Town of Cazenovia Climate Action Plan 2015

Appendix D: Action Strategy Summary Document

Acknowledgements

The Town of Cazenovia and Madison County wish to thank the following community members, organizations, and staff for their contributions to developing this Climate Action Plan.

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Acronyms Explained

Btu and MMBtu: British Thermal Units and Millions of British Thermal Units. A Btu is the amount of energy needed to cool or heat one pound of water by one degree Fahrenheit, and MMBtu represents 1 million Btu.

CAFE: Corporate Average Fuel Economy. CAFE standards have been set by the federal government for the years 2016 and 2025.

CAPPA: Climate and Air Pollution Planning Assistant. CAPPA is a tool provided by ICLEI – Local Governments for Sustainability to help local communities assess the effectiveness of certain emissions reduction strategies in their communities. CAPPA is the tool that was used for all of the calculations in this document.

DPW: Department of Public Works.

GHG: Greenhouse Gas

kW: Kilowatt. kW is a unit of power equal to 1,000 watts.

kWh: Kilowatt hour. A kilowatt-hour (symbolized kWh) is a unit of energy equivalent to one kilowatt (1 kW) of power expended for one hour (1 h) of time.

$MTCO_2e$: Metric Tons of Carbon Dioxide Equivalent. $MTCO_2e$ converts the warming potential of each greenhouse gas (i.e. carbon dioxide, nitrous oxide, methane, etc.) into one measurement.

NYSERDA: New York State Energy Research and Development Authority. NYSERDA is a public benefit corporation created in 1975. Its goal is to help New York meet its energy goals of reducing energy consumption, promoting the use of renewable energy sources, and protecting the environment. NYSERDA offers a variety of incentive programs to help New York residents achieve these goals.

PV: Photovoltaic. Solar PV systems convert sunlight directly into electricity.

VMT and DVMT: Vehicle Miles Traveled and Daily Vehicle Miles Traveled. Vehicle Miles Traveled (VMT) is the total number of miles driven by all vehicles within a given time period and geographic area. It is used by regional transportation and environmental agencies for planning purposes. VMT is influenced by factors such as population, age distribution, and the number of vehicles per household. However, the greatest factor by far is how land uses are arranged.

Introduction

Background

The Town of Cazenovia was recruited to participate in the Central New York Climate Change Innovation Program (C2IP) in the spring of 2013. The Town had previously adopted the Climate Smart Communities (CSC) pledge in 2009, pledging their commitment to energy and emissions reduction. The Town received technical assistance from the Central New York Regional Planning and Development Board (CNY RPDB) and SUNY College of Environmental Science and Forestry (ESF) in the spring of 2013 to complete a greenhouse gas (GHG) inventory for the 2010 (baseline year) calendar year. The GHG inventory report was compiled to detail energy use and the sources of emissions in the Town. The inventory provided the Town with a better understanding of its contribution to carbon emissions, and also serves as a basis for the development of a targeted action plan for reducing GHG emissions over time.

The Town received additional assistance through the C2IP program in cooperation with the CNY RPDB and SUNY ESF throughout the spring of 2014 to begin to analyze potential strategies for reducing emissions. CNY RPDB staff and ESF students worked to analyze potential strategies for reducing the Town's emissions for both municipal operations as well as at a community-wide scale. CNY RPDB staff and ESF students utilized a software tool developed by ICLEI-Local Governments for Sustainability known as CAPPA (Climate and Air Pollution Planning Assistant) version 1.5 to calculate potential GHG reductions as well as cost savings for each strategy. CAPPA is an Excel-based decision-support tool designed to help U.S. local governments explore and identify potential opportunities to reduce greenhouse gas emissions and other air pollution emissions. CAPPA provides a starting point for two major tasks: determining an achievable emissions reduction target and selecting strategies to include in a local government–operations or community-scale emissions-reduction plan, commonly called a climate action plan. CAPPA users can compare the relative benefits of a wide variety of emissions reduction and clean air measures, and identify those most likely to be successful for their community based on its priorities and constraints.

The action strategies explored in this document provide the Town of Cazenovia with an estimate of potential reductions as well as costs and other co-benefits. By implementing the strategies noted in this document, the community will not only be able to reduce GHG emissions, but will also be able to reduce energy costs, decrease reliance on non-renewable, foreign sources of energy, and conserve Cazenovia's resources for the future.

Overview

Global concern with climate change is primarily focused on the amount of greenhouse gases in the atmosphere. Greenhouse gases, such as carbon dioxide, water vapor, and methane, among others, are an essential part of our atmosphere, and they serve a vital role in making our planet warm enough for life. Greenhouse gases trap energy (in the form of long wave radiation) that is being emitted by the Earth, reflecting it back into the atmosphere to warm the planet. As the amount of carbon dioxide in the

atmosphere has increased or decreased over time, the planet's temperature has changed in roughly the same proportion. Scientists have determined this relationship from studying ice cores taken from Antarctica from over 400,000 years ago. Right now there is more carbon dioxide in the atmosphere than at any time measured in the ice core.[1] Scientists expect that this will lead to a gradual warming of the planet in most areas.

Anthropogenic emissions of carbon dioxide and other greenhouse gases into the atmosphere are major contributors to global climate change. Therefore, it is imperative for municipalities around the world, including the Town of Cazenovia, to take immediate action towards decreasing emissions.

The Purpose of this Document

The role of this document is to identify and analyze local actions that the Town of Cazenovia can take to reduce greenhouse gas emissions caused by human activities occurring within the Town. The document does not debate the issue of global climate change. In recent years, the scientific community has reached a nearly unanimous consensus that climate change is occurring, that human activities are a primary cause, and that the potential consequences could be severe. Climate scientists around the world, represented by the Intergovernmental Panel on Climate Change (IPCC), have an unequivocal position: human activity is changing the earth's climate through the release of GHG emissions resulting from the combustion of fossil fuels. The longer communities delay taking action, the greater the risk humans face of irreversibly depleting nonrenewable resources and harming our environment. This strategy summary document is designed to act as a blueprint for the community's response to the challenges posed by climate change.

The Town of Cazenovia cannot solve the global climate crisis alone, but together with partners in county, state, and federal government, the Town has committed to taking steps to reduce emissions and create new programs and services that will support the community and families in doing the same.

This document offers suggestions that can make homes more energy efficient and increase the amount of locally produced renewable energy. It explores strategies for reducing emissions from transportation. Finally, this document outlines measures that can make the Town's municipal operations a model for efficiency and resource-conservation.

Town of Cazenovia Greenhouse Gas Reduction Target

Through the analysis of the strategies outlined in this document the Town of Cazenovia has identified an emissions reduction target goal of 20%, representing a total of 8,312 metric tons of CO_2 reduced by 2025.

[1] In January 1998, the collaborative ice-drilling project between Russia, the United States, and France at the Russian Vostok station in East Antarctica yielded the deepest ice core ever recovered, reaching a depth of 3,623 m (Petit et al. 1997, 1999). The extension of the Vostok CO_2 record shows the present-day levels of CO_2 are unprecedented during the past 420 kyr. Pre-industrial Holocene levels (~280 ppmv) are found during all interglacials, with the highest values (~300 ppmv) found approximately 323 kyr BP.

Strategy Summary

GHGs are gases in Earth's atmosphere that prevent heat from escaping into space. GHG emissions are typically associated with the burning of fossil fuels, such as coal and oil, and are classified into scopes.

- Scope 1 emissions are direct GHG emissions from sources that are owned or controlled by the entity. Scope 1 can include emissions from fossil fuels burned on site, emissions from entity-owned or entity-leased vehicles, and other direct sources.
- Scope 2 emissions are indirect GHG emissions resulting from the generation of electricity, heating and cooling, or steam generated off site but purchased by the entity, and the transmission and distribution (T&D) losses associated with some purchased utilities (e.g., chilled water, steam, and high temperature hot water).[1]
- Scope 3 emissions include indirect GHG emissions from sources not owned or directly controlled by the entity but related to the entity's activities. Scope 3 GHG emission sources that are typically quantified include T&D losses associated with purchased electricity, employee travel and commuting, contracted solid waste disposal, and contracted wastewater treatment. Additional sources may include GHG emissions from leased space, vendor supply chains, outsourced activities, and site remediation activities.[2]

Utilizing CAPPA a variety of strategies were identified and analyzed to determine their potential for achieving emissions reductions either at the municipal operations level or the community scale. The analysis team also explored the potential impacts of one external large scale factor on the Town's emissions profile: New Federal CAFE Standards that will increase the average fuel economy of vehicles sold in the U.S. through 2025. The results of these analyses are summarized in the tables below. In most cases, if there were multiple potential strategies addressing a singular target area (e.g. vehicle fuel sources: electric, diesel, hybrid, natural gas), the strategy that was the most cost effective with the largest emissions reduction impact was chosen to be included in the final summary.

