behind at $1.4 million, Streetlights & Traffic Signals were third at $1.2 million, the Vehicle Fleet was half a million, and Employee Commute was about $600.

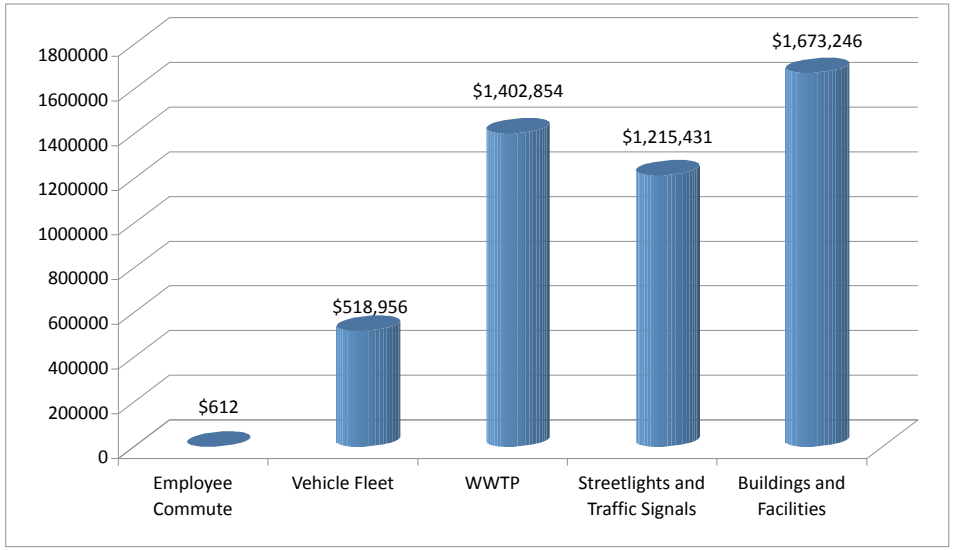

Figure 5: City of Youngstown Energy Cost for Municipal Operations ($)

Figure 6 shows the costs by type of energy used. Eighty-two percent of energy dollars were spent on electricity, 8% were spent on unleaded gas, 5% on steam heat, 3% on deisel fuel, and 2% on natural gas.

The City's 2009 total energy-related CO_2e emissions appear by source in Figure 7. Electricity makes up 71% of Youngstown's energy use emissions, or 30,453 tonnes of CO_2e. The high emissions here are due to the City's main source of electricity coming from the burning of bituminous coal. Emissions from the other energy sources are minimal in comparison, with natural gas at 1,158 tonnes CO_2e or 3%, steam heat at 8,465 tonnes of CO_2e or 20%, unleaded gas at 1,658 tonnes CO_2e or 4% of the total, and diesel gas at 703 tonnes CO_2e or 2%.

A comparison of these Figures shows that electricity is by far the most expensive energy source and highest GHG emitter. This is partly because electricity is the most commonly used, but more importantly, the burning of bituminous coal is an inefficient and environmentally damaging process. The alignment of monetary savings and GHG reductions provides an important argument for green alternatives.

Municipal Scope Analysis

The WWTP releases both Scope 1 and Scope 2 emissions. The Scope 1 value is 10,697 tonnes CO_2e from incineration and N_2O production. The Scope 2 value is 12,350 tonnes CO_2e from the electricity used to power the plant. Buildings and Facilities emit only Scope 2 emissions--10,120 tonnes CO_2e from electricity, natural gas and steam heat produced elsewhere. Streetlights & Traffic Signals also only emit Scope 2, with a combined value of 9,142 tonnes CO_2e. The Vehicle Fleet's emissions at 2,359 tonnes CO_2e are classified as Scope 1 since the gasoline used is purchased by city government and used within the city.

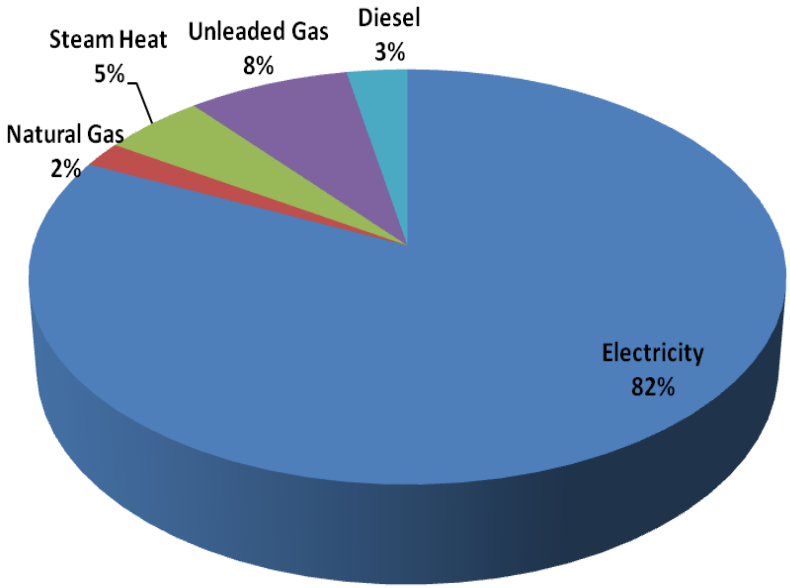

Figure 6: Municipal Costs ($) by Source

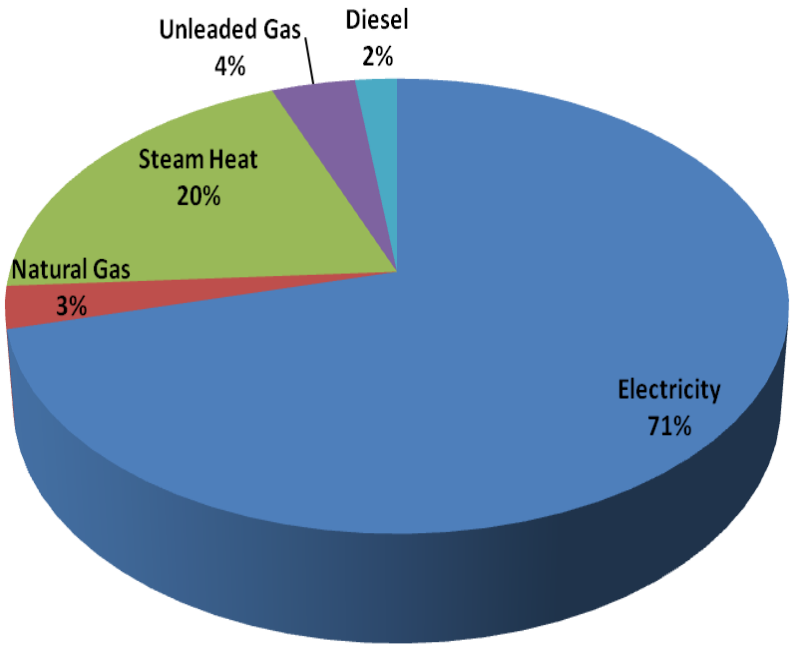

Figure 7: Municipal Costs ($) by Source

Employee Commute, however, with emissions of two tonnes, is classified as Scope 3 because the cars belong to the employees who purchase their gasoline elsewhere. Figure 8 shows municipal emissions by scope and sector.

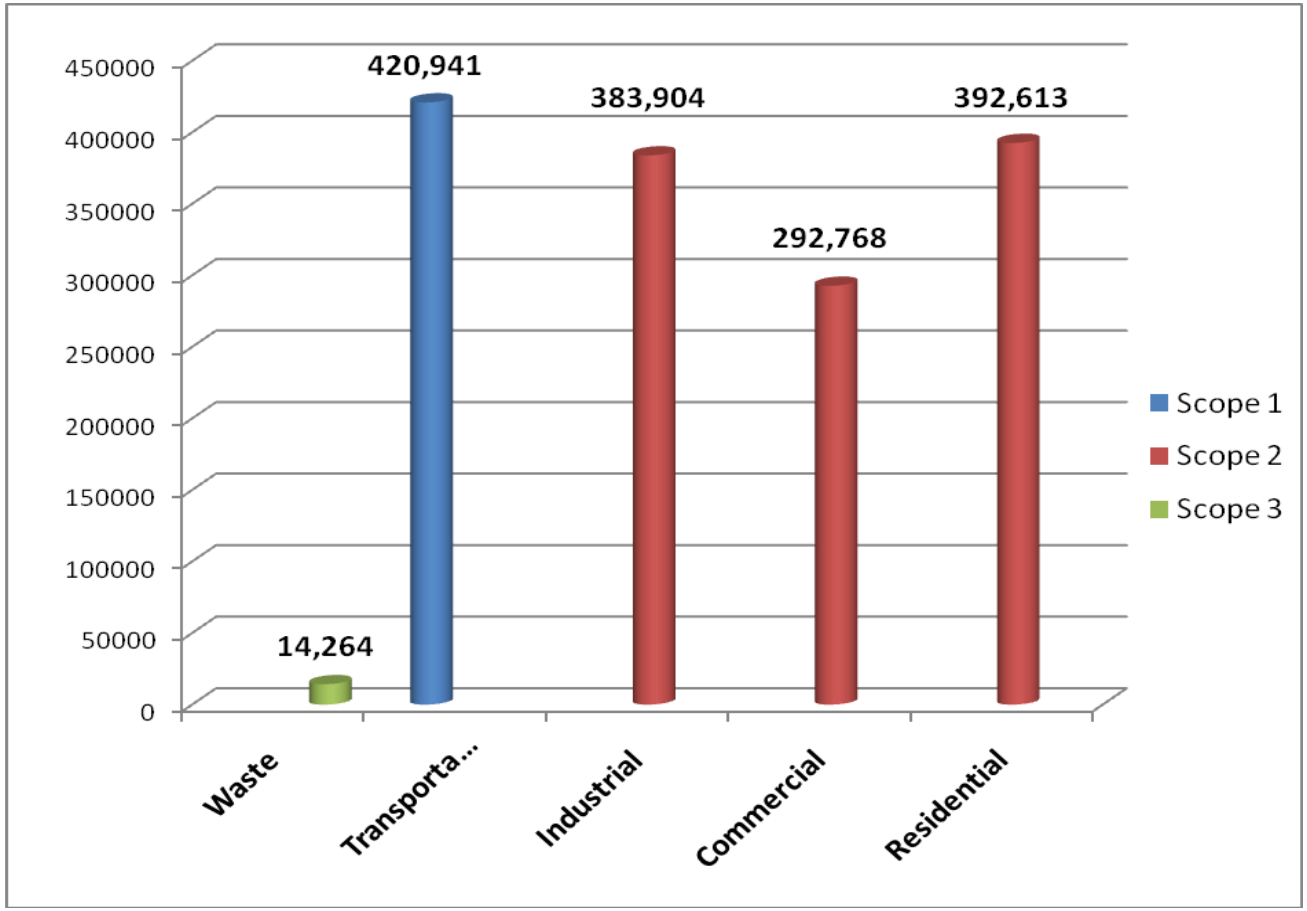

Figure 8: Municipal GHG Emissions CO_2e (tonnes) by Scope

Municipal Sector Detailed Analysis

Buildings and Facilities

The first sector, Buildings and Facilities, were analyzed by department. The Buildings and Grounds Department has two addresses. City Hall Annex is one building. The Economic Department has three buildings. The Fire Department has 11 stations. There are 31 city-run parks in the Parks Department, which has sufficient amount of buildings and equipment to maintain the 31 city parks. The Police Department has four buildings, Public Works has five buildings. The Sign Shop has one building. The Street Department has two buildings. Finally the Water Department has 21 facilities the majority of which are pumping stations.

Electricity

Buildings and Facilities had the highest CO_2e of all municipal sectors. The Water Department used the most electricity, 5,945,186 kWh at a cost of $609,170.25. Next in kWh usage was the 20W Federal Building with 2,116,231 kWh at a cost of $202,070.02. The Police Department/City Hall used 1,354,743 kWh at a cost of $133,356.14. City Hall Annex was next at 1,246,020 kWh costing $122,306.10, followed by the Fire Department at 647,455 kWh costing $69,819.19. The Police Department followed at 278,576 kWh costing $66,025.00, then the Sign Shop at 83,361 kWh costing $7,277.28. The Street Department used 25,922 kWh at a cost of $3,807, Federal Plaza used 21,744 kWh at $3,335.00, and the Parking Facilities used 6,157 kWh at $1,133.52. These numbers are expressed in Figures 9 and 10 on the following pages.

Figure 9 shows the kWh usage by department/building. In 2009, the Water Department accounted for 50% of city government's total electricity consumption. The 20W Federal Building, which is city-owned with some city functions but mostly leased out to other business used 18%; the police department/City Hall, 12%; City Hall Annex, 11%; the Fire Department, 6%; the Park Department, 2%; the Sign Shop, 1%; while Parking Facilities, Federal Plaza and the Street Department all used less than 1%.

The electricity-use data detailed in Figure 9 are understandably similar to the cost data. Figure 10 shows 2009 electricy costs by building/department. The Water Deparment spent $609,170, 50% of the total. The 20W Federal Building spent $202,070 or 17%. The Police Department/City Hall spent $133,356 or 11%, City Hall Annex spent $122,306 or 10%, the Fire Department spent $69,819 or 6%, the Park Department spent $66,025 or 5%, and the Sign Shop spent $7,277 or 1%. The remaining three buildings/departments made up <1% of the total because their costs were so low comparatively: Parking Facilities spent $1,134, Federal Plaza spent $3,335, and the Street Department spent $3,807.

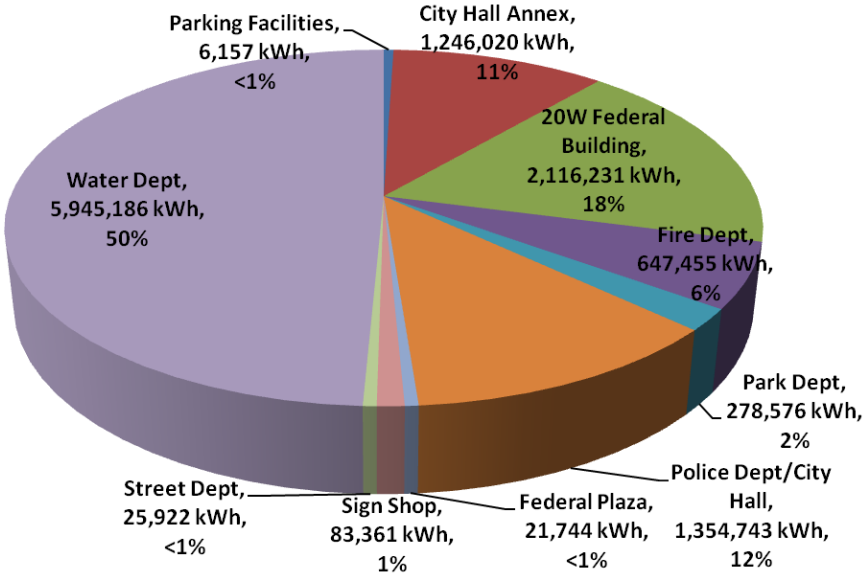

Figure 9: CIty Electricity Usage by Department / Building

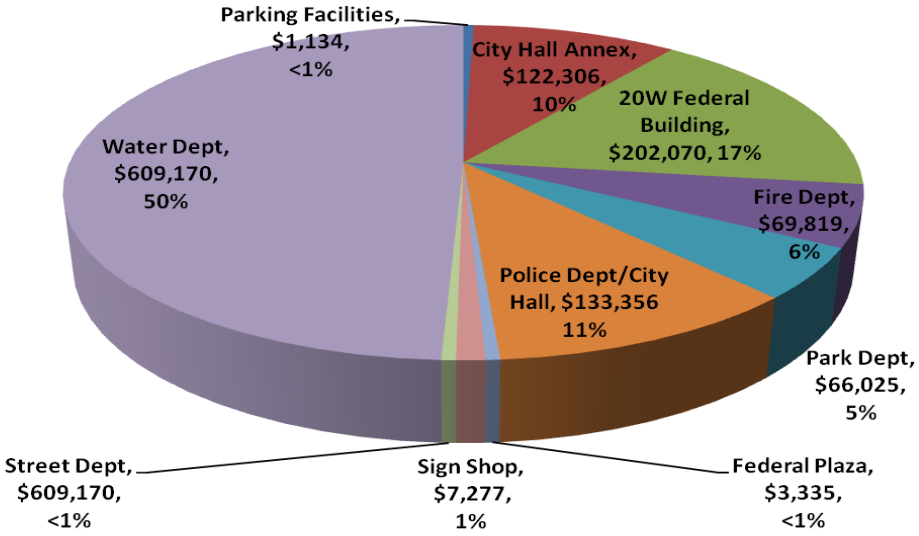

Figure 10: Municipal Electricity Cost by Department/Building

Municipal Heating Usage

	Natural Gas		Steam Heat		Total	
	Therms	Cost ($)	Therms	Cost ($)	Therms	Cost ($)
City Hall	3,820.00	1,710.00	48,740.00	101,380.00	52,560.00	103,090.00
City Hall Annex			19,090.00	39,354.00	19,090.00	39,354.00
20W Federal Building			30,000.00	72,311.00	30,000.00	72,311.00
Fire Department	34,176.00	19,684.00	306.00	6,789.00	34,482.00	26,473.00
Park Department	66,920.00	29,728.00			66,920.00	29,728.00
Police Department	6,684.00	3,813.00			6,684.00	3,813.00
Sign Shop	9,331.00	5,096.00			9,331.00	5,096.00
Street Department	23,950.00	11,688.00			23,950.00	11,688.00
Water Department	71,696.00	40,471.00			71,696.00	40,471.00
Total	**216,577.00**	**112,190.00**	**98,136.00**	**219,834.00**	**314,713.00**	**332,024.00**

Heating

The table above shows municipal building and department heating usage in therms of natural gas and steam heat, and includes the cost for each. Four city buildings use steam heat: City Hall, City Hall Annex, the Economic Department, and one of the fire stations. Of those four, City Hall and the other fire stations also use natural gas heating. The heating costs were highest in the buildings that use steam heat, which is produced by heating water in a boiler through the burning of bituminous coal.