[2] http://www.epa.gov/oaintrnt/ghg/ Greening EPA

Figures

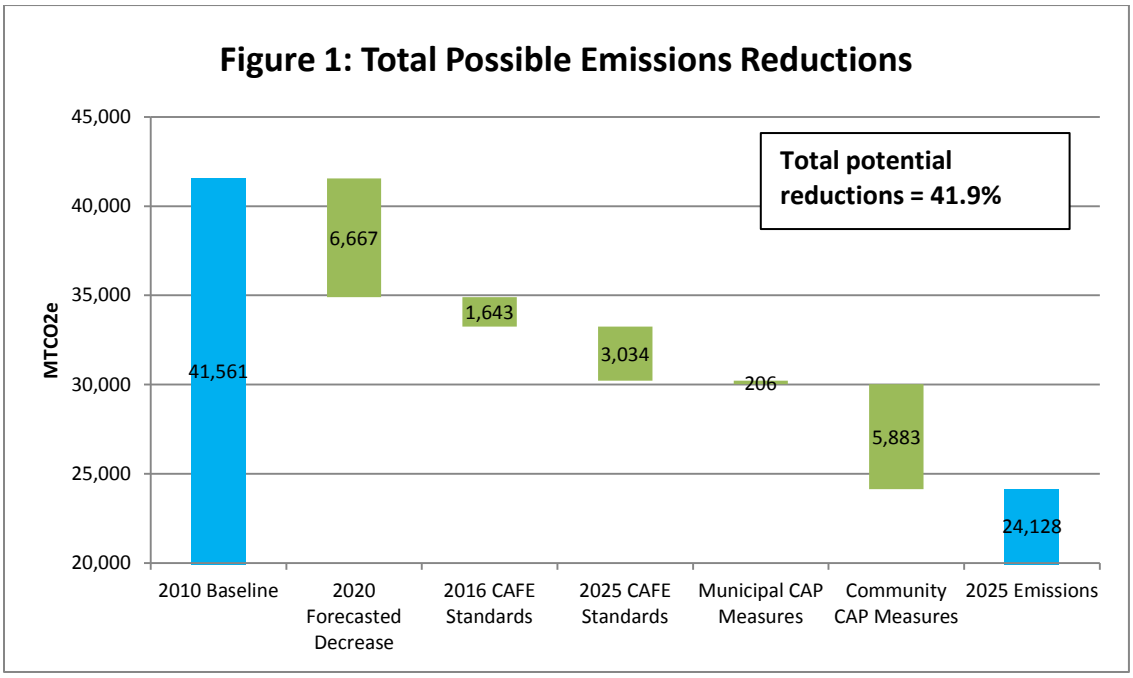
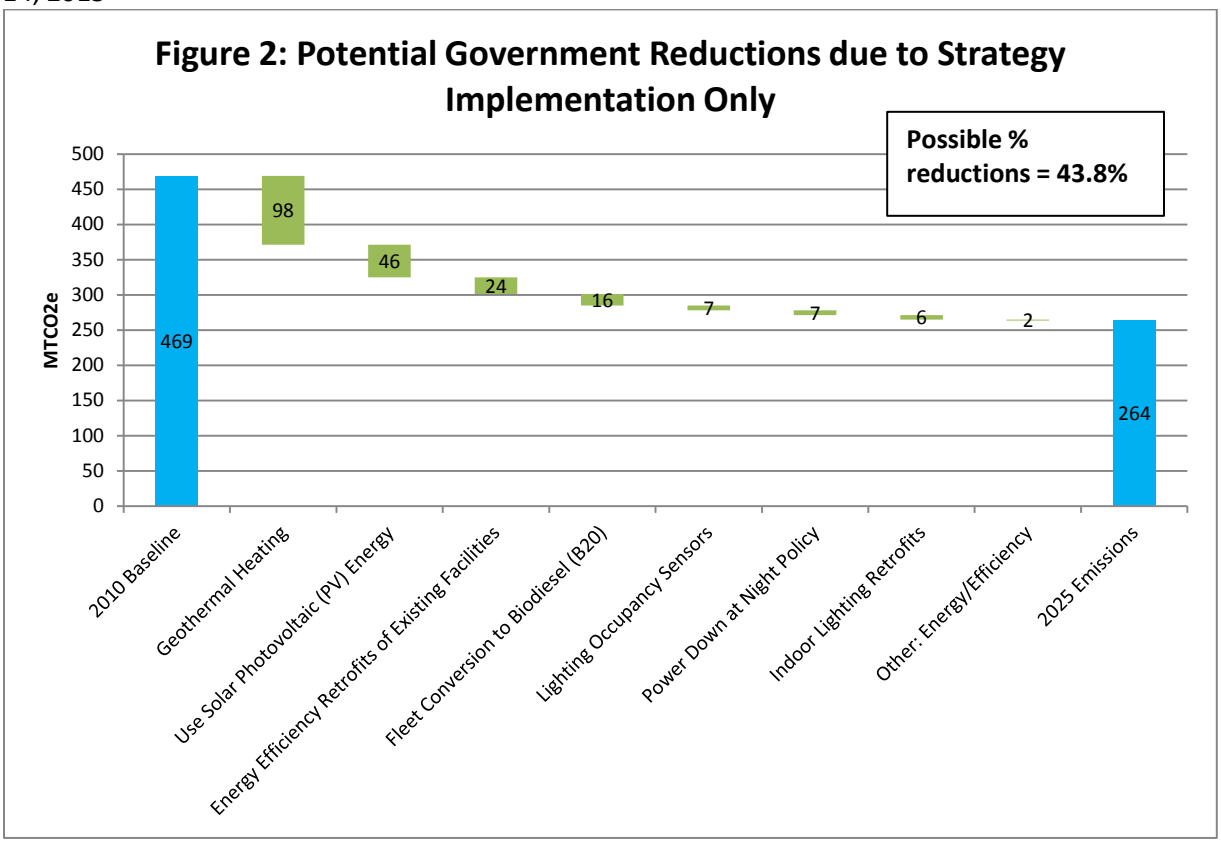
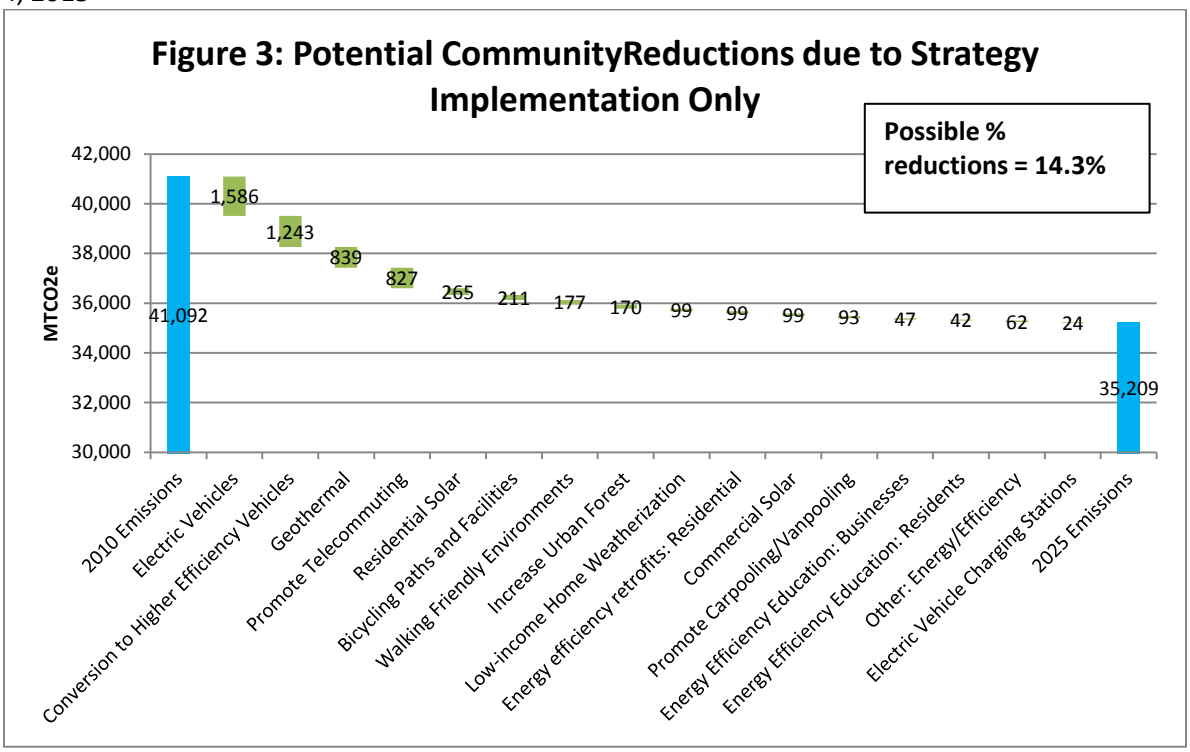


Figure 1 summarizes the results of the Town's GHG inventory, a 2020 emissions forecast based on current trends, impacts from the strengthening of Federal CAFE standards, as well as the reductions associated with the Climate Action Strategies that were analyzed for the Town separated into community-wide measures as well as municipal operations measures. It is projected that Cazenovia's total GHG emissions in 2025 could be reduced by 41.9% if the Town implements all of the recommended community-wide and municipal operations measures.



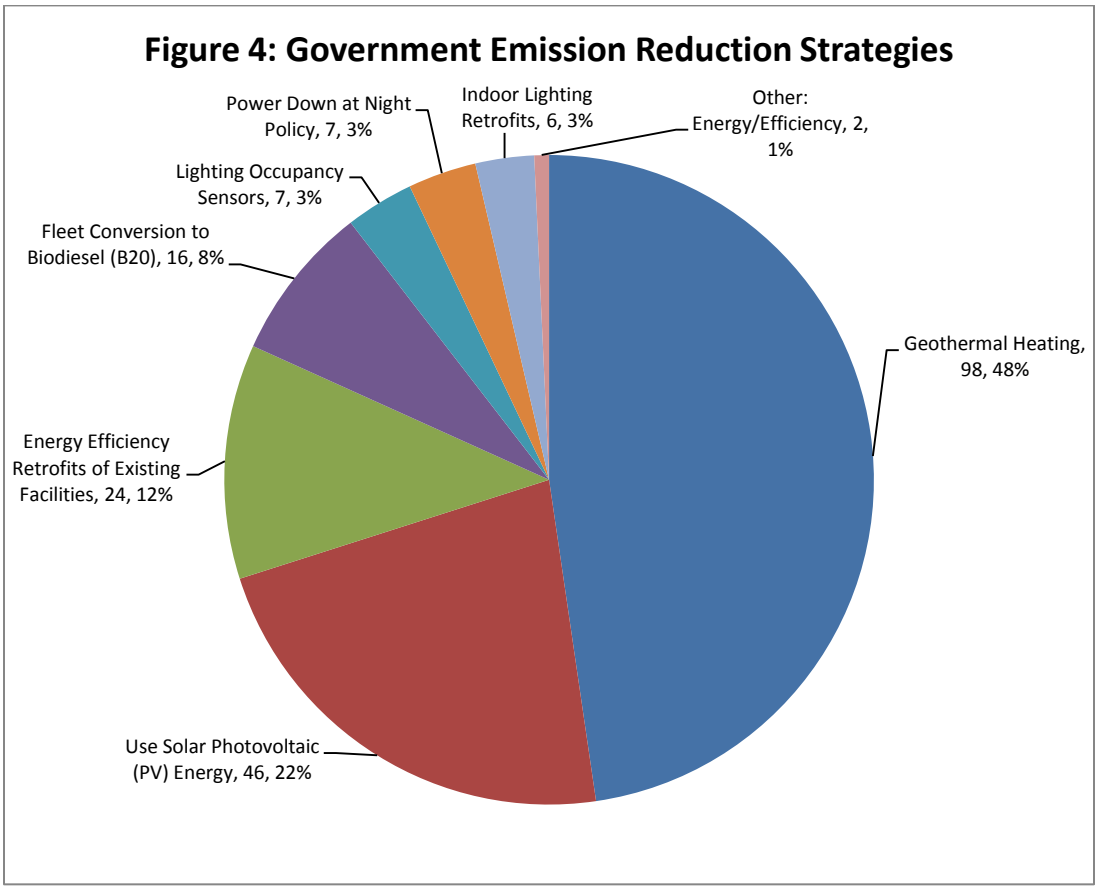
*Other: Energy/Efficiency includes: Energy Efficient Appliances; and Water Saving Faucets and Toilets.

Figure 2 depicts the Town of Cazenovia's 2010 baseline municipal emissions as recorded by the GHG inventory report, potential reductions due to suggested strategies, and potential emissions in 2025 should each of the suggested strategies be implemented. It is estimated that there will be a 43.8% reduction in community emissions if all suggested strategies are implemented.



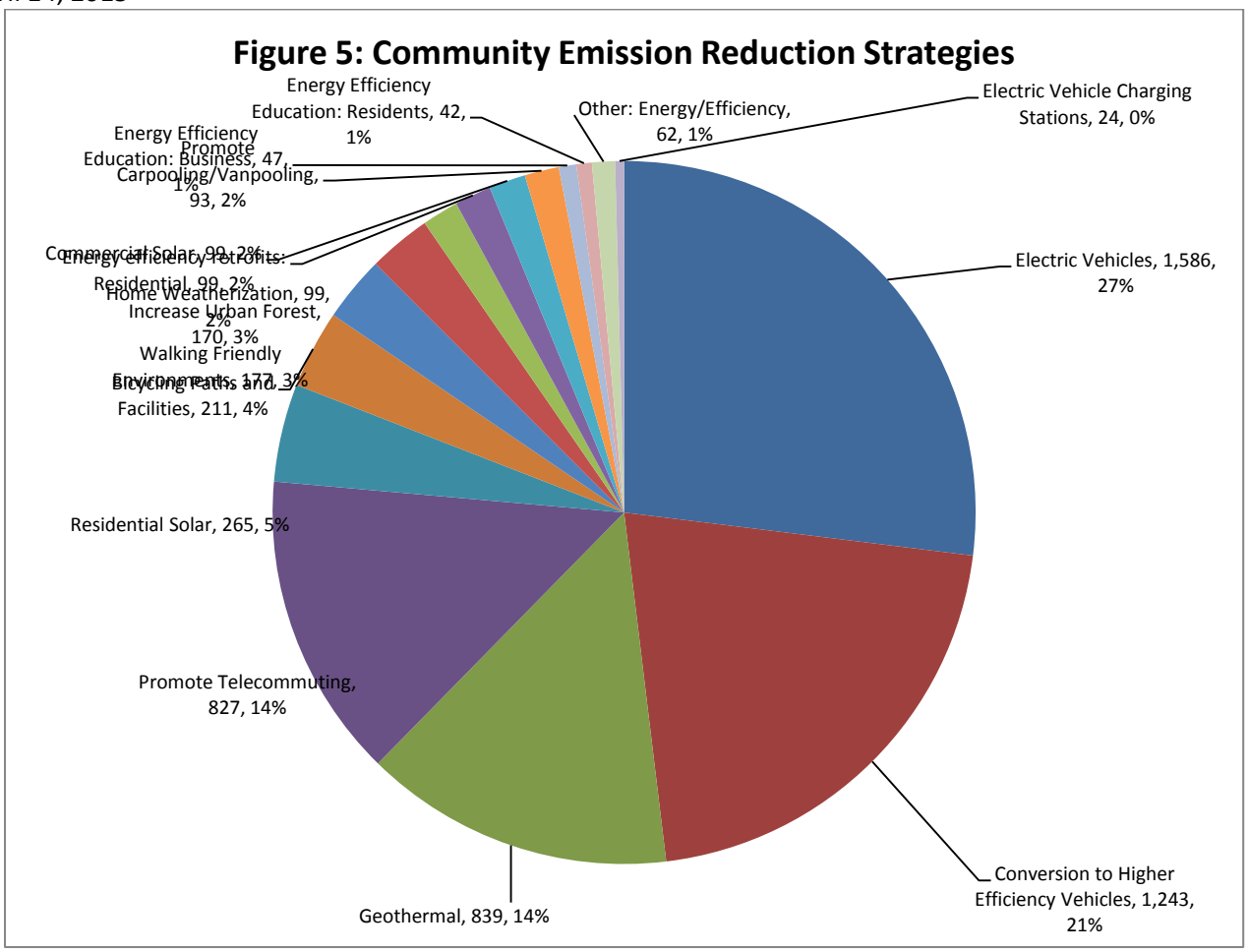
*Other: Energy/Efficiency includes: Energy Efficient Refrigerators; Power Down at Night Policy; Energy Efficiency Computers; High Efficiency Toilets; Organics Composting; Lighting Occupancy Sensors; Establish/expand Curbside Recycling Programs; and Expand Yard Waste Composting.

Figure 3 depicts the Town of Cazenovia's 2010 baseline community emissions as recorded by the GHG inventory report, potential reductions due to suggested strategies, and potential emissions in 2025 should each of the suggested strategies be implemented. It is estimated that there will be a 14.3% reduction in community emissions if all suggested strategies are implemented.