City Hall used 48,740 therms of steam heat at a cost of $101,380, and 3,820 therms of natural gas heat at $1,710. City Hall Annex, which relies solely on steam heat, used 19,090 therms at $39,354. The Economic Department's steam heating used 30,000 therms, costing $72,311. The Water Department uses natural gas and used 71,696 therms at $40,471. The

Park Department used 66,920 therms of natural gas at $29,728. The one steam-using fire station used 306 therms at $6,789, while the rest of the fire stations used 34,176 therms of natural gas costing a total of $19,684; total therms for the Fire Department were 34,482 with a combined cost of $26,473. The Street Department used 23,950 therms at $11,688; the Sign Shop used 9,331 at $5,096; and the Police Department used 6,684 therms at $3,813.

Figure 11 displays 2009 building/department heating usage as percentages of City's total consumption while Figure 12 shows the 2009 cost of heating by building/department. City Hall is one of the buildings that use both steam heat and natural gas, and a comparison of the two Figures below shows the cost of steam heating is substantially higher. City Hall, which only used 17% of the overall energy in therms, accounted for 31% of the City's total heating cost. Similarly, the 20W Federal Building, which uses solely steam heat and consumed 30,000 therms of energy, accounted for 10% of total usage and 22% of total cost. City Hall Annex used 19,090 therms of steam heat: 6% of the total energy and 12% of the City's total energy cost at $39,354.

The buildings and departments that used only natural gas had a much better consumption to cost ratio. For instance, the Water Department consumed 22% of total heating energy and accounted for 12% of total cost. This ratio remained positive across the board for natural gas: the Park Department consumed 21% of total heating energy, at 9% of total cost; the Fire Department used 11% of the energy at 8% of the cost; the Street Department used 11% of the energy at 3%; the Sign Shop used 4% of the energy at 2% of the cost; and the Police Department used 3% of the total energy at 1% of the total cost. The data makes it clear that steam heating is inefficient and costly, and emits greater quantities of GHGs compared to natural gas

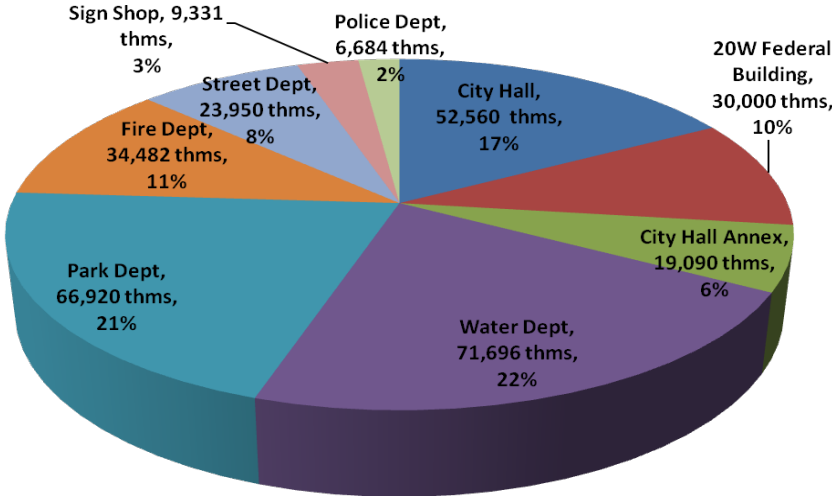

Figure 11: 2009 Municipal Heating Usage

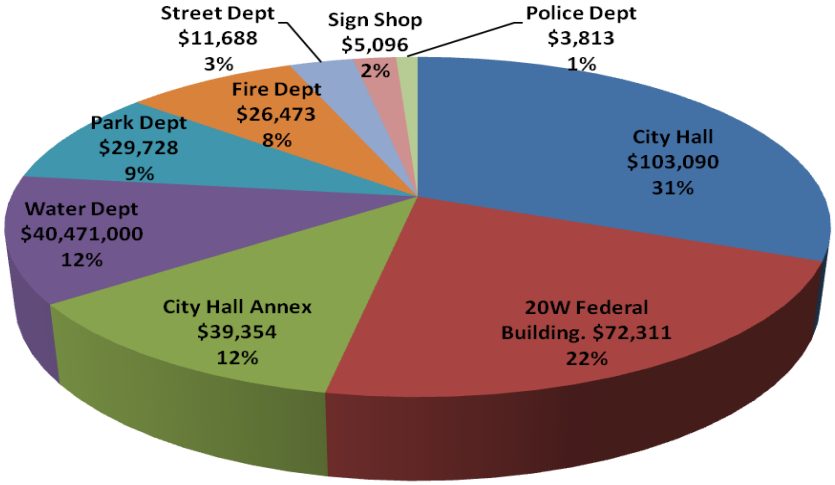

Figure 12: Municipal heating Cost by Department/Building

Streetlights and Traffic Signs

Youngstown has 10,407 streetlights that are lit approximately 4,200 hours annually. Additionally there are 250 traffic signals that run continuously all year long. Since 2009, four traffic signals have been switched from incandescent to LED bulbs. LEDs last up to 100,000 hours and use significantly less energy. The kWh use and the cost for streetlights and traffic signals are shown in Table 6. Streetlights used 10,773,090 kWh in 2009 and cost the city $1.1 million, while traffic signals used 2.3 million kWh and cost $139,924.

Streetlight and traffic Signal usage and Traffic Signal Usage and Cost

	kWh	Cost ($)	Number
Streetlights	10,773,090.00	1,075,507.00	10,407.00
Traffic Signals	2,261,379.00	139,924.00	250.00

Wastewater Treatment Plant

A little less than half of the WWTP's emissions come from treatment processes, while the rest comes from its electricity use. Table 7 shows the source of WWTP emissions. The WWTP's electricity use cost the city $1.4 million in 2009, generating 12,350 tonnes CO_2e or 53% of total WWTP emissions. The incinerator burns dried sludge for approximately 4,245 hours annually, and emitted 8,464 tonnes CO_2e, 37% of WWTP emissions in 2009. The treatment process produced 2,233 tonnes CO_2e of N_2O in 2009, 10% of total emissions.

Sources and Cost of GHG Emissions from WWTP

Source	CO2e (tonnes)	Energy Cost ($)
Electricity	12,350.00	1,402,854.00
Incineration	8,464.00	N/A
Treatment	2,233.00	N/A

Vehicle Fleet

The City's Vehicle Fleet emitted 2,359 tonnes CO_2e in 2009, using 185,948 gallons of unleaded gasoline and 71,325 gallons of diesel. When these values are calculated as CO_2e numbers, gasoline usage emitted 1,656 tonnes CO_2e and diesel usage emitted 703 tonnes CO_2e. Fuel use and cost for both unleaded and diesel gasoline are shown in Figure 13. The city spent $375,901 on 185,948 gallons of unleaded gasoline, and $143,056 on 71,325 gallons of Diesel.

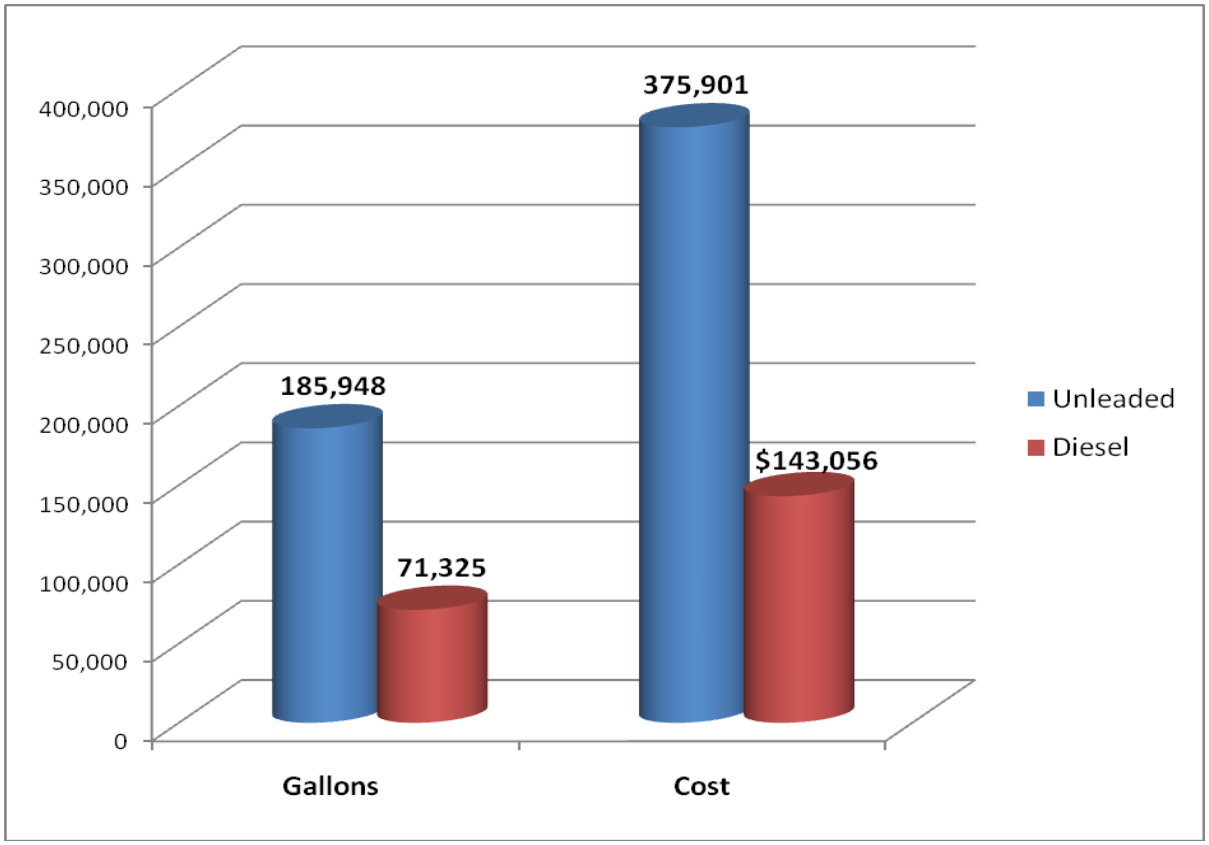

Figure 13: 2009 Municipal Fuel Usage (gallons) and Cost ($)

Community Inventory

This inventory provides an overview of residential, commercial, industrial, transportation and waste sectors for all of Youngstown. This analysis, because of its broader scale, does not go into the same level of detail as the municipal inventory. Utility companies FirstEnergy and Dominion East Ohio provided energy consumption data for the residential, commercial and industrial sectors. Transportation emissions were calculated by estimating the number of vehicles driven in Youngstown, excluding city vehicles, for 330 days per year. ICLEI protocol recommends using 330 days to account for less traffic on holidays and weekends. These calculations were made using daily average miles driven in Mahoning County from the Ohio Department of Transportation. ICLEI recommended using county-wide data in absence of city specific data.[18] Emissions from waste reflect all trash collected and brought to landfills by the six garbage collection companies employed by the City's Waste and Litter Control Department. Transportation was the lead contributor at 420,941 tonnes CO_2e or 28%. Residential and industrial followed closely, producing 392,613 and 383,904 tonnes respectively, about 26% each. The commercial sector had 292,768 tonnes, or 20%; and waste produced almost 14,264 tonnes CO_2e at 1%.

Community GHG Emissions

	CO2 (tonnes)	N2O (kg)	CH4 (kg)	CO_2 Equivalent (tonnes)	(%)	Energy (MMBtu)
Residential	391,226.00	2,713.00	26,011.00	392,613.00	26.10	5,537,938.00
Commercial	291,503.00	3,212.00	12,840.00	292,768.00	19.50	3,020,398.00
Industrial	382,148.00	5,325.00	5,013.00	383,904.00	25.50	2,925,356.00
Transportation	413,379.00	23,063.00	19,617.00	420,941.00	28.00	5,802,141.00
Waste	-	-	679,262.00	14,264.00	0.90	N/A
Total	1,487,256.00	34,314.00	742,744.00	1,504,491.00	100.00	17,285,832.00

[18] U.S. Census Bureau. 2010. State and County Quick Facts. Available at http://quickfacts.census.gov/qfd/states/39000.html

Energy Source Analysis

Figure 14 below shows distribution of energy consumed, while Figure 15 displays the distribution of emissions from all community sources. Most notable is electricity use, which comprises only 17% of overall energy consumption (3 million MMBtu), yet created 41% of total community GHG emissions (682 tonnes CO_2e). Natural gas, which provided for 50% of the community's energy needs (8.5 million MMBtu), only produced 30% (497 tonnes CO_2e) of GHG emissions. Emissions from gasoline, at 23% (389 tonnes CO_2e) of the total, were more on par with usage at 28% (just under 5 million MMBtu). Diesel was the smallest contributor, accounting for 5% (935 thousand MMBtu) of the energy consumption and 5% of the emissions (76 tonnes CO_2e). 1% of community GHG emissions came from landfills (16 tonnes CO_2e).

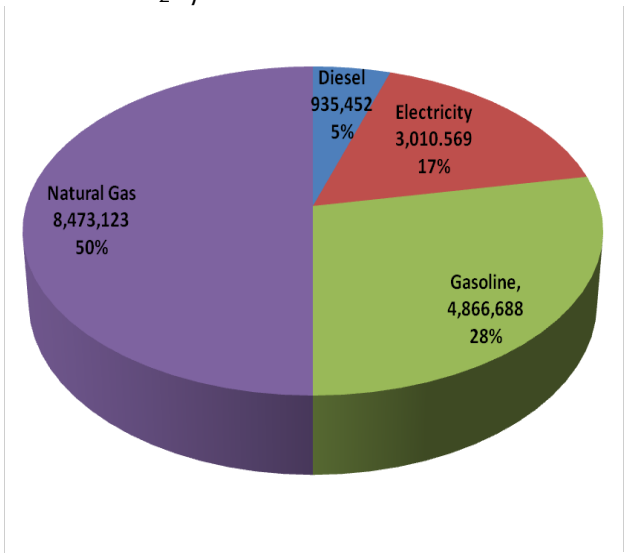

Figure 14: Community Consumption by Source (MMBtu)

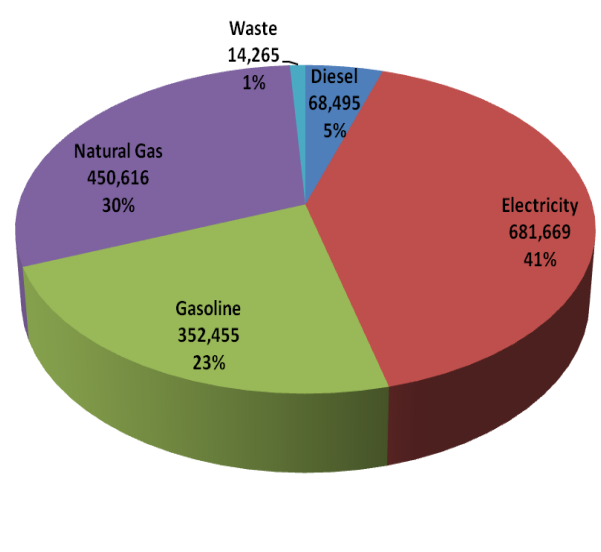

Figure 15: Community GHG Energy Emissions (tonnes CO_2e)

Community Scope Analysis

In the community inventory, only community transportation falls into Scope 1, direct GHG emissions. As shown in Figure 16 below, gas accounted for 420,941 tonnes CO_2e. Scope 2 emissions, from consumption of purchased fuel, cover the residential, industrial and commercial sectors with emissions of 392,613 tonnes, 383,904 tonnes and 292,768 tonnes CO_2e respectively. Waste is the only Scope 3 emission at 14,264 tons CO_2e.