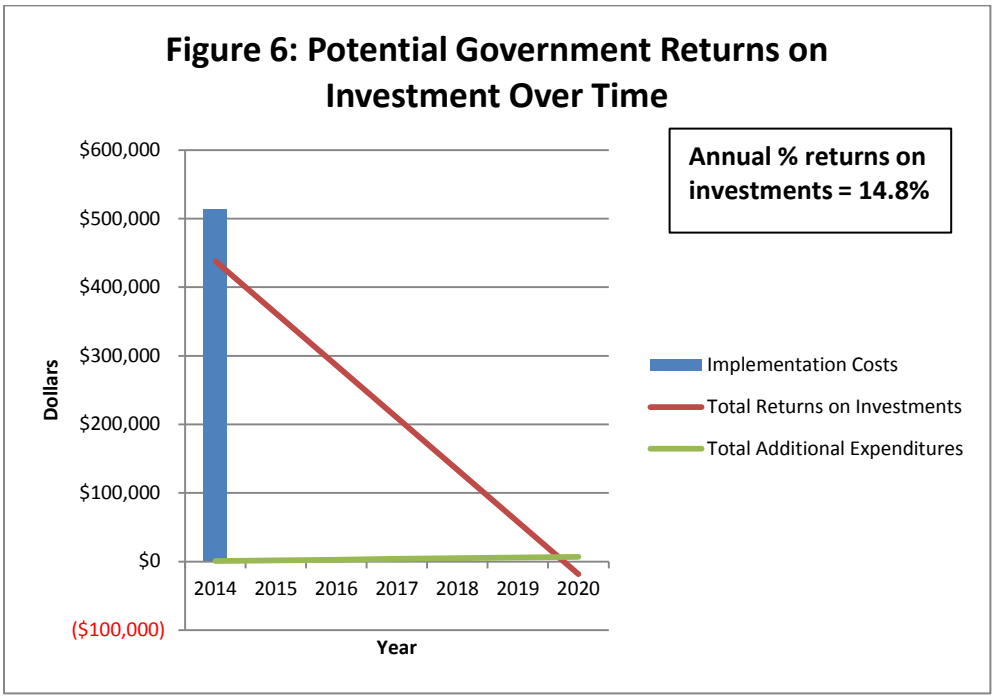
*Other: Energy/Efficiency includes: Energy Efficient Appliances; and Water Saving Faucets and Toilets

Figure 4 depicts each of the suggested municipal reduction strategies and their contribution to overall municipal emissions reductions.



*Other: Energy/Efficiency includes: Energy Efficient Refrigerators; Power Down at Night Policy; Energy Efficiency Computers; High Efficiency Toilets; Organics Composting; Lighting Occupancy Sensors; Establish/expand Curbside Recycling Programs; and Expand Yard Waste Composting.

Figure 5 depicts each of the suggested community reduction strategies and their contribution to overall municipal emissions reductions.



*Strategies included in Total Additional Expenditures: Fleet Conversion to Biodiesel.

Figure 6 depicts the total implementation cost of all suggested municipal emissions reduction strategies and their annual returns on investment. It also shows additional expenditures that would be incurred due to strategy implementation. It is estimated that the annual return on investments for all of the suggested municipal emissions reduction strategies is approximately 14.8%.

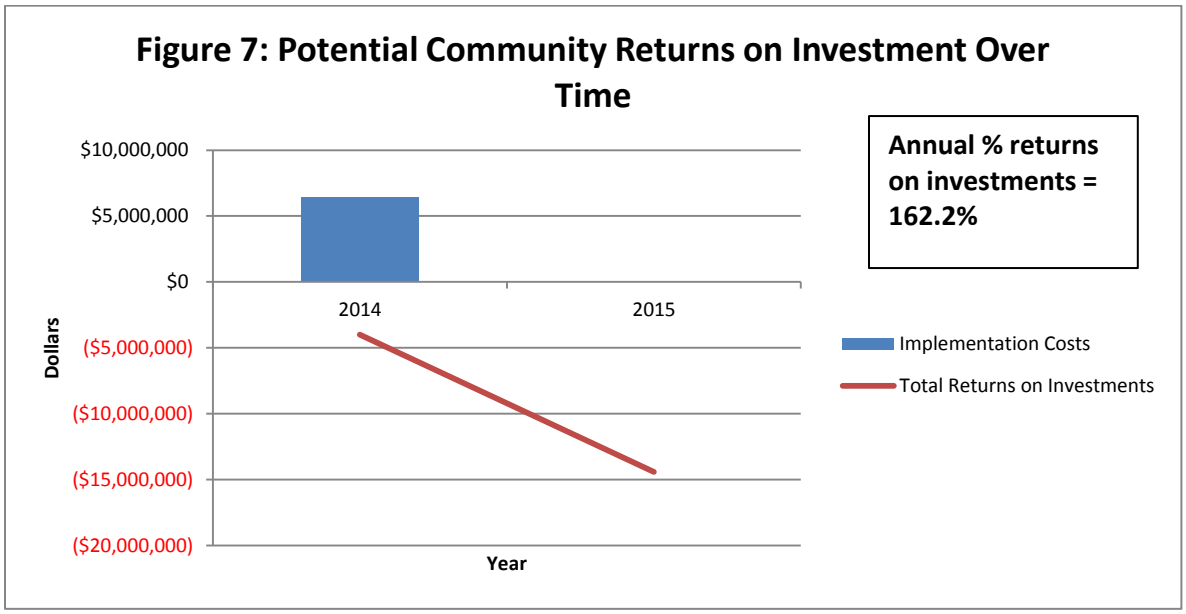


Figure 7 depicts the total implementation cost of all suggested community emissions reduction strategies and their annual returns on investment. It also shows additional expenditures that would be incurred due

to strategy implementation. It is estimated that the annual return on investments for all of the suggested emissions reduction strategies is approximately 162.2%.

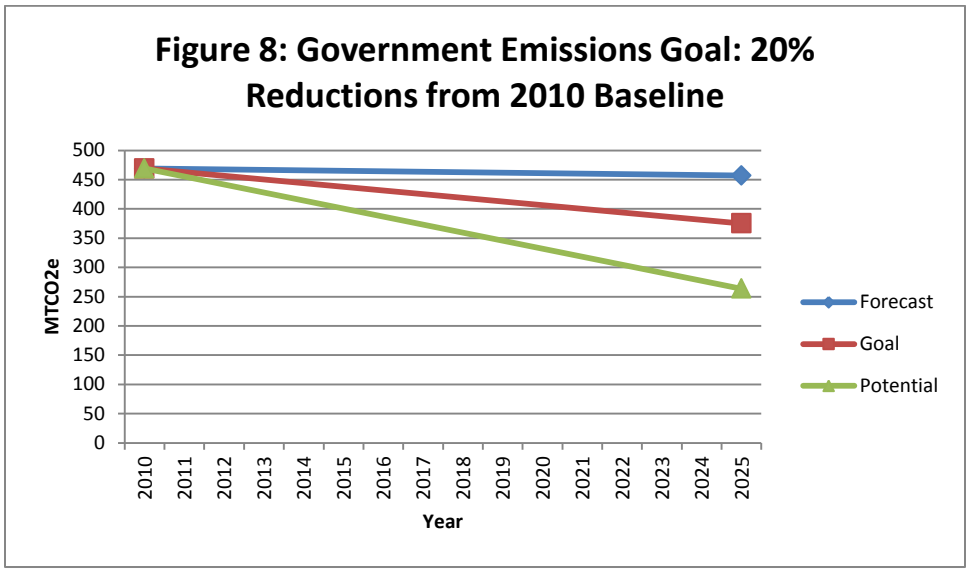


Figure 8 depicts forecasted emissions for the Town of Cazenovia in the year 2025 if no action is taken, emissions if a 20% government reduction goal is reached, and the emissions potential if all the suggested strategies are adopted.

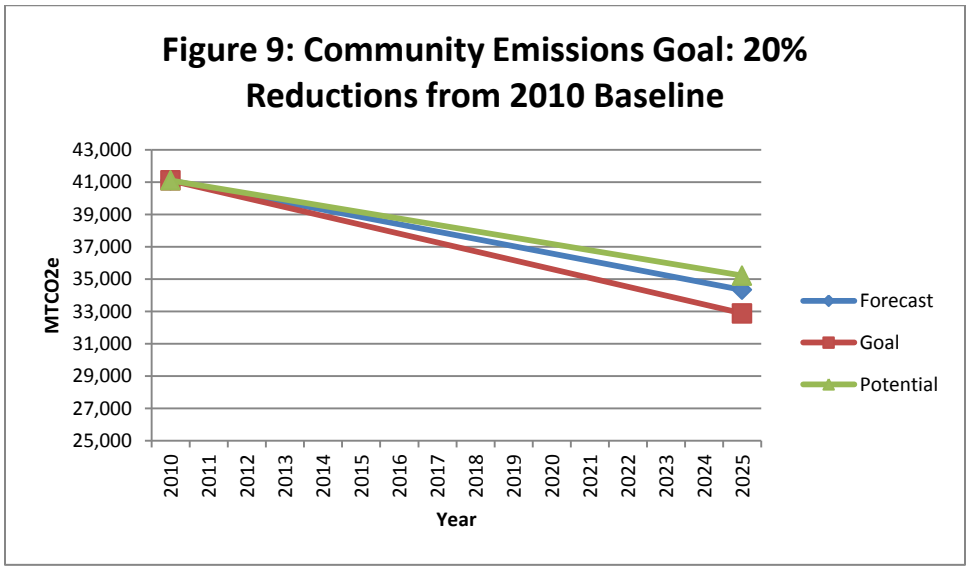


Figure 9 depicts forecasted emissions for the Town of Cazenovia in the year 2025 if no action is taken, emissions if a 20% community reduction goal is reached, and the emissions potential if all the suggested strategies are adopted.

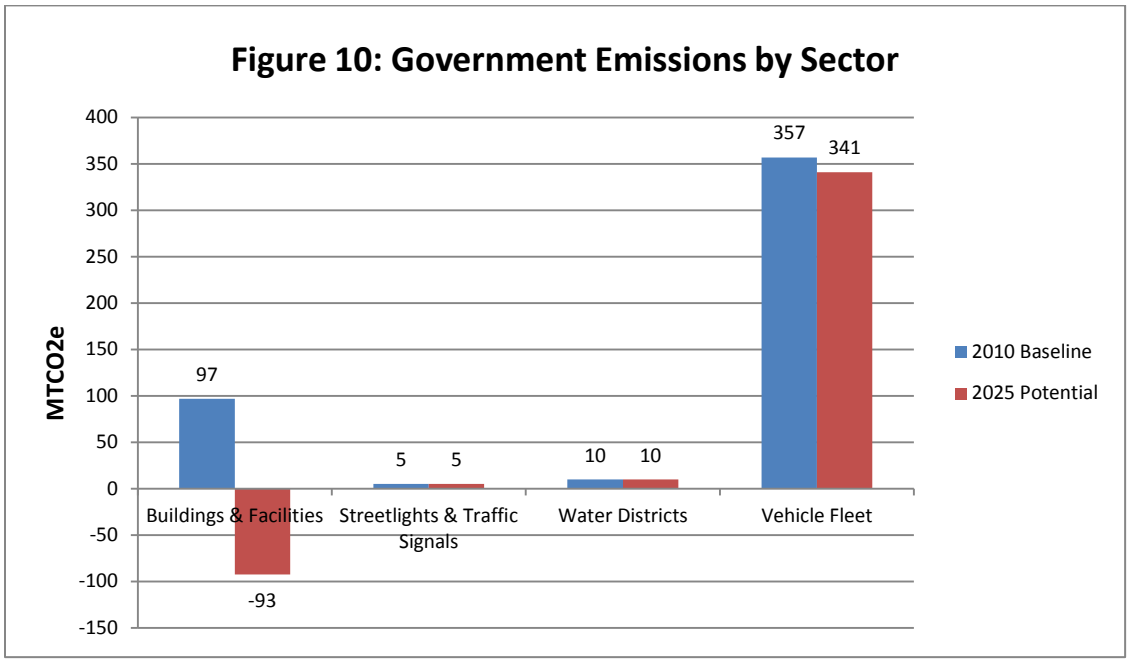


Figure 10 compares the municipal emissions per sector in the 2010 base year and 2025 emissions potentials if each of the suggested strategies is implemented.

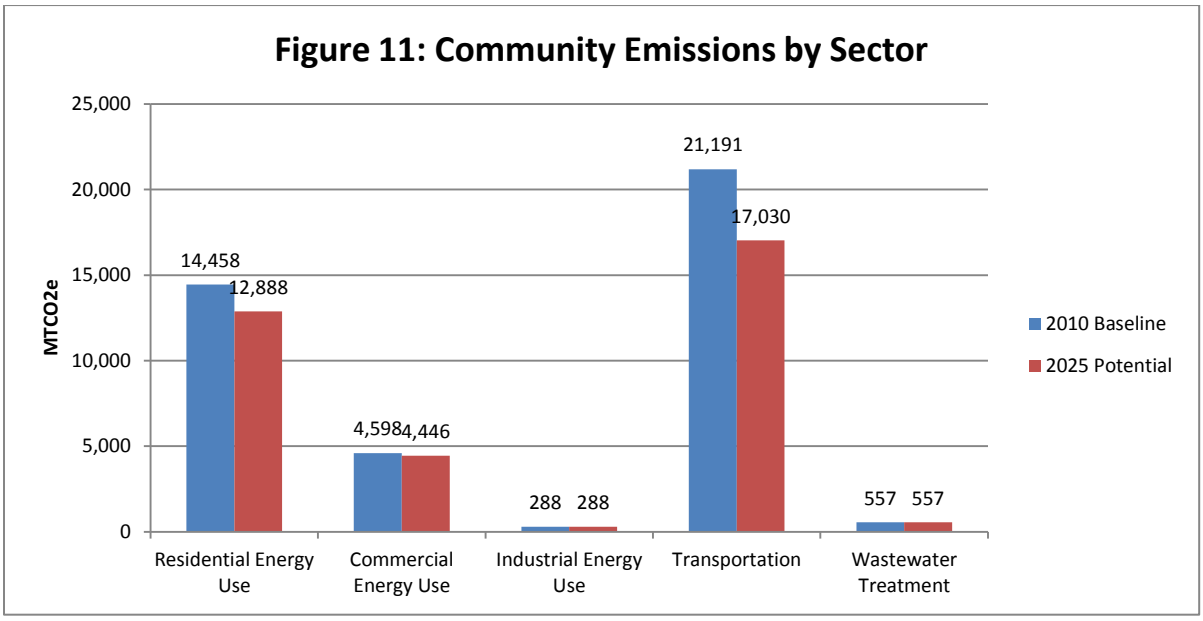


Figure 11 compares the community emissions per sector in the 2010 base year and 2025 emissions potentials if each of the suggested strategies is implemented.