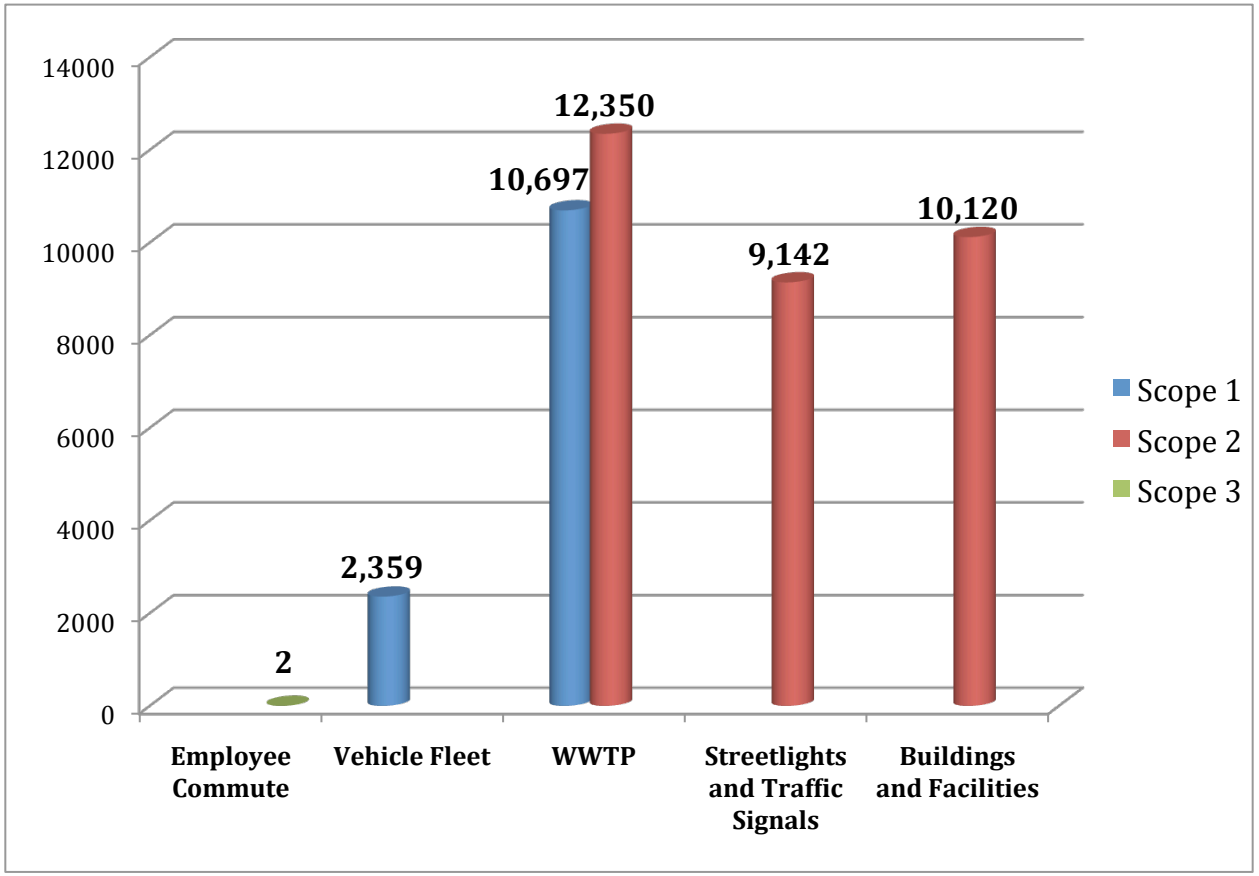

Figure 16: Tonnes CO_2e by Scope

Community Sector Detailed Analysis

Total community energy use in 2009 is displayed in Figure 17 by sector. Transportation produced the most emissions at 34%, closely followed by Residential at 32%. Commercial and Industrial follow, both at 17%.

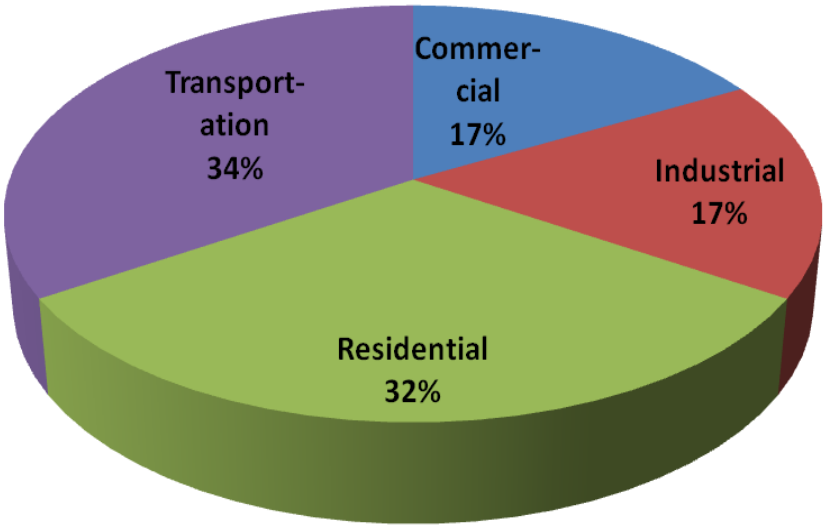

Figure 17: Percentage Energy Use by Sector (MMBtu)

Solid Waste Inventory

Youngstown's total waste production in 2009 was 30 thousand tons. Four landfills service the community: Carbon Limestone Sanitary Landfill, Elkrun Industries Inc., Total Waste Logistics LAS LLC, and Waste Management Landfill. Six garbage collection services haul trash from city neighborhoods the landfills, all of which are located outside city limits. The trash transport emissions are included in the transportation sector.

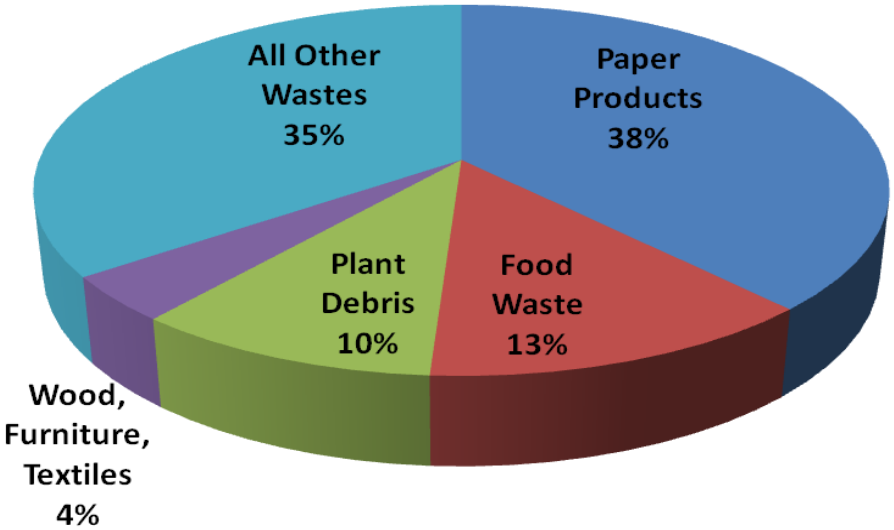

Figure 18: Typical U.S. Community Landfill Waste (%)

Forecast for Business as Usual Scenario

Interestingly, the "business-as-usual" forecast shows that Youngstown's projected emissions will decrease over time. This is because the City's population has been steadily declining for the past 40 years and the forecast assumes a continuation of this trend. The "business-as-usual" decrease in GHG emissions by 2015 is -2.84%, a reduction of 41,482 tonnes of CO_2e. By 2050 this decrease would be -16.56%, a reduction of 213,739 tonnes of CO_2e. If the population does not decline, GHG emissions will possibly rise. In either case it is important for residents and government operations to develop better practices to create a more sustainable city.

RECOMMENDATIONS

This section reviews those sectors in the Community as a whole and within Local Government with the highest GHG emissions and recommends strategies and methods for reduction. Ninety-seven percent (97%) of Youngstown's GHG emissions come from the community-at-large. There is no one sector that emits the vast majority of GHGs in the Youngstown community. Residential, industrial and commercial emissions follow closely behind transportation (28%) at 26.1%, 25.5% and 19.5%, respectively. Additionally, electricity makes up 90% of Youngstown's energy use, and the city relies heavily on highly-polluting bituminous coal to produce that energy. Community-wide change will require innovative legislation, investment in appropriate technologies, and a city-wide commitment to sustainability.

Offer Alternatives to Gasoline Powered Vehicles

A key component to lowering community emissions is reducing use of private vehicles. In 2009, community transportation accounted for 34% of the community's energy use, and made up 28% of the community's total emissions, with 420,941 tonnes CO^2e. This number far outweighs the largest municipal emitter, the WWTP, which released 23,047 tonnes CO^2e in 2009.

City government and the Youngstown community can take immediate steps to reduce transportation emissions. One of the most important gains will be convincing citizens to make small changes that can collectively have a large impact, such as emphasizing basics such as riding a bike to work rather than driving. Additionally, Youngstown must become an effective proponent of energy efficient vehicles by advocating for state and federal legislation and participating in pilot programs that support America's growing electric and alternative fuel vehicle market

- ***Make bike lanes and alternative-fuel public transportation more available.***
- ***Endorse parking "cash-out" programs at local companies, which offer monetary and lifestyle incentives to employees who opt to utilize bikes, carpools or public transportation.***

Develop an Outreach and Education Program

Education and outreach to residents and business is the first order of business in reducing GHG emissions in these sectors. City government, or a non-governmental organization (NGO) supported by the city, should develop an outreach program that educates home and business owners about the importance of energy efficiency, specific measures they can take, and what return on investment they can expect.

Youngstown, like other cities across the country, must **explore creative financing methods for increasing energy efficiency in all sectors of the community**. In June, 2010, Ohio's state legislature authorized cities and counties to set up revolving loan funds.[19] *Youngstown could benefit from a revolving loan fund designed for energy efficiency and renewable energy projects.* These funds are self-sustainable after the initial investment since borrowers make their payments directly back to the fund, which is then available for other projects. The Keystone Home Energy Loan Program in Pennsylvania has a good track record and might be a good model for Youngstown.[20]

Ohio building owners can **access tax incentives and programs for green building.** Youngstown and its utilities must provide residents with easily accessible and understandable information on current incentives, such as the following:

- Green Energy Ohio offers homeowners a rebate on solar water heating systems, providing $30 per projected kBtu produced per day with a limit of $2,400.