Government Strategies

Transportation

1. Fleet Conversion to Biodiesel

Strategy Description:
Using biodiesel in municipal fleet vehicles is a simple and effective way to achieve large reductions in CO2 emissions from fleet operations. If biodiesel made from waste cooking oil is available, the emissions reduction is compounded, because fossil fuel inputs to agriculture are avoided. Garbage trucks, snowplows, fire trucks, maintenance vehicles, and transit buses are all good options for using biodiesel. There is no need to convert the vehicles, so there is no capital cost to the switch. Biodiesel can be used by itself (called B100 for 100% biodiesel), or mixed with petroleum diesel. A popular mix is B20, 20% biodiesel with 80% petroleum diesel. Using biodiesel produced locally, from waste cooking oil or from locally-grown oil crops, infuses fuel dollars back into the local economy.

Methodology:
Fleet Conversion to Biodiesel (B20)

- Assume one vehicle is switched to biodiesel on an experimental basis
- Price of diesel
  - $3.53 per gallon [1]
- Price of biodiesel
  - $3.95 per gallon [2]
- Average fuel economy of vehicles switching to biodiesel (mpg)
  - 6.4 mpg [3]
- Average annual miles
  - 13,125 miles per year [4]

Government Operations

1	Number of Vehicles Switching from Diesel to Biodiesel

Government Operations

$3.53	Price of Diesel ($ per gallon)
$3.95	Price of Biodiesel ($ per gallon)
6.4	Average Fuel Economy of Vehicles switching to Biodiesel (mpg)
13,125	Average Annual Miles Driven by Vehicles switching to Biodiesel
2,065	Gallons of Fossil Diesel Reduced
2,083	Gallons of Biodiesel Purchased
$947.41	Increased Fuel Costs

Government Operations

CO2e (metric tons)
16

Benefits:

The fleet vehicles are responsible for 76% of the town government's emissions; switching even one of the town's fleet vehicles to biodiesel on an experimental basis will reduce CO2e emissions by 16 metric tons. Wider implementation of the biodiesel program would have a huge impact on CO2 emissions.

Co-Benefits

-Reduces US dependence on imported diesel

-Creates green jobs

-Recycles agricultural and cooking oils

-Suitable for conventional diesel engines without retrofit[5]

Organic Valley Farms employees holding samples of sunflower oil crushed on their organic dairy farm in Groton, NY to be used as biodiesel to fuel fleet trucks.

Success Stories

-Cornell's Farm Services' 20-plus vehicle fleet runs on B20 biodiesel and reduces emissions by 17%[6].

-Ian Heatwole, a dairy farmer of Weyer's Cave, VA, switched to biodiesel about 3 years ago and has been using at least B20 ever since. He began experimenting on making his own batches of biodiesel as well, and has been successful with very small batches and plans to purchase equipment so he can make community-scale, on-farm biodiesel.[7]

-Organic Valley Farms began using biodiesel in their fleet trucks in 2002 and started an On-Farm Biofuels program in 2009 so that farmers can render waste vegetable oil or use oilseed crops like sunflowers, camelina, or canola to create biofuel. The organic meal that is left over after the oil is extracted is an excellent protein source to supplement Organic Valley's pasture based dairy farms.[8]

Piedmont Biofuels Industrial, NC- Piedmont Biofuels Cooperative, a small group of backyard biofuel brewers, decided to create a community-scale "distributed" biofuel center (one that gathers, processes and sells feedstocks locally). Only 6 months after opening, the plant reached its production target of 80,000 to 100,000 gallons per month.[9]

Buildings and Facilities

1. **Install Geothermal Heating System in Town Garage Building (User Defined 2)**

Strategy Description:
Propane and fuel oil are some of the most expensive heating fuels available. Many of today's large facilities use propane or fuel oil to heat their buildings. Most are located in rural areas where there is no access to lower cost fuels such as natural gas. Heating costs for these operations are a significant portion of their operating expenses, and more cost effective heating systems are needed for these industries to stay competitive and grow, or in this case continue to function efficiently at the lowest possible cost. An opportunity exists for the replacement of these high cost fuels with geothermal heat pumps. Geothermal systems support cost effective renewable energy, reduce GHG emissions, offset imported fossil fuels, stimulate local economies, and create jobs.

While geothermal systems increase the demand for electricity to power the system, they still reduce emissions, since electricity in upstate NY is much cleaner than burning propane. Also, a solar PV system can be used to offset the additional electric usage required for a geothermal system, therefore reducing energy use, costs, and emissions even further.

- **Methodology:**
- **Methodology:**
  - Buildings converted
    - Assume Town Hall Garage is converted from propane to geothermal (16,900 square feet)
  - Price of electricity ($ per kWh)
    - $0.125 per kWh[10]
  - Price of propane ($ per gallon)
    - $1.82 per gallon[11]
  - Annual propane use
    - 23,100 gallons[12]
  - Annual energy used for cooling (gallons of fuel oil)
    - 11,035,738 electricity used total for residential [13]
    - 11% electric bill towards cooling [14]
    - 1,213,931 kWh total /1,514 homes occupied in town =802 kWh for cooling per household [15]
    - Assume similar in Garage building
  - Cost of geothermal heat pump system ($ per sq. ft.) = $10 / sq. ft. [16]

Government Operations

16,900	Government Implementation Level: Square feet

Government Operations (propane to geothermal)

$0.1250	Price of Electricity ($ per kWh)
$1.82	Price of Propane ($ per gal)
23100	Annual Propane use (gal)
60	Efficiency of Propane Boiler (%)
563,418	Annual Heat Demanded For Building (kWh conversion)
4	COP of Geothermal Heat Pump
140,854	Annual Electricty Demanded For Heat With Geothermal (kWh)
802	Annual Cooling Electricity Use (kWh)
10	EER Of Air Conditioning
2.93	COP of Air Conditioning
2,351	Annual Heat Removed From Building (kWh conversion)
35	EER Of Geothermal Heat Pump
229.14	Annual Electricity Demanded for Cooling After Geothermal (kWh)
$10.00	Cost per Square Foot of Geothermal
141,886	Total Additional Annual Electricity usage (kWh)
23,100	Total Annual Propane Savings (gal)
$24,306	Annual Cost Savings
7.0	Simple Payback (years)

Government Operations

CO2e (metric tons)
98

Co-Benefits

-Reduce reliance on fossil fuels

-Decrease local air pollution

-Decrease energy costs

Geothermalgenius.org Banner

Success Stories

-The new net-zero Skaneateles Village Hall uses solar PV to capture energy from the sun, as well as geothermal heating and cooling, a geothermal water heater, Energy Star appliances, occupancy sensors, and Solatube light wells.[17]

2. Install Solar Photovoltaic (PV) Energy

Strategy Description:

Solar photovoltaic (PV) energy production harnesses the sun's energy to produce electricity. GHG emissions reductions from this strategy are equal to the emissions that would have been produced if the electricity was supplied through fossil fuel based sources by the local utility because electricity generated from PV systems displaces electricity demand which would ordinarily be supplied by the local utility. Putting solar panels on city buildings is a good way to increase the visibility of solar energy in the community, while providing clean energy for building use. Contrary to popular belief solar power has been shown to be viable in a wide variety of climates that are not thought of as "sunny". Local governments can borrow money at low interest rates through bond issues, making solar more economical than it is for individuals or businesses. Some cities have combined solar energy with efficiency measures, with the shorter payback period of the efficiency measures helping to pay for the solar.

Many residents or businesses would like to use solar power, but the large up-front cost is an obstacle. Local governments can help overcome this barrier by paying a portion of system costs, offering low-interest loans, or organizing group-buying programs to negotiate lower prices such as the Solarize Madison program in Madison County. These programs are an effective way of combining public and private funds for renewable energy. The New York State Energy Research and Development Authority (NYSERDA) provides incentives for the installation of Solar PV based on system size. Additionally there are state and federal tax credits for residential and commercial Solar PV installations. Educational and technical assistance programs can also promote solar power. Local governments can offer information clearinghouses and connect consumers with solar installers.

An increasingly popular way for a local government to overcome the financial hurdles of installing a photovoltaic system is through the "solar services model" also known as a Power Purchase Agreement (PPA). Through this type of arrangement the owner of a property can provide the space for a power producer to install the system. The property owner then agrees to buy the power produced from that system at a set rate that is competitive with grid electricity. Since the power producer retains ownership of the equipment, there are no installation and maintenance costs to the consumer of the electricity produced. This is particularly attractive to government entities that are unable to take advantage of tax based incentives for renewable energy.

Methodology:

- Number of kW installed: 185 kW – Broken down into 100 kW on Town Garage Building Roof and an additional 85 kW for Salt Building Construction
- **100 kW :** Used PV Watts Calculator to calculate approximate size of array that would fit on the Town Garage Building's Roof [18]
    - Building Address: 3425 Constine Bridge Road Cazenovia, NY 13035

- **85 kW :** Estimated PV Needed to construct salt pile building
  - Building Size : 60ft x 100ft = 557 m^2
  - Size of conventional Sun Power E-20 PV Panel = 1.6 m^2 [19]
  - 557 m^2 / 1.6 m^2 = 348 panels * 240W/panel = ~ 85 kW
- Price of electricity
  - $0.145 per kWh [20]
- Sun hours per day
  - 3 hours [21]
- Government: Cost of PV installation ($ per kW)
  - $1,100 [22]

Government Operations

185	kW of PV Installed

Government Operations

$0.1450	Price of Electricity ($ per kWh)
3.0	Sun Hours per Day
$1,100	Cost of PV installation ($ per kW)
202,575	Annual Energy Production (kWh)
$29,373	Annual Cost Savings
7	Simple Payback (years)

Government Operations

CO2e (metric tons)
46

Benefits:

If the government installed 185 kW of PV on the Town Garage Building, the town would save 46 $MTCO_2e$, saving the town $29,373 annually, with a simple payback of 7 years. 202,575 kWh of electricity would be generated on average annually.

Co-Benefits

-Renewable energy
-Local energy
-Produces no air pollutants

Preble Town Hall with 9 kW solar PV panels installed on roof

Success Stories

-9 kW installed on Town Hall building in Preble, expected to save 9,720 kWh annually.[23]

3. Existing Building Retrofit

Strategy Description:

The Town of Cazenovia has several large buildings that are direct consumers of fossil fuels. To reduce greenhouse gas emissions and improve building efficiency, a strategy to retrofit the existing HVAC systems in these buildings was created.

"Buildings account for 40% of total energy use and about 35% of GHG emissions in the United States. Over the next few decades, existing buildings will use most of this energy. Many measures can be applied to existing buildings to improve their efficiency, including using efficient light bulbs and fixtures, replacing appliances with more efficient ones, increasing insulation, replacing windows, and upgrading HVAC systems. Local governments can set an example by making efficiency improvements to their own buildings. The jurisdiction can require improvements to private buildings when renovations are made or buildings are sold. Governments can also encourage efficiency improvements by offering low or zero interest loans to building owners for improvements." [24]

Methodology:

- Assume three town buildings will be retrofitted to further insulate the existing structures, thus reducing the annual natural gas consumed as well as electricity consumed. Upgrading the insulation requires increasing the buildings R-value, or ability to retain heat. By increasing the R-value of the walls and ceilings, less heat will be lost. [25] This retrofit applies to 25,150 sq. ft. of government facilities (Cazenovia Town Hall, Town Highway Garage, New Woodstock Garage)[26]
    - Price of electricity
        - $0.1450 per kWh [27]
    - Price of natural gas
        - $0.994 per therm [28]
    - New construction annual energy use (kWh)
        - 3.308 kWh [29]
    - New construction annual energy use (therms)
        - 0.54 therms [30]
    - Percent electricity savings
        - 25% [31]
    - Percent natural gas savings
        - 25% [32]
    - Retrofit cost per square foot
        - $5.00 [33]

Government Operations	
25,150	Square Foot of Facilities Retrofitted

Government Operations	
$0.1450	Price of Electricity ($ per kWh)

$0.99	Price of Natural Gas ($ per therm)
3.3	Typical New Construction Annual Energy Use per Square Foot (kWh)
0.54	Typical New Construction Annual Energy Use per Square Foot (therms)
25	Percent Electricity Savings
25	Percent Natural Gas Savings
$5.00	Retrofit Cost ($ per square foot)
20,799	Total Annual Electricity Savings (kWh)
3,395	Total Annual Natural Gas Savings (therms)
$6,391	Annual Cost Savings
19.7	Simple Payback (years)

Government Operations

CO2e (metric tons)
24

Co-Benefits: -Reduce energy costs for heating and cooling -Makes geothermal, solar and wind energy more feasible	 Energy Star's Portfolio Manager tool helps local governments track and assess energy and water consumption in existing buildings, identify the best opportunities for improvement, track immediate and cost effective reductions over time and document savings results.[34]	Success Stories: - Village of Montebello, NY - An Energy Audit of municipal buildings was completed along with lighting, insulation and Energy Star upgrades, saving one third on the village's energy bill. Montebello has also installed solar panels on the village hall. The mayor estimates that the village netted about $3,000 in "returned electricity."[35]

4. Power-Down at Night Policy Adoption

Strategy Description:

Many buildings waste a significant amount of energy when lights and other electronics are left on at night when they are not in use. Creating a policy of turning lights and other electronics off throughout buildings at the end of the workday reduces electricity wasted during non-business hours, therefore reducing GHG emissions from buildings and facilities. Lighting is typically the largest electricity user in commercial buildings. A power down at night policy can use a combination of education and technology like timers, power strips, and motion sensors.