- Homeowners are eligible for a 3% loan rate reduction for energy efficient projects through the State's Energy Conservation for Ohioans (ECO)-Link program.[21]

- The Ohio Department of Development (ODOD) offers a wide range of green building and retrofit funding options including specific programs for multi-family and low-income households.[22]

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[19]Ohio Legislative Service Commission. May 24, 2010. Fiscal Note and Local Impact Statement. Am. Sub. S.B. 232 of the 128th G.A. Available at http://www.lsc.state.oh.us/fiscal/fiscalnotes/ 128ga/sb0232sp.htm
[20] Find more information at: http://www.keystonehelp.com/index.php
[21] Find information at: http://www.tos.ohio.gov/ForYou/Default.aspx?Section=ECO
[22] Dsireusa.org. 2010. Ohio Incentives/Policies for Renewables and Energy Efficiency. http://www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=OH

Commercial rate payers have even more incentives available, and Youngstown/local utilities must promote these programs to commercial, industrial, nonprofit, and local government customers:

- A rebate for 50% of total project costs (limit $300,000) for replacement of refrigerators, lights, furnaces, heat pumps, air conditioners, and more through AEP Ohio's Commercial Custom Project Rebate Program

- A diverse range of Ohio-specific, non-residential building and retrofit incentives through ODOD. This includes funding for distributed energy options, including combined heat and power, biomass, and micro-turbines, as well as renewable energy financing for solar water heaters, photovoltaics, and wind.[23]

- In summer 2010, ODOD received $150 million in Advanced Energy Job Stimulus Funds to enhance creation, development and implementation of advanced alternate energy technologies. The program offers $66 million for clean coal projects and $84 million for non-coal projects, an incentive that could help break Youngstown's reliance on bituminous coal

- The Advanced Energy Job Stimulus Funds also expanded traditional Ohio Air Quality Development Authority (OAQDA) programs that cover a wide range of retrofit rebates. This secured financing for the construction, purchase and installation of solar thermal, solar electric, wind, biomass, hydroelectric, and combined heat and power systems in industry and commercial buildings.[24]

- Some local governments in Ohio have been authorized to set up PACE financing, a program that offers low-interest, 30 year loans for energy efficient technologies.[25]

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[23] Dsireusa.org. Ohio Incentives/Policies for Renewables and Energy Efficiency.
[24] Find information on these incentives and more at http://www.dsireusa.org/incentives/allsummaries.cfm?State=OH&&re=1&ee=1
[25] Dsireusa.org. 2010. All Summaries.

Reducing Municipal Emissions and Energy Use

Through implementing reduction measures the city of Youngstown can play an important leadership role and realize immediate savings for the municipal budget. In 2009, the City spent approximately $5 million on municipal energy costs, 82% of which was for electricity.

City government can lead by example by encouraging city employees to change their commuting habits. City administrators can be creative, initiating green workplace or commute competitions, securing coveted parking spaces for carpoolers, installing amenities for bikers, and offering training and information sessions that make the transition to a green lifestyle easier and more desirable. Additionally, the City should consider advertisement campaigns that highlight simple strategies for decreasing transportation, water and energy use impacts.

The largest producer of GHGs in Youngstown's municipal operations is the Wastewater Treatment Plant. The WWTP emitted 51.6% of the city's total GHGs—23,047 tonnes CO^2e in 2009. Additionally, the plant used 5.9 million kWh of energy in 2009, nearly four million more kilowatt hours than the second highest energy user. The electricity cost of $609,000 was $400,000 more than the next most expensive sector. Clearly, addressing the plant's consumption and emissions is a priority not only for environmental reasons.

The City must implement a dual approach to reducing energy use at the WWTP:

1) An outreach campaign to reduce water usage citywide, and

2) Research and investment in new technologies for wastewater treatment.

Encourage citizens to employ water-saving techniques that confront the problem from the demand side. Residential and commercial building owners can install dual-flush toilets, and other low flow fixtures in their buildings as well as raingardens and cisterns on their properties to reduce stormwater runoff. Industries can often re-use cooling water, saving thousands of gallons a day. Again, the City can set an example by implementing water-saving measures in its own buildings to decrease the amount of grey water and rainwater flowing to the WWTP.

Research and invest in new technologies for wastewater treatment by finding an expert who can provide a detailed report outlining options and pricing on technologies that reduce both cost and emissions. Some ideas for further research and consideration follow:

- Install a hydroelectric generator in an outflow pipeline. On site generation would replace using utilities, and could potentially be produced through anaerobic sludge digesters that produce biogas fuel, which can be supplemented by natural gas when necessary. The heat produced could be harnessed for WWTP processes such as sludge drying, digester heating, and space conditioning.

- The City could also save money and reduce strain on grid by treating sewage at off-peak hours. This may require installing storage facilities. Additionally, minimizing aeration through upgrading technologies will save on energy costs.

- Artificial wetlands or algae filtration are methods that use natural, non-energy intensive processes to treat wastewater.

- Conduct Energy Audits, Utilize Incentives, Set New Building Standards, and Organize Employees

In 2009, the City's buildings and facilities guzzled 32% of the City's energy. Utility bills were highest for this sector at $1.7 million. **The City must conduct an energy audit of its buildings and facilities to determine the most appropriate and cost effective energy efficiency measures for each building.** The most commonly recommended efficiency improvements include lighting upgrades, HVAC tune ups, and sealing of the building envelope. An ESCO or Energy Service Company can be employed to do the audit, make the upgrades and provide a maintenance-contract if the City so desires. These types of agreements, also known as performance contracts, are guaranteed to pay for themselves, but the City may also opt to train or hire staff to conduct upgrades and maintenance to increase savings and speed up payback.

One or more City staff should be assigned to seek and apply for appropriate rebate and incentive programs that can help the City meet its emission reduction goals. These include:

- **AEP Ohio Energy Efficiency Rebate Program**
- **AEP Ohio Commercial Custom Project Rebate Program**
- **AEP Ohio Commercial Self Direct Rebate Program**
- **Dayton Power and Light Business and Government Energy Efficiency Rebate Program**
- **ODOD Non-Residential Distributed Energy Incentive**
- **ODOD Non-Residential Renewable Energy Incentive**
- **Ohio Job Stimulus Plan**
- **Interconnection Standards**
- **Solar Easement**[26]

The City should take advantage of the Federal Energy Efficient Commercial Buildings Tax Deduction for new construction, which allows government to qualify for an otherwise commercial-focused program by transferring the tax deduction to hired contractors or developers. The IRS offers $.30-$1.80 per square foot depending on the technology and level of energy reduction from improvements to water heaters, lighting, furnaces, boilers, heat pumps, central air conditioners, duct and air sealing, insulation, window and doors, siding, roofs, and more.[27] This process grants the government an advantage in the Requests for Proposals (RFP) process, as it favors contractors who include an application for the energy efficient deduction in their proposals.

Youngstown should pass an ordinance requiring all new government and commercial buildings and major renovations to be certified by a green building program such as the United States Green Building Council (USGBC)'s Leadership in Energy and Environmental Design (LEED). These and other green building programs provide a framework starting with the design phase for ensuring high-performance buildings.

Finally, the City must involve its buildings' users in all facility-related energy efficiency initiatives. ENERGY STAR, a national program funded by the EPA and DOE to provide energy

[26] For a detailed summary of requirements and eligibility for these programs see Dsireusa.org. All Summaries.
[27] Dsireusa.org. November 01, 2010. Federal Incentives/Policies for Renewables and Efficiency. Available at http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US40F &re=1&ee=1

efficient technologies and information, offers techniques for engaging building residents and users on its website. These include offering employee orientation programs, undertaking poster campaigns, periodic workshops and Earth Day events, increasing energy use transparency, and providing information on energy utilities and individual appliances' energy consumption.[28]

One obstacle that building managers face, especially at workplaces, is that users see little personal benefit from increasing a building's energy efficiency. Often, their comfort is more important to them. The options above attempt to address this issue by providing users with more knowledge, but many energy efficiency programs also provide incentives such as energy saving competitions to increase participation. For instance, when the Housing Authority of Danbury, Connecticut, entered into an energy performance contract, they set up a Resident Program Fund in which they placed the money saved through the energy changes. The Housing Authority used the fund to make improvements that directly benefitted building users such as playground upgrades, locked mailboxes, doorbells, permit parking, and new house numbers for the apartments.[29] The City of Youngstown should use both outreach and incentives to ensure its employees begin matching the City's energy efficiency efforts with their own.

Install LEDs in Traffic Signals and Streetlights

Many cities across the United States are taking advantage of LEDs to save energy and money. In 2001 the city of Portland, Oregon replaced 13,300 red and green traffic signals with LEDs. They recovered their initial investment within three years and estimate that they now save $380,000 annually on maintenance and energy costs.[30] Youngstown should replace its 250 incandescent traffic signals with LEDS to immediately reduce the 2.3 million kWh of energy

[28] Energystar.gov. Step 5.2, Raise Awareness. Buildings and Plants Guidelines. Available at http://www.energystar.gov/index.cfm?c=implement_plan.raise_awareness
[29] Hebert, Scott; Morse, Deborah; Nolan, Sandra. January 1998. Energy Conservation for Housing- A Workbook. ABT Associates. p. 21. Available at http://www.abtassociates.com/reports/D19980034.pdf
[30] Nichols, Curt. Energy Efficiency Success Story: LED Traffic Signals = Energy Savings for the City of Portland, Oregon. Northwest Energy Alliance. p. 3. Available at http://www.portlandonline.com/bps/index.cfm?a=111737&c=41888

consumed annually at a cost of $134,000. Portland now runs 13,050 more traffic signals than Youngstown, yet only consumes 1.2 million kWh of energy annually at a cost of $80,000.