Methodology:

- Number Of buildings: Town office building, town highway garage, and the New Woodstock old garage, New Woodstock water, Wellington water, and Mount Pleasant water, police station.
  - Assume half participate= 13,188 square feet[36]
- Price of electricity
  - $0.1450 [37]
- Annual lighting energy use per square foot
  - 6.85 [38]
- Percent savings with policy
  - 35% [39]
- Cost of implementation
  - $0.06 [40]

Government Operations

13,188	Square Feet with Lights Out at Night Policy

Government Operations

$0.1450	Price of Electricity ($ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
35	Percent Savings With Policy
$0.06	Cost of Implementation ($ per square foot)
31,618	Total Annual Electricity Savings (kWh)
$4,585	Annual Cost Savings
0.2	Simple Payback (years)

Government Operations

CO2e (metric tons)
7

Co-Benefits	Success Stories
-Reduces light pollution -Reduces energy bill  	- NYSERDA estimates that power management (turning off underused office equipment or adjusting thermostats, upgrading to energy-efficient equipment, and encouraging changes in employee behavior) can reduce plug load by 40-60%, which would mean a statewide emissions reduction of more than 57,000 tons of CO_2 every year and significant savings on local government energy bills.[41] - Buffalo, NY - A project team found that low-cost/no-cost measures could reduce city government's power consumption by 595,060 kWh annually, saving an estimated $71,000. Measures for city hall include turning off copiers and printers after hours; shortening the period of inactivity before copiers go into "sleep mode" during business hours; reminding staff to shut down personal computers, monitors, and other plug-load equipment during extended daytime absences; replacing inefficient appliances with ENERGY STAR® models; specifying an upcoming new copier lease bid to ensure energy efficient models installed and properly configured.[42] - In 2009, Dunwoody, Georgia implemented a successful “power down” policy, aimed at reducing energy use while buildings are not in use. The municipality found that in order to successfully require businesses and citizens to participate, an ordinance must be constructed.[43]

5. Install Lighting Occupancy Sensors

Strategy Description:

Lighting is typically the largest electricity user in commercial buildings. Lights left on when no one is using them wastes much energy. Installation of lighting occupancy sensors prevent this by using sensors to detect motion in the lighted space and turning lights off if no one is present. Sensors can reduce energy use for lighting by an average of 35%.

Sensors are usually either ultrasonic or infrared. If no motion is detected after a set delay period, the sensor turns off or dims lights. Occupancy sensors are a low-cost way to save energy on lighting, with a typical payback time of less than one year.

More efficient lighting as a stand-alone measure will have a small effect on local air quality, but when efficient lights are purchased as a part of a broader green procurement or energy efficiency program, a significant reduction in electricity use can be realized. Communities with fossil fuel power within their air shed could contribute to the reduction of criteria air pollutants created from electricity generation through such a program.

Methodology:

- Square Feet of Government Lighting Occupancy Sensors Installed = 13,188
  - Half of all government facilities [44]
    - Town Office Building: 6,500 sq. ft.
    - Town Highway Garage: 16,900 sq. ft.
    - NW Old Garage: 1,750 sq. ft.
    - New Woodstock Water: 150 sq. ft.
    - Mount Pleasant Water: 500 sq. ft.
- Price of electricity
  - $0.145 per kWh [45]
- Annual Lighting Energy User Per Square Foot (kWh): 6.85 [46]
- According to NYSERDA's clean power estimator, an installing lighting occupancy sensors in all government owned municipal buildings save approximately 35% on total energy costs. [47]
- Community: Cost of Sensors and Installation ($ per Square Foot)
  - $0.06 [48]

Government Operations

13,188	Square Feet Installed with Occupancy Sensors

Government Operations

$0.1450	Price of Electricity ($ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
35	Percent Savings With Occupancy Sensors

$0.06	Cost of Sensors ($ per square foot)
31,618	Total Annual Electricity Savings (kWh)
$4,585	Annual Cost Savings
0.2	Simple Payback (years)

Government Operations

CO2e (metric tons)
7

Benefits:

If the government installed lighting occupancy sensors in all of their buildings, the town would save 14 $MTCO_2e$, saving the town $9,169 annually, with a simple payback of 0.2 years.

Co-Benefits

- Security provided by motion sensor lighting

- Work automatically once installed

A typical lighting occupancy sensor

Success Stories

- DeWitt Town Hall installed light sensors in bathrooms, supply rooms, and other rooms where lights might normally be left on.[49]

6. Indoor Lighting Retrofit

Strategy Description:
Lighting is typically the largest electricity draw in commercial buildings. Most commercial buildings use fluorescent lighting, which is relatively efficient, but many buildings still have older fixtures with magnetic ballasts and T-12 size fluorescent tubes. New electronic ballasts with T-8 size tubes use 30% less energy and can provide better light quality without flicker.

- **Methodology:**
  - Square feet retrofitted with efficient lighting
    - Assume half government buildings receive occupancy sensors by 2025→ 13,188 square feet[50]
  - Price of electricity ($ per kWh)
    - $0.1450 [51]
  - Annual lighting energy use per square foot (kWh)
    - 6.85 (CAPPA estimate)
  - Percent savings with retrofit
    - 30% (CAPPA estimate)
  - Cost of retrofit ($ per square foot)
    - $0.06 (CAPPA estimate)

13,188	Square Feet Installed with Occupancy Sensors

$0.1450	Price of Electricity ($ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
30	Percent Savings With retrofit
$0.06	Cost of retrofit ($ per square foot)
27,101	Total Annual Electricity Savings (kWh)
$3,930	Annual Cost Savings
0.2	Simple Payback (years)

CO2e (metric tons)
6

Co-Benefits

- Reduce energy costs
-Better lighting quality

T-8 LED Fluorescent tube

Success Stories

- The Town of Cazenovia recently replaced lighting in its DPW garage with T-8 fluorescent tubes. They have since seen a significant reduction in energy use for that building.[52]

7. Equipment Retrofit: Buy Energy Star Appliances

Strategy Description:
Energy Star is a partnership between the U.S. Environmental Protection Agency and industry to voluntarily label products that meet certain energy efficiency criteria. Converting to Energy Star computers is a beneficial switch. Energy Star products include home electronic appliances, office equipment, and light fixtures. For example switching to efficient monitors uses 20-60% less energy than other monitors. Overall switching to Energy Star computers can consume less energy and at the same time be an efficient addition to home appliances.

- **Methodology: Computers**
  - Number of buildings: Town office building, town highway garage, and the new Woodstock old garage, new Woodstock water, wellington water, and mount pleasant water, police station.
    - Town has 6 computers that are updated every 5 years. Assume all 6 are updated.
    - Price of electricity
      - $0.1450 per kWh [53]
    - Annual energy savings of one computer
      - 201 kWh [54]
    - Incremental cost of purchase one computer
      - $0 [55]

Government Operations

6	Computers replaced with ENERGY STAR Computers

Government Operations

$0.1450	Price of Electricity ($ per kWh)
201	Annual Energy Savings of one ENERGY STAR Computer (kWh)
$0	Incremental Cost to Purchase an ENERGY STAR Computer ($)
1,206	Total Annual Energy Savings (kWh)
$175	Annual Cost Savings
0.0	Simple Payback (years)

Government Operations

CO2e (metric tons)
0.3

- **Methodology: Refrigerators**
  - Assume Town updates 3 refrigerators by 2025.
  - Price of electricity
    - $0.145 per kWh[56]
  - Annual energy savings of one refrigerator
    - 464 kWh [57]
  - Incremental cost of purchase one refrigerator
    - $30[58]

Government Operations

3	Refrigerators replaced with ENERGY STAR refrigerators

Government Operations

$0.145	Price of Electricity ($ per kWh)
464	Annual Energy Savings of one ENERGY STAR refrigerator (kWh)
$30	Incremental Cost to Purchase an ENERGY STAR refrigerator ($)
1,392	Total Annual Energy Savings (kWh)
$202	Annual Cost Savings
0.4	Simple Payback (years)

Government Operations

CO2e (metric tons)
0.3

- **Methodology: printers**
  - Assume Town updates 7 printers by 2025.
  - Price of electricity
    - $0.145 per kWh[59]
  - Percent of printers < 10 ppm, 10-30 ppm, and >30 ppm
    - 33%, 34%, 33%[60]
  - Annual energy savings of one printer < 10 ppm
    - 229 kWh [61]
  - Annual energy savings of one printer 10-30ppm
    - 316 kWh [62]
  - Annual energy savings of one printer >30 ppm
    - 569 kWh [63]
  - Incremental cost of purchase one printer >30cpm
    - $10[64]

Government Operations

7	Printers replaced with ENERGY STAR refrigerators

Government Operations

$ 0.145	Price of Electricity ($ per kWh)
33	Percent of Printers < 10 ppm
34	Percent of Printers 10-30 ppm
33	Percent of Printers >30 ppm
229	Annual Energy Savings of one ENERGY STAR Printer <10 ppm (kWh)
316	Annual Energy Savings of one ENERGY STAR Printer 10-30 ppm (kWh)
569	Annual Energy Savings of one ENERGY STAR Printer >30 cpm (kWh)
$10	Incremental Cost to Purchase an ENERGY STAR Printer ($)
2,595	Total Annual Energy Savings (kWh)
$376	Annual Cost Savings
0.2	Simple Payback (years)

Government Operations

CO2e (metric tons)
0.6

If every home office product purchased in the United States this year met ENERGY STAR requirements, we would:

- Save more than $100 million in annual energy costs
- Prevent 1.4 billion pounds of greenhouse gases, equivalent to emissions from 125,000 cars
- Save more than 900 million kWh of electricity

- Activating power management features on an ENERGY STAR qualified desktop delivers lifetime energy savings that can go a long way towards paying the cost of a new computer:

8. Installing Low-flow Faucets and Toilets

Strategy Description:
Switching to more efficient faucets will have a negligible effect on local air quality as a stand-alone action. When faucets are purchased as a part of a broader water and energy conservation program, a significant reduction in water use can be achieved. Water pumping, purification, and wastewater treatment can represent a large portion of municipal energy use. Communities with fossil fuel power plants within their air shed could contribute to the reduction of criteria air pollutants created from electricity generation through such a program.

Toilet flushing can account for one third of water use in commercial and office buildings. New High Efficiency Toilets with the WaterSense label use 1.3 gallons per flush or less, compared to the current federal standard of 1.6 gallons per flush. Old toilets may use 3.5 or 5 gallons or more per flush. High Efficiency Urinals use 0.5 gallons per flush or less compared to the current federal standard of 1.0 gallon per flush. Old urinals may use 2-3 gallons or more per flush. Non-flushing urinals with zero water use are also available, using a liquid seal. Because these urinals do not need a flush valve their maintenance costs are lower. The greatest savings are obtained by replacing older toilets and urinals with a high flush volume, and toilets in high use areas. Switching to more efficient toilets will have a negligible effect on local air quality as a stand-alone action. When toilets are purchased as a part of a broader water conservation program, a significant reduction in water use can be achieved. Water pumping, purification, and wastewater treatment can represent a large portion of municipal energy use. Communities with fossil fuel power plants within their air shed could contribute to the reduction of criteria air.

- **Methodology: Faucets**
  - Replace: 15 faucets
  - Price of water
    - $0.0025 per gallon[65]
  - Price of electricity
    - $0.1450 per kWh [66]
  - Price of natural gas
    - $0.994 per therm [67]
  - Percent hot water
    - 70% [68]
  - Energy use per gallon of water
    - 0.0054 kWh [69]
  - Energy use per gallon of hot water
    - 0.19 kWh [70]
  - Energy use to heat gallon of hot water
    - 0.0098 therms [71]
  - Cost per faucet
    - $8 [72]

Government operations

15	Faucets Replaced

Government operations

$0.0025	Price of Water ($ per gallon)
$0.1450	Price of Electricity ($ per kWh)
$0.994	Price of Natural Gas ($ per therm)
270	Annual Water Savings per Faucet
70	Percent Hot Water
0.0054	Energy Use per Gallon of Water (kWh)
0.19	Energy Use to Heat Gallon of Hot Water (kWh)
0.0098	Energy Use to Heat Gallon of Hot Water (therms)
0	Percent Water Heating from Electricity
$8	Cost per Faucet
4,050	Total Annual Water Savings (gallons)
2,835	Total Annual Hot Water Savings (gallons)
22	Total Annual Electricity Savings (kWh)
28	Total Annual Natural Gas Savings (therms)
$38	Annual Cost Savings
3.0	Simple Payback (years)

Government Operations

CO2e (metric tons)
0.16

Co-Benefits:

Lower Bills, with Low-Flow Faucets : HGTV Remodels solve it for you.

Low-flow showerheads and faucets cost $10 and upward, and they can reduce your water use by 30 percent to 50 percent. Resulting savings in water use and hot water heating can be $50 to $90 or more a year, just by installing a couple of water-saving fixtures.

Methodology: Toilets

- Toilets or urinals replaced
  - Assume 10
- Price of Water
  - $0.0025 [73]
- Gallons per flush saved per toilet
  - 2.2 gal [74]
  - Based on replacing 3.5 gpf toilets with 1.3 gpf toilets and 2.7 gpf urinals with 0.5 gpf urinals
- Flushes per day
  - 20 flushes per day [75]
- Energy use per gallon of water
  - .0054 kWh[76]
- Price of toilet
  - $448 per toilet [77]

Government operations

10	Toilets or Urinals Replaced

Government operations

$0.0025	Price of Water ($ per gallon)
2.2	Gallons per Flush Saved per Toilet
20	Flushes per Toilet per Day
0.0054	Energy use per Gallon of Water (kWh)
$448	Cost per Toilet
114,714	Total Annual Water Savings (gallons)
619	Total Annual Electricity Savings (kWh)
$287	Annual Cost Savings
15.6	Simple Payback (years)

Government Operations

CO2e (metric tons)
0.14

Co-Benefits

-Utility bill savings

Success Stories

-Between 2007-2009, TIAA-CREF implemented a set of strategic energy management initiatives, including purchasing Energy Star qualified appliances, to more than 40 multifamily properties that reduced its communities' common area energy consumption by 9.1%, leading to energy cost savings of about $500,000 each year. [78]

9. Information Item: Micro-Hydroelectric Power Systems

Hydropower is a renewable energy and it has the potential to be one of the cheapest forms of renewable energy in terms of per kilowatt-hour of electricity produced. [79] In a hydropower system moving water turns a turbine and the turbine spins a generator, producing electricity. [80] The environmental impact of installing these systems is minimal. [81] The Town of Cazenovia has a micro-hydro system, but is considering expanding the use of this type of system.

The town worked with Phil Hoffmyer of Morrisville State College's Alternative Energy program to install their existing system in New Woodstock.[82] The existing system is small, only 800 W and produces 7,000 kWh/yr. [83] Morrisville College paid for the installation and maintenance. [84] It had been planned to be used for educational purposes in order to demonstrate old technology vs. new, but it can serve as a gateway for expanded use throughout the area. [85] The Town is looking into installing another system on Mill Street in the Hamlet of New Woodstock which will be about 2.5 to 3kW in capacity and will produce 21,500 to 26,000 kWh/yr. for municipal use, covering a significant portion of the annual electric needs of the Town Highway Department.[86]

In order to determine whether or not a site is appropriate for a hydropower installation, certain characteristics need to be analyzed. First, flowing water must be present. There are two components of the water that must then be measured: 1) the head, or the vertical distance the water falls, and 2) the flow, or the quantity of water falling. [87]

In order to determine the head at a micro-hydro site, a professional can measure it or a rough estimate can be acquired by using the "hose-tube method". [88] Both gross head and net head must be considered. [89] Gross head can be defined as the vertical distance between the top of the penstock, which carries the water and the point where the water discharges from the turbine.[90] The net head is the gross head minus losses due to friction and turbulence in the piping. [91]

The flow at micro-hydro sites can be obtained from past documents at offices such as The U.S. Army Corps of Engineers and The U.S. Geological Survey, or can be calculated using the "bucket method" or "weighted-float method". [92] After the head and flow are determined and assuming 53% efficiency, the potential power can be calculated by using the equation: [net head (feet) x flow (gmp)]/10 = W. [93]

Once power is calculated, then economic feasibility can be evaluated. In order to determine how much the system will cost in dollars per Watt, this equation must be used: (the estimated costs of developing and maintaining the site for a lifetime)/(the amount by the system's capacity in Watts). [94] This number should be compared to the cost of utility provided power/ other alternative power sources. [95] All of these analyses are necessary if the Town of Cazenovia wishes to implement more micro-hydro systems to benefit their community members.

Many existing examples of hydropower exist throughout the United States. Juniper Ridge is a small-hydro system located outside of Bend, Oregon. [96] It was built in 2009 by the Central Oregon Irrigation District and has been operating since 2010. [97] The system produces a little more than three megawatts of electricity with a capacity of 5 megawatts.[98] It has earned $100,000 in annual revenue and proceeds are expected to increase to $1 million annually once it reaches its payback year (expected to be

in 16 years). [99] Juniper Ridge cost about $24 million to build and the Oregon Department of Energy Small-Scale Energy Loan Program provided funding. [100] They financed $17 million and the Central Oregon Irrigation District who invested over $2 million. [101]

A hydro system is also being implemented in the Pawtuxet River of West Warwick, Rhode Island. [102] The project is expected to begin producing electricity in the winter of 2014. [103] The estimated cost is $1.7-$1.8 million. [104] The hydro system is expected to produce $250,000 in annual revenue along with 1.5 million kilowatt hours generated per year. [105] In order to move forward with this project, the Economic Development Corporation has loaned $200,000 towards the $475,000 estimated cost of the permitting process. [106] National Grid has reported that 3.2% of last year's electricity in Rhode Island came from domestic hydro generators. [107] There are already 3 of these commercial systems in the state, which have generated 3.3 megawatts per year. [108]

Boulder, Colorado has a system of five small hydroelectric units, which produce 7% of the electricity consumption for the city's 125,000 residents. [109] Two more hydroelectric units are in the process of being constructed. [110] Together, these have a combined capacity of 4.1 Megawatts. [111] They operate 96% of the time or around 50 weeks per year. [112] The Maxwell hydro station generates 513,382 kWh, has an annual revenue of $20,573 and cost $110,000 to construct. [113] The Kohler hydro station generates 598,889 kWh, has an annual revenue of $32,903 and cost $280,000 to construct. [114] The Orodell hydro station generates 823,022 kWh, has an annual revenue of $19,507 and cost $540,000 to construct.[115] The Sunshine hydro station generates 4,151,523 kWh, has an annual revenue of $177,833 and cost $1,100,000 to construct. [116] The Betasso hydro station generates 9,056,116 kWh, has an annual revenue of $539,419 and cost $3,200,000 to construct. [117] The local electricity company aids Boulder with $790,000 a year for these hydroelectricity systems. [118] The five hydro plants cost $5.2 million to construct, have an average cost of $1,280/kW and has a simple payback period of 10-15 years. [119]

10. <u>Information Item: Implement variable speed water pumping</u>

Variable speed water pumps are more efficient than single-speed water pumps because they pump water at a rate that is necessary for local requirements. Variable speed pumps are therefore less active and using less energy when water requirements are lower, as opposed to single-speed water pumps which use the same amount of energy regardless of water demand. Installing variable speed water pumps is something that the Town can do to reduce energy use, energy costs, and emissions.

Wastewater Treatment

1. **Information Item: Convert Septic Systems to Piped-Sewage System**

Currently, only about 5% of the Town's population utilizes the Wastewater Treatment Facility, and the remaining 95% utilize on-site septic systems. Methane emissions from septic systems can be significant because generally the methane produced is released directly to the atmosphere uncollected, uncontrolled, and without treatment.[120] In fact, the majority of methane emissions from wastewater treatment in the United States come from septic tanks (76%)[121]. According to the 2010 GHG inventory report for the Town of Cazenovia, septic tanks contributed to emissions of 556 $MTCO_2e$.

One method of reducing emissions from wastewater treatment in the Town of Cazenovia is to convert some or all of the septic systems to a piped-sewage system that is treated at the Wastewater Treatment Facility. Emissions can be significantly reduced if wastewater is treated at a well-managed central location. Emissions can be reduced even further if methane emitted during the treatment process is collected and utilized for electricity, or even if it is simply flared and converted to CO_2, since methane is a greenhouse gas 21 times more damaging than carbon dioxide.

2. Information Item: Technologies and Strategies to Reduce Nitrogen Emission in Septic Tanks/Sewage Treatment Plants

As a part of the Town of Cazenovia's Climate Action Plan, a plan has been devised to reduce nitrogen emissions. According to the Town of Cazenovia's GHG Report, algae blooms are common in Cazenovia Lake.[122] Nitrogen and Phosphorus are the causes of these algae blooms. Marine ecosystems require these two nutrients to thrive, but too much of them can cause algae to grow quicker than the ecosystems can handle.[123] Consequently, as water quality worsens, harm is inflicted among food resources and habitats, and oxygen in the ecosystem decreases.[124] Nitrogen can also be harmful to humans and their drinking water.[125] Also, additional nitrogen in the air can bring about pollutants like ammonia which has its own health effects.[126] Reducing nitrogen emissions is a necessary process in the Town of Cazenovia's Climate Action Plan to protect the well-being of their ecosystems and residents.

Nitrogen can come from many sources, one of the most common sources is waste. In the Town of Cazenovia, 95% of the population uses septic tanks.[127] Therefore, nitrogen from the waste is going directly in to the ground. Runoff from precipitation will wash the nitrogen emissions with it and into the lake, contributing to the problem of algae blooms and polluted ground water. In order to reduce nitrogen emissions, the Town of Cazenovia would have to install septic tank technology that removes nitrogen from waste before it enters the ground.

Long Island has a similar problem in their bays and oceans. Brown tide is quite common especially in eastern Long Island. A non-profit organization, Citizen's Campaign for the Environment (CCE), has started working on a campaign to install new septic tank technology that removes nitrogen from waste. CCE does not have a set plan on the technology they plan to use to reduce nitrogen emissions, but they have some ideas. The Town of Cazenovia can model this plan to reduce nitrogen emissions in its own Climate Action Plan.

One option for the Town of Cazenovia that CCE is looking into is the use of In-Pipe Technology. The utilization of this technology would require the switch from septic tanks to a wastewater treatment plant. Considering the Town of Cazenovia already has a wastewater treatment plant, an expansion may have to occur. In-Pipe Technology puts bacteria in key locations in the pipes of a wastewater treatment plant.[128] These bacteria break down the sludge before it gets to the plant.[129] CCE has utilized In-Pipe Technology in the Huntington wastewater treatment plant and has reduced nitrogen, expanded the sewer district and saved $68,000.[130] This technology reduces operations costs and is sustainable since it uses natural methods to reduce nitrogen emissions.[131] It is able to reduce costs of the operation of a plant is by reducing the sludge delivered to the wastewater treatment plant which in turn reduces energy costs that have to do with aeration.[132] In-Pipe Technology could serve as a dual purpose for the Town of Cazenovia because it will reduce nitrogen emissions as well as overtime, it would reduce the operation costs of a sewage treatment plant. This option would be ideal if the Town of Cazenovia was considering converting septic tanks to a piped-sewage system with water treated at the wastewater treatment facility.

Engaging in this process would be more sustainable and help minimize nitrogen emissions. Although the Town of Cazenovia has shown opposition to switching over to a sewage treatment plant, it is still something to consider for the future.

Another option for the Town of Cazenovia is to use the system Nitrex. Nitrex removes nitrogen from septic tanks before it enters the ground. CCE is considering this technology in their efforts to reduce nitrogen emissions.[133] What this technology does is denitrify waste.[134] First the technology converts ammonium to nitrate, and then it is able to go through the denitrification process.[135] This technology is expected to reduce nitrogen emissions by 50-70%.[136] In addition, Nitrex is the one of the only single-pass nitrate removal technologies out on the market.[137] Another benefit of the Nitrex filter is that after installation, it is practically maintenance free for many years.[138] The estimated cost of installing a Nitrex system is $16,000- $22,000 for a 3-4 bedroom home septic system. In the Town of Cazenovia alone, there are 1,514 households.[139] Assuming this estimated price for installing a Nitrex system for one 3-4 bedroom household, implementing this technology for the town will cost from $24,224,000-$33,308,000. Implementing a Nitrex system may be more favorable considering the town's opposition to changing over to a wastewater sewage treatment plant, but the expenses are high. The LaPine Oregon Project evaluated Nitrex and sixteen other nitrogen removing technologies, and determined that the Nitrex system is the most effective.[140] Not only is the Nitrex filter patented, but it has been used to for USEPA projects.[141]

The initial implication of these two projects would be expensive. Eventually these systems will save the town money, but the starting costs are hefty. CCE is battling with this problem as they work on this issue. One way they plan to approach this problem is to advocate for funding.[142] To continue with this project, it is possible to apply for state and federal funding.[143] For those residents who are concerned about higher taxes with the implementation of these systems, it is important to emphasis that they are cost saving in the long term.