Youngstown should further reduce energy and cost by replacing its 10,407 incandescent streetlights. In 2009, these streetlights consumed 10.8 million kWh and cost the city $1.1 million, while the traffic lights consumed 2.3 million kWh and cost $139,924. Youngstown can opt for an LED leasing arrangement (like Portland[31]) if it finds the initial change-over too expensive to pay for at one time. Additionally, the City should take advantage of any state or federal tax credits for these retrofits.

Transitioning traffic and streetlights to LEDs is a critical first step, which should be combined as appropriate with solar-powered streetlights particularly in areas not served by the City's electric grid or where the grid needs major repairs.

Reduce Dirty Steam Heat and Introduce CHP

Youngstown's own experience demonstrates that natural gas is much more cost effective way to provide heat than steam.[32] Natural gas is also the more environmentally-friendly option since Youngstown produces its steam by burning bituminous coal, a heavy contributor to Scope 1 GHG emissions. Youngstown should favor natural gas over steam heat when upgrading existing buildings or constructing new facilities.

Youngstown should take advantage of Combined Heat and Power (CHP) to increase its heating efficiency. CHP provides excellent fuel efficiency[33] by recovering excess heat produced by thermal energy generators and using it for other energy needs. Instead of purchasing coal-sourced electricity from a utility and reburning coal on-site for thermal energy, large consumers can fulfill their energy needs by more effectively harnessing their

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[31] Nichols, Curt. Energy Efficiency Success Story. p. 2.
[32] In 2009, municipal heating systems used 216,577 therms of natural gas at a cost of $112,190 and 98,136 therms of steam heat at a cost of $219,834.
[33] US Department of Energy. 2009. Combined Heat and Power: A decade of promise, a vision for the future. Gulf Coast Clean Energy Application Center. Available at http://www.gulfcoastcleanenergy.org/CleanEnergy/CombinedHeatandPower/tabid/1698/ Default.aspx

electricity generator. Powering steam generators with coal alternatives can further increase a CHP system's environmental benefits.

CHP produces more than 12% of the total electricity generated in the U.S.[34] It is not a new technology for Ohio—the oldest active unit in the State is owned by the Package Corporation of America in a building that began operating in 1928. As of May 2010, there were 48 CHP units in Ohio with a total capacity of 706,438 kW. This includes 22 boilers or steam turbines running on biomass with a capacity of 558,103 kW, seven combustion turbines using natural gas and propane with a capacity of 126,350 kW, 15 reciprocating engines using wood with a capacity of 15,415, and three micro-turbines using waste such as black liquor[35] with a capacity of 570kw.[36]

Youngstown can seek funding for CHP through an ODOD Advanced Energy Program Grant, a program designed to subsidize distributed energy resources that transmit power from the same property or a nearby site. This program covers commercial and industrial properties as well as nonprofits, schools, and government buildings, and offers 25% of installation cost (up to $100,000) for energy efficient installations including CHP.[37]

Support Renewable Energy

Renewable energy such as solar, geothermal, wind and hydroelectric must be a key part of Youngstown's GHG reduction and general sustainability strategy. The Public Utilities Commission of Ohio (PUCO) regulates the state's utilities, but Youngstown can certainly **advocate for more renewable energy from its power providers** (FirstEnergy and Dominion East Ohio). Ohio enacted a Renewable Portfolio Standard (RPS) in 2008, requiring that 25% of Ohio's power be generated by alternative energy sources by 2025, and includes specific

[34] US Department of Energy. 2009. Combined Heat and Power: A decade of promise, a vision for the future.
[35] The left over substance from the pulping processes used to transform wood into paper.
[36] ICF International. Combined Heat and Power Units Located in Ohio. Energy and Environmental Analysis Inc. Available at http://www.eea-inc.com/chpdata/States/OH.html
[37] Dsireusa.org. Ohio Incentives/Policies for Renewables and Efficiency. Available at http://www.dsireusa.org/incentives/allsummaries.cfm?State=OH&&re=1&ee=1

benchmarks for renewable and solar energy.[38] The City can work with FirstEnergy and Dominion to see that these alternatives are implemented in Youngstown.

The City should work with its utilities to educate residents, businesses and industrial facilities about net metering. Ohio's original net-metering law was enacted in 1999; PUCO revised its net metering rules in March 2007; and legislation enacted in 2008 further amended Ohio's net metering law removing all limitations related to energy generation technology and system size on systems sited at hospitals.[39]

Recognize Vacant Property as a Resource

• Explore urban agriculture as a means to reduces "food miles" and generate local jobs

• Evaluate reforestation of vacant parcels as a strategy to sequester carbon and provide a low maintainance way to increase ecological resilience.

• Provide an open space buffer adjacent to the Mahoning River and Crab Creek to mitigate potential flood damage from extreme weather events.

•Promote, assist, and collaborate with sustainability leaders such as Youngstown Neighborhood Development Corporation, Mahoning/Youngstown Community Action Partnership, Grey to Green Festival, Treez Please, Mahoning Valley Organizing Collaborative. Commonwealth, Youngstown Business Incubator and Youngstown State University.

Support Existing Resources

A number of organizations and programs are already dedicated to Youngstown's green rebirth. The City must continue to promote, assist and collaborate with these sustainability leaders:

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[38] http://dsireusa.org/summarymaps/index.cfm?ee=1&RE=1
[39] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OH02R&re=1&ee=1

Youngstown Neighborhood Development Corporation (http://www.yndc.org/)
This local neighborhood development organization launched in 2009, and YNDC runs green programs such as Lots of Green along with its other development initiatives. Through the Lots of Green program, the YNDC transforms vacant houses and lots in troubled neighborhoods into community-maintained gardens and parks. On November 10, 2010, the Ohio Environmental Education fund invested $30,022 in Lots of Green to develop a market gardening training program and incubation site. YNDC will use this funding to train participants to produce fruit, vegetables and cash crops to sell for a profit, giving residents secondary or even primary income opportunities.[40] YNDC also runs a Green Homes program in which they buy and retrofit older houses to make them energy efficient and affordable to lower income families.

Mahoning/Youngstown Community Action Partnership (http://www.my-cap.org/)
The state of Ohio incorporated MYCAP in 1965, creating a local administrative body that offers a variety of programs to low-income families. MYCAP is currently made up of over 250 full- and part-time employees. In December 2006, Youngstown's Community Development Agency (CDA) entered into a partnership with MYCAP to provide financial support to low-income families looking to upgrade their home's insulation or furnace.

Grey to Green Festival (http://www.greytogreenfestival.org/)
Youngstown hosted its first annual Grey to Green Festival in 2008, with over 500 local government officials, non-profit staff members and Youngstown citizens in attendance. Two years later, the event continues to provide a venue for environmentally conscious companies and nonprofits to share their information, keynote speakers to present on green topics, and the community to engage with Youngstown's growing green movement. The 2010 festival took place September, 11th in Wick Park on Youngstown's North Side, and with 50 green vendors and more than 475 attendees on its Facebook page the event was another success.

Treez Please (http://treezplease.org/meadplant2.html)
Treez Please is a volunteer organization that creates green space to benefit the health and quality of life of Youngstown residents. Its members have been involved in such projects as

[40] www.YNDC.org press release November 11, 2010

the Grey to Green Festival, 2010 streetscape tree planting, demonstration meadow planting on Brier Hill, and the Wick Park Planting of 2009.

Mahoning Valley Organizing Collaborative (http://www.mvorganizing.org/)
The MVOC was launched in 2007 as a broad-based organizing effort. Staff members work with over 60 churches, neighborhood organizations, unions, and other grass roots organizations throughout the Youngstown/Warren region to develop neighborhood leaders focused on building healthier, greener communities. Additionally, the MVOC has brought together many city and state government officials to discuss the region's vacancy and land use issues. Other projects include sponsoring creation of the YNDC, and providing resources for Youngstown's Gray to Green neighborhood transformation.

Commonwealth (http://www.commonwealthinc.org/)
Commonwealth is a versatile community development organization with projects throughout Youngstown. At "The Homes on Baldwin," the organization constructed two new energy efficient residencies, one of which was purchased and the other is for sale. They also organize farmers markets downtown and on the northside, offering fresh produce and economic opportunity to Youngstown residents. Soon, a kitchen incubator will allow community gardeners to prepare foods for market. Another effort creates urban gardens in Youngstown, including one in the Wick Park neighborhood.