Finally, the Town of Cazenovia can update its septic code to reduce run-off and leaching from septic systems into Cazenovia Lake. An updated septic code could include items such as: increasing the minimum separation distances between leach fields and the lake; increasing depth of septic system upon installation to prevent seepage; and requiring percolation tests on the leach field site prior to construction of new septic systems.

All of these proposals are viable solutions to reduce nitrogen emissions within the Town of Cazenovia. Reducing nitrogen emissions would not only minimize the effects of algae blooms within Cazenovia Lake, but it would also improve the water quality of the groundwater. The In-Pipe Technology would make more sense if the Town of Cazenovia were considering switching from septic tanks to a wastewater sewage treatment plant. But if there is strong opposition against the plant, technology such as Nitrex, that removes nitrogen from waste before it enters the ground, is an alternative solution to this problem, and perhaps is the simpler route.

Streetlights

1. **Information Item: Install LED Streetlights**

Strategy Description:
Street lighting is often one of the largest items in a local government's energy budget. Many cities still have older, inefficient, mercury vapor lamps or incandescent bulbs in streetlights. LEDs have been used to successfully reduce energy use for traffic signals, and some cities are choosing to install LEDs for street lighting applications. LEDs are highly efficient, and their light is directional, making it easy to focus them on roads, avoiding ambient light pollution and energy waste. Perhaps the most attractive feature of LEDs for local governments is the maintenance savings from their long lift (10-12 years in streetlight applications)

Older, inefficient mercury vapor lamps or incandescent bulbs in streetlights require more energy than newer, more efficient LED (light emitting diode) bulbs. Switching inefficient lighting with LEDs will reduce electricity use; therefore, reducing associated GHG emissions.

The Town of Cazenovia still operates high-pressure sodium streetlights, which are far less efficient than LED light bulbs; however, the Town does not own their streetlights, but could analyze this data in the consideration of a buyout program of streetlights from National Grid.

Methodology:

- Town has 37 Streetlights in the New Woodstock area, all of which are owned by National Grid [144]
  - 1 high pressure sodium lamp at 150 Watts [145]
  - 1 high pressure sodium lamp at 250 Watts [146]
  - 35 high pressure sodium lamps at 100 Watts [147]
    - Because CAPPA only allows one input for Wattage, the 100 Watt input is being utilized because 95% of the lamps are 100 Watts.
- Price of electricity
  - $0.246 per kWh [148]
- Annual Lighting Energy User Per Square Foot (kWh): 6.85 [149]
- Community: Cost of Sensors and Installation ($ per Square Foot)
  - $0.06 [150]

Government Operations

37	Street Lights Replaced with LED Street Lights

Government Operations

11	Hours of Streetlight Operation

$0.2460	Price of Electricity ($ per kWh)
0	Percent Mercury Vapor Lamps
0	Percent Metal Halide Lamps
100	Percent High Pressure Sodium Lamps
0	Percent Low Pressure Sodium Lamps
182	Wattage of Mercury Vapor Lamps
200	Wattage of Metal Halide Lamps
100	Wattage of High Pressure Sodium Lamps
180	Wattage of Low Pressure Sodium Lamps
7,428	Total Annual Energy Savings (kWh)
$1,827	Annual Cost Savings
0.0	Simple Payback (years)

Government Operations

CO2e (metric tons)
2

Benefits:

If the government were able to successfully negotiate with National Grid the implementation of LED Streetlights in all 37 lights, the town would save 2 $MTCO_2e$, saving the town $1,827 annually, with an almost immediate simple payback while saving 7,428 kWh of energy.

Co-Benefits		Success Stories
-Reduce energy costs -Lower maintenance costs -Useful life of LED bulbs are much greater than traditional bulbs		- The Village of Solvay, NY converted their municipally-owned streetlights to LED streetlights in the summer of 2012. Their electric usage is less than half of what it was with the older lights and saved the village $12,000 annually.[151]

Community Strategies

Transportation

1. Electric Vehicles

Strategy:
Electric (EVs) vehicle drive trains are much more efficient than the drive trains used on standard internal combustion engine vehicles. Electric motors, rather than pistons and shafts, provide necessary propulsion. EVs use regenerative braking to capture and reuse the energy of the vehicle's momentum in stop-and-go traffic, greatly increasing their efficiency in city driving. Neighborhood electric vehicles (NEVs) have a top speed of 25 mph, and are suitable for meter reading, parking enforcement, and small deliveries. A number of smaller companies have recently introduced electric utility pickups and delivery vans appropriate for fleet use. The effect of EVs on greenhouse gas emissions will depend on the source of electricity used and the particular vehicles being compared. In an area where most electricity come from coal, an electric vehicle may produce more GHGs than a gasoline vehicle of the same size. In an area with a relatively low-carbon electric grid an electric vehicle can significantly reduce emissions. If EVs are charged from renewable energy, emissions are zero.

Methodology:

- Assume one fourth of town residents are in the market for a new vehicle
  - 3,066 community vehicles in the Town [152]
  - Assume 15% = 460 vehicles.
- Price of gasoline
  - $3.46 per gallon [153]
- Cost of electricity from National Grid
  - $0.1250 per kWh [154]
- Fuel Economy based on average US fuel efficiency
  - 23.5 mpg [155]
- Average annual miles per vehicle
  - Total community VMT in baseline year: 39,703,390 – 105,000 (government VMT) = 39,598,390 community miles total [156]
  - Assume 1/3 of miles are through traffic (do not begin or end in Town). 39,598,390 * (2/3) = 26,398,927 / 3,066 vehicles in Town = 8,610 annual miles per vehicle)
- Incremental Cost based on Nissan Leaf [157]

Community

460	Number of Electric Vehicles

Community

$3.46	Price of Gasoline ($ per gallon)
$ 0.1250	Price of Electricity ($ per kWh)
23.5	Miles per Gallon of Vehicle Replaced
8,610	Average Annual Miles per Vehicle
$5,160	Incremental Cost of Electric Vehicle
168,536	Annual Gasoline Savings (gallons)
1,427	Annual Electricity Use (kWh)
$583,462	Annual Cost Savings
4.1	Simple Payback (years)

Community

CO2e (metric tons)
1,586

Benefits:

If 15% of community vehicles are converted to electric vehicles, the Town will reduce emissions by 1,586 metric tons of CO_2e while saving 168,536 gallons of gasoline. The community will save a total of $583,462.

Co-Benefits	Success Stories
-Reduces local air pollution -Lower operating cost than gasoline vehicles	-Governor Cuomo announced on April 11, 2013 that more than 360 electric vehicle and plug-in hybrid charging stations will be installed across the state in support of his Charge NY initiative, which is an initiative to create a statewide network of up to 3,000 public and workplace charging stations over the next five years and to put up to 40,000 plug-in vehicles on the road during that period.[158] -The Kanagawa Prefecture in Japan is the most successful electric vehicle region in the world, with 2,183 registered electric vehicles. In the US, citizens of cities like Los Angeles (2,000 registered electric vehicles), Portland (1,300 registered electric vehicles), New York City (238 registered electric vehicles), and Research Triangle, NC (134 registered electric vehicles) have begun to realize the benefits of electric vehicles as well[159]. -California offers several types of incentives to encourage drivers to make the switch to electric vehicles. The California Air Resource Board improved an initiative that allows EVs to access HOV lanes, which are usually reserved only for high-occupancy vehicles, via the use of a green decal sticker. The state also offers a $1,500 rebate through the Clean Vehicle Rebate Project towards the purchase or lease of an approved "clean" vehicle.[160]
 Installation of Blink electric car charging station in Syracuse, NY	

2. Conversion to Higher Efficiency Vehicles

Strategy Description:
One easy way to improve the efficiency of vehicles is simply to use a smaller one. The smallest vehicle that can accomplish a task will usually be the most efficient. When considering a vehicle purchase, identify whether an SUV, pick-up or full-size sedan is actually necessary, or whether a compact car can do the same job.

Hybrids are also a good option when converting to a higher efficiency vehicle. They are less expensive to operate than regular vehicles, and while key issues related to battery life still remain, maintenance and fuel savings costs are expected to outweigh the price of battery replacement.

One way that the Town can encourage conversion from pick-ups/SUVs to smaller vehicles is to offer truck or trailer rentals for occasions when residents need to haul items to and from their homes. This way, residents will not feel the need to purchase and drive larger vehicles year-round but can still have access to them when needed.

- **Methodology**
  - Number of smaller vehicles used
    - 3,066 community vehicles in the Town [161]
    - Assume 30% = 920 vehicles.
  - Price of gasoline
    - $3.46 per gallon [162]
  - Small vehicle MPG
    - Mpg of 2013 Hyundai Elantra = 30 mpg[163]
  - Average MPG of vehicles replaced
    - Mpg of 2013 Ford F-150 = 20 mpg[164]
  - Average annual miles per vehicle
    - Total community VMT in baseline year: 39,703,390 – 105,000 (government VMT) = 39,598,390 community miles total [165]
    - Assume 1/3 of miles are through traffic (do not begin or end in Town). 39,598,390 * (2/3) = 26,398,927 / 3,066 vehicles in Town = 8,610 annual miles per vehicle)

920	Number of Smaller Vehicles Used

$3.66	Price of Gasoline ($ per gallon)
30	Small Vehicle Miles per Gallon
20.0	Miles per Gallon of Vehicle Replaced
8,610	Average Annual Miles per Vehicle
132,020	Annual Gasoline Savings (gallons)
$480,553	Annual Cost Savings

CO2e (metric tons)
1,243

Co-Benefits	Success Stories
- Reduces local air pollution -Reduces reliance on foreign oil -Generally lower purchase price than larger vehicles	-Converting from a truck to a sedan can save upfront on the overall cost of the vehicle as well as long-term savings on gasoline. For example, switching from a Ford F-150 to a Hyundai Elantra can save Town residents $240,276 annually, along with an upfront savings of $7,305 per vehicle.[166]

3. Bicycling paths and Facilities

Strategy Description:

Bicycles are the most efficient mode of transportation. Bicycles are especially appropriate in reducing the number of short trips—up to five miles or so—which constitute more than half of all driving. Dedicated bike paths and bicycle lanes on roadways reduce the danger motor vehicles pose to bicyclists. They also make bicycling faster and more pleasant. Well-maintained surfaces, good lighting, a feeling of security, and strategic locations constitute the elements of a good bicycle route network. Employers can encourage bicycle commuting by providing lockers for safe storage of bicycles and shower facilities. Governments can set an example by providing these facilities for their employees.

Methodology:

- Weekly trips changed from car to bicycle
  - Annual VMT = 39,703,390 miles * (2/3) [167] = 26,468,927
  - 26,468,927 AVMT / 365 days = 72,518 DVMT
  - 72,518 DVMT * 210 days bicycles could be in use = 15,228,780 AVMT possible for bicyclists
  - 15,228,780 AVMT / 2 (one-way trips- accounting for one trip to work and one trip home) = 7,614,390 AVMT of one-way trips
  - 7,614,390 AVMT of one-way trips / 210 days of bicycling = 36,259 daily VMT of one-way trips
  - 36,259 daily VMT of one-way trips * 40%[168]= 14,504 DVMT of one-way trips less than 2 miles
  - 14,504 DVMT of one-way trips less than 2 miles / 1 mile (assumed average trip length of all trips than 2 miles) = 14,504 total daily trips less than 2 miles
  - 14,504 total daily trips less than 2 miles * 5% (assumed percentage of trips changing to bicycle) = 1,450 daily trips less than 2 miles changed to bicycle
  - 725 daily trips less than 2 miles changed to bicycle * 7 days per week = 5,075 weekly trips than 2 miles changed to bicycle
- Price of gasoline
  - $3.46 per gallon [169]
- Average length of avoided trip
  - 2 miles [170]
- Average fuel economy
  - 23.5 mpg

Community

5,075	Weekly Trips Switching from Car to Bicycle

Community

$3.46	Price of Gasoline ($ per gallon)
2	Avg. length of avoided trip (mi)
23.5	Average Fuel Economy
527,800	Annual Vehicle Mile Reduction
22,460	Annual Gasoline Savings (gallons)
$77,778	Annual Cost Savings

Community

CO2e (metric tons)
211

Co-Benefits

-Alternate transportation such as biking promotes exercise and a healthier population

-Reduced fuel costs

-Reduced local pollution

-Reduced reliance on foreign oil

Bicyclists on the Onondaga Creekwalk, Syracuse, NY

Success Stories

-The Creekwalk in Syracuse, NY allows walking or biking through the city, including to and from Destiny USA.[171]

-Midtown Greenway in Minneapolis, Minnesota – 5.5 mile bike pathway is traveled by 3,500 cyclists daily, often allowing them to travel faster than drivers.[172]

4. Promote Telecommuting

Strategy Description:
Computers, modems, the Internet, telephones and fax machines—everything is now in place to allow many employees to work at home. Some can do it part time, some full time. Use advanced telephones and, if possible, video cameras to meet with individuals rather than travel to meet with the people face to face. A variation on this theme is to furnish or rent office space at a strategic location near employees who formerly commuted long distances. Other ways to reduce the need to commute: change the work week—to ten hours a day for four days, or nine hours a day for nine days, for example. All these options reduce commuting miles for employees and shift traffic to more efficient off-peak hours[173].