Youngstown Business Incubator (http://www.ybi.org/)
YBI, located in a remodeled building downtown, opened in 1995, and became full-scale after a second construction phase in 1997. YBI houses small technology-based businesses, giving them assistance with commercialization, counseling on market strategies, identifying funding resources, networking, and accesses to physical infrastructure. YBI is home to a number of developing companies including Visual Impact Imagining, ERIS Medical Technologies, Wellness Integrated Network, and GreenEnergyTV.com.

Youngstown State University (http://web.ysu.edu/home)
YSU is an urban research college located just north of the City center. The University boasts excellent recycling and composting facilities and recently finished constructing a new business building, certified LEED Gold. It's Science and Technology College is installing solar panels on the roof. YSU educates future green leaders through various programs including its

Planning Department, Geological and Environmental Science Department, and the Civil and Environmental Engineering Program. YSU's students are environmentally active, particularly through a student group called Youngstown Environmental Sustainability Society (YESS). This organization sponsors events such as campus Earth Day and its members volunteer around the community in activities such as Mill Creek Park clean-ups.

Global Green USA (http://www.globalgreen.org/)
Global Green is a non-profit organization focused on creating green buildings and cities in an effort to fight climate change. The organization has developed a unique, multifaceted approach to addressing global environmental challenges. Its four strategically-located offices reach out to residents, institutions and local decision makers across the United States in Santa Monica, New York, Washington and New Orleans. Simultaneous efforts include working to affect policy change, educating communities on sustainability, and providing technical assistance to individuals, organizations and institutions. Global Green helps local governments, nonprofits, and schools find practical, affordable strategies for making environmentally conscious development decisions. The City of Youngstown has partnered with Global Green to develop a sustainability plan and design a green economic development project in a selected neighborhood.

Implementing Green Strategies

In addition to the organizations outlined above, several efforts are underway by the City of Youngstown that should reduce its GHG emissions while improving quality of life.

Youngstown 2010
Youngstown 2010 is the city's most recent general plan, completed in 2005. Publications such as Entrepreneur Magazine, Reuters, and Next American City have praised the plan for its goals and proper construction. The plan embraces four major themes—Youngstown will: 1) adapt to its new status as a smaller city; 2) define its role in the new regional economy; 3) improve its image and quality of life for its residents by embracing sustainable industries; and 4) commit to working on a new direction for the city.

City of Youngstown Deconstruction Program

Youngstown's vacant house deconstruction program offers a "green" alternative to demolition, benefitting the city in many ways. Traditional demolition creates excessive waste by sending all materials other than masonry to the landfill. By contrast, the deconstruction program recycles or reuses 75% of the material from disassembled houses. Once workers remove a deconstructed house, community members often convert the empty lots into gardens and green space, making a positive environmental impact. As an added bonus, deconstruction provides jobs. Taking down a house rather than demolishing it is much more labor-intensive, and the work is providing needed employment to Youngstown residents. The economy is also bolstered by the recycling of materials—local building material distributors now have inexpensive products to sell.

City of Youngstown Recycling Program

The City of Youngstown and the Mahoning County Green Team have implemented a successful recycling program. In 2009, over 550 tons of recyclable waste was diverted from the landfill through drop off centers and curbside programs. Figure 20 shows the breakdown of materials collected.

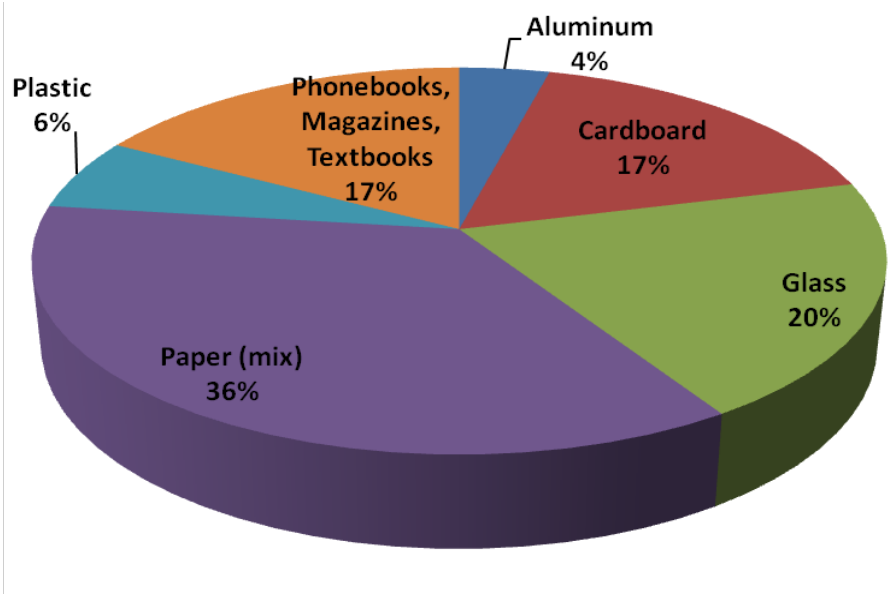

Figure 19: 2009 Recycling Results

Future GHG Emissions Inventories

This GHG baseline report sets the bar from which to improve. Annual follow up reports will help to keep the City on track as it works to meet its goals. To make the process as painless as possible, it is recommended that each department and entity that supplies information identify a person to collect and store the appropriate data (i.e., utility bills, employee commute miles, street and traffic light energy usage, and waste water information) for each year. In the future, additional information should be included such as the use and escape of Freon from many different sources,[41] as well as city-wide traffic data, and a breakdown of the waste types entering the landfills. These data would replace the current defaults utilized by the ICLEI software.

Some minor adjustments should be made to the ICLEI software. For example, Youngstown's wastewater treatment plant uses an incinerator to burn off the excess methane created in the treatment process. The CACP software can account for the emissions, but the protocol does not specify any action to be taken to integrate them into the software. Instead of manually inputting incinerator data into the inventory, the software should be designed to handle such additions. Finally, the software only divides emissions data into two groups: government and community. It does not analyze each of the larger community sector generators like hospitals and universities, but rather places them in the same data section as homes and smaller producers. Adding another section comprised of larger community generators would be useful for a more particular data analysis. ICLEI has been notified of these concerns and expects release of new updated software soon that may take care of some of these issues and lead to greater accuracy in future analyses.

[41] The fugitive Freon is important data, because the chemicals in Freon (chlorine, fluorine, carbon, etc. can be detrimental to the environment in gaseous form. ICLEI also has a designated section for fugitive Freon in the CACP 2009 software.

CONCLUSION

This report is the culmination of a thorough analysis of 2009 energy consumption data from the City of Youngstown. It offers a detailed breakdown of energy use and GHG emissions in community and municipal government sectors from that year. Additionally, the report provides an inventory of entities and programs that are working to green the community and a number of suggestions for further improvements. The combination provides a snapshot of the city's sustainability status and a catalogue of tools for policy makers and residents to substantially reduce GHG emissions. Youngstown is making important strides in reducing its environmental impact and with a little effort, can easily multiply the benefits.

One of the larger purposes of this report is for Youngstown to influence other Rust Belt cities to go green through leading by example. However, before addressing other cities, the City must start by inspiring its own citizens. Youngstown can begin putting its house in

order through green makeovers of its buildings and facilities and by replacing old technologies like incandescent streetlights. Additionally, the City can actively support community efforts through financial incentives, provide outreach on energy efficiency technologies, techniques and programs, and initiate large-scale programs such as a revolving loan fund. The City of Youngstown must both support and inspire action in the larger community.

The City should actively target its largest emitters by identifying the most cost-effective energy saving measures for the WWTP and building and facilities. However, demand-side reductions must be matched with supply side adjustments—finding alternatives to fossil fuels. The City must become an advocate for renewable energy options, and help the local utilities increase their commitment to renewable energy and energy efficiency.

There is much work to be done, however with great challenges come great opportunities. There is no doubt that Youngstown is committed to embrace a more sustainable way of life to enhance its viability for future generations. This report provides some guidelines and some tools to take advantage of those opportunities.

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Glossary

CACP: Clean Air and Climate Protection software
CDA: Community Development Agency
CH_4: methane
CO: carbon monoxide
CO_2: carbon dioxide
CO_2e: carbon dioxide equivalent; a measure used to compare the emissions of various greenhouse gases and how mush CO_2 would be needed to produce a similar warming effect
EPA: Environmental Protection Agency
GHGs: greenhouse gases
ICLEI: ICLEI Local Governments for Sustainability
KWh: kilowatt hours
LED: light- emitting diode
LEED: Leadership in Energy and Environmental Design (Green Building Rating System from the U.S. Green Building Council)
Mlb: thousand pounds
MMBtu: standard measurement for heat energy in fuels. A thousand thousand British Thermal Units
MYCAP: Mahoning Youngstown Community Action Partnership
NASA: National Aeronautics and Space Administration
NO_x: nitrogen oxide
PM10: particulate matter up to 10 micrometers in size
SO_x: sulfur oxide
VMT: vehicle miles traveled
WWTP: Wastewater Treatment Plant
YNDC: Youngstown Neighborhood Development Corporation