Telecommuting is a solution to increasing emissions from cars. It will help employees work from home and therefore reduce their commute time to zero, and car emissions to zero. This strategy will only be provided to community members, as it is more difficult for government employees to work at home. According to the Town of Cazenovia Zoning Laws, no occupation shall be conducted in the Town without a permit. The Zoning Ordinance Enforcement Officer can prescribe the application process. There is a fee that is set by the Town Board at the annual reorganization meeting. The Zoning Ordinance Enforcement Officer will then automatically renew the application.

Methodology:

- Employees offered telecommuting incentives
  - 2,300 people with primary jobs in Town of Cazenovia,[174] assume all are offered incentives but only 10% utilize them (below)
- Price of gasoline
  - $3.46 per gallon [175]
- Percent of employees telecommuting each workday
  - 10% of employees will telecommute[176]
- One way commute length
  - 18.7 miles [177]
- Average passenger vehicle fuel economy
  - 23.5 mpg [178]

Benefits:
Many employees report increased productivity and job satisfaction from telecommuting. Flexibility to work from home can reduce employee needs for childcare. Telecommuting is attractive to employers as a way to retain employees who would otherwise leave because of long commute distances or family needs[1].

Community

2,300	Employees Offered Telecommuting Incentives

Community

$3.46	Price of Gasoline ($ per gallon)
10	Percent of Employees Telecommuting each Workday
18.7	Average One-way Commute Length (mi)
23.5	Average Passenger Vehicle Fuel Economy
2,064,480	Annual Vehicle Mile Reduction
87,850	Annual Gasoline Savings (gallons)
$303,962	Annual Cost Savings

Community

CO2e (metric tons)
827

Co-Benefits

- Reduces traffic

- Reduces local noise and air pollution

- Reduces reliance on foreign fuels

Success Stories

- The State of Arizona has successfully encouraged more than 4,000 state employees to telework, reducing driving by 5.25 million miles a year.[179]

5. Walking Friendly Environments

Strategy Description

Walking brings health and environmental benefits, reduces traffic congestion, and brings customers to business along the walking route. Planning that prioritize pedestrian needs will yield a quite different design from planning that prioritizes automobiles. Adequate sidewalks and crosswalks are essential. Wide sidewalks are more attractive, and a barrier between pedestrians and traffic, such as trees, planters, or on-street parking feels safer. A smaller curb radius at intersections leaves a smaller distance for pedestrians to cross and forces turning vehicles to slow down. Slowing down traffic increases pedestrian safety. People prefer to walk in interesting environments. Building facades and architecture, and urban art contribute to this.

Methodology:

- Weekly trips switching from car to walking.
  - Annual VMT =39,703,390 miles*(2/3)[3]/365 = 72,518 DVMT
  - (72,518 * 28% of trips are less than 1 mile) [180] * 5% changing to walking * 7 days = 7,107 trips switching from car to walking
- Price of gasoline based on east coast average
  - $3.46 per gallon [181]
- Average length of avoided trip
  - 1 mile [182]
- Fuel Economy based on average US fuel efficiency
  - 23.5 miles per gallon [183]

Community

7,107	Weekly Trips Switching from Car to Walking

Community

$3.46	Price of Gasoline ($ per gallon)
1	Average Length of Avoided Trip (mi)
23.5	Average Passenger Vehicle Fuel Economy
369,564	Annual Vehicle Mile Reduction
18,760	Annual Gasoline Savings (gallons)
$64,964	Annual Cost Savings

Community

CO2e (metric tons)
177

[3] Assuming 1/3 VMT is through-traffic

Benefits:

Encouraging walking, even on a moderately small scale will increase public health and save the community a combined total of $97,422 as well as reducing annual CO2e emissions by 265 metric tons.

Co-Benefits

-Alternate transportation such as walking promotes exercise and a healthier population

-Reduced fuel costs

-Reduced local pollution

-Reduced reliance on foreign oil

Creekwalk in Syracuse, NY

Success Stories

-The Creekwalk in Syracuse, NY allows walking or biking through the city, including to and from Destiny USA.[184]

6. Promote Carpooling/Vanpooling

Strategy Description:
A carpool is a group of two or more people who commute to work or other destinations together in a private vehicle. Carpool members work out their own agreements on who drives and how often, schedules, and payments for gas and maintenance. Carpooling allows multiple people to share a personal vehicle, so less fuel is used per passenger. Carpooling reduces total VMT, thus reducing GHG emissions and fuel costs.

One way to encourage carpooling/vanpooling is to create an electronic bulletin board where community members can go to request or offer rides. This bulletin board could be placed on the Town website or some other easily accessible location. Another possibility is to encourage community members to take advantage of carpooling smart phone apps, such as Uber or Lift, which also provide a forum for requesting rides. Another program that will encourage carpooling and vanpooling is to offer a guaranteed ride home. Studies have shown that many employees commute by car so they can get home quickly if something comes up— such as an emergency or a call from school. Address this concern by guaranteeing employees a ride home—by taxi or company car—when needed.

- **Methodology**
  - Number of Employees Offered Carpool Incentives
    - 2,300 total primary jobs – 696 Village primary jobs = 1,604 - 381 in Village = 1,223 Town residents commuting outside of Village
    - Assume 15% participate in carpooling
    - 1,223* 15% = 183
  - Price of Gasoline ($ per gallon)
    - $3.46 per gallon [185]
  - Percent Reduction in Commute Vehicle Trips
    - Assume 10%
  - Average One-way Commute Length (mi)
    - 646 – 226 (V) commute less than 10 miles to work (avg. 5 miles)[186]
      - 420 x 5 = 2,100 miles
    - 1,187-403 commute 10-24 miles to work (avg. 17 miles)
      - 784 x 17 = 13,328 miles
    - 308-66 commute 25-50 miles to work (avg. 37.5 miles)
      - 242 x 37.5 = 9,075 miles
    - 159-1 commute more than 50 miles to work (50 miles)
      - 158 x 50 = 7,900 miles
    - 2,100 + 13,328 + 9,075 + 7,900 = 32,403 miles total
    - 32,403 / 1,223 (total primary jobs) = 26.5 miles
  - Average Passenger Vehicle Fuel Economy
    - 23.5 mpg[187]

Community	
183	Employees Offered Carpool and Vanpool Incentives

Community

$3.46	Price of Gasoline ($ per gallon)
10	Percent Reduction in Commute Vehicle Trips
26.5	Average One-way Commute Length (mi)
23.5	Average Passenger Vehicle Fuel Economy
232,776	Annual Vehicle Mile Reduction
9,905	Annual Gasoline Savings (gallons)
$34,273	Annual Cost Savings

Community

CO2e (metric tons)
93

Co-Benefits

- Reduces local air pollution

-Reduces reliance on foreign oil

-Improve relations between community members

www.transportation.boisestate.edu

Success Stories

- **Albany, NY Carpool Incentive Program**
The Office of General Services (OGS) and the Governor's Office of Employee Relations offers a carpool incentive program for state employees working in downtown Albany. The program is designed to decrease the number of vehicles on Capital District roadways, improve air quality, and provide convenience and reduced costs to those seeking parking in OGS-managed lots and garages.[188]

7. Electric Vehicle Charging Stations on Parking Structures

Strategy Description:

Electric vehicle (EVs) drive trains are much more efficient than the drive trains used on standard internal combustion engine vehicles. Electric motors, rather than pistons and shafts, provide necessary propulsion. EVs use regenerative braking to capture and reuse the energy of the vehicle's momentum in stop-and-go traffic, greatly increasing their efficiency in city driving. One way to encourage EV use is to construct parking spaces in large parking structures that are reserved for EVs and have a charging connection.

Methodology:

Electric Vehicle Charging Stations on Parking Structures

- Assume 5 charging spaces installed.
- Price of gasoline based on east coast average
  - $3.46 per gallon [189]
- Fuel Economy based on average US fuel efficiency
  - 23.5 mpg [190]
- Average annual vehicle miles per charging space
  - Approximate driving range of 100 miles before needing to be to be recharged [191]
  - Nissan Leaf owners did 67% of their charging at home in 3rd quarter of 2012 [192] 100% - 67% = 33% of charging done at charging stations.
  - 33% of 100 = 33 miles per charge at charging station
  - 33 miles x 365 days per year = 12,045 avg. annual vehicle miles per charging space

Community

5	Number of Charging Spaces

Community

$3.46	Price of Gasoline ($ per gallon)
$0.1250	Price of Electricity ($ per kWh)
23.5	Miles per Gallon of Vehicle Replaced
12,045	Average Annual Vehicle Miles per Charging Space
2,563	Annual Gasoline Savings (gallons)
22	Annual Electricity Use (kWh)
$8,872	Annual Cost Savings

Community

CO2e (metric tons)
24

Benefits:

Even with a small addition of charging stations to encourage electric vehicle ownership the town will reduce its CO_2e emissions by 24 metric tons. Community members will save a total of $8,872 on fuel costs.

Co-Benefits	Success Stories
-Reduces local air pollution -Lower operating cost than gasoline vehicles  Installation of Blink electric car charging station in Syracuse, NY	-Governor Cuomo announced on April 11, 2013 that more than 360 electric vehicle and plug-in hybrid charging stations will be installed across the state in support of his Charge NY initiative, which is an initiative to create a statewide network of up to 3,000 public and workplace charging stations over the next five years and to put up to 40,000 plug-in vehicles on the road during that period.[193] -The Kanagawa Prefecture in Japan is the most successful electric vehicle region in the world, with 2,183 registered electric vehicles. In the US, citizens of cities like Los Angeles (2,000 registered electric vehicles), Portland (1,300 registered electric vehicles), New York City (238 registered electric vehicles), and Research Triangle, NC (134 registered electric vehicles) have begun to realize the benefits of electric vehicles as well[194]. -California offers several types of incentives to encourage drivers to make the switch to electric vehicles. The California Air Resource Board improved an initiative that allows EVs to access HOV lanes, which are usually reserved only for high-occupancy vehicles, via the use of a green decal sticker. The state also offers a $1,500 rebate through the Clean Vehicle Rebate Project towards the purchase or lease of an approved "clean" vehicle.[195]

Residential Energy Use

3. Geothermal heating/cooling pumps (User Defined 3)

Strategy description:

Geothermal heat pump technology utilized the physical phenomenon of fairly constant annual temperatures several feet below the surface of the earth. During the winter, a heat exchanger fluid is pumped into the ground where the heat is transferred to the fluid and then delivered to the building as heat. During the summer, the heat exchanger fluid takes away the heat in the building and discharges it into the ground, thus cooling the building. Electricity is used to run the pumps for the geothermal system, meaning there will still be greenhouse gas emissions associated with heating and cooling unless the electricity is supplied by non-carbon sources, however, the energy use and emissions will be much less than with a traditional heating/cooling system. Because energy used for heating and cooling represents the majority of energy use in a building, installing a geothermal system can significantly reduce overall energy use and emissions.

Methodology:

- Number of homes using
  - 454 homes in Town using fuel oil to heat - 15 homes in Village (Census Report, 2010) [196] = 439 homes in Town using fuel oil to heat.
  - Assume 20% convert to geothermal. 439 → assume 50 homes[197]
- Annual Oil use per house
  - 439 homes in town using fuel oil to heat, 50,832 mmBTU /439 =115.79 mmBTU per home = 834 gallons per home per year
- Price of oil ($ per gallon)
  - $4.22 per gallon [198]
- Efficiency of oil boiler
  - 80% [199]
- COP of Geothermal heat pump
  - 4 [200]
- Annual Cooling Electricity Use per house (kWh)
  - 11,035,738 electricity used total [201]
  - 11% electric bill towards cooling [202]
  - 1,213,931 kWh total /1,514 homes occupied in town =802 kWh for cooling per household [203]
- EER of Air-conditioning
  - 10 [204]
- Cost per square foot of geothermal
  - $10.00 [205]
- Square foot of average house
  - 2,437 [206]

Community

50	Number of Homes using

Community (fuel oil to geothermal)

$0.1250	Price of Electricity ($ per kWh)
$4.22	Price of Oil ($ per gal)
834	Annual Oil Use Per House (gal)
80	Efficiency of Oil Boiler (%)
27,122	Annual Heat Demanded For Building (kWh conversion)
4	COP of Geothermal Heat Pump
6,781	Annual Electricity Demanded For Heat With Geothermal (kWh)
802	Annual Cooling Electricity Use Per House (kWh)
10	EER Of Air Conditioning
2.93	COP of Air Conditioning
2,351	Annual Heat Removed From Building (kWh conversion)
35	EER Of Geothermal Heat Pump
229.14	Annual Electricity Demanded for Cooling After Geothermal (kWh)
$10.00	Cost per Square Foot of Geothermal
2437	Square Footage of Average House
-310,384	Total Annual Electricity Savings (kWh)
41,700	Total Annual Oil Savings (gal)
$137,176	Annual Cost Savings
8.9	Simple Payback (years)

Community

CO2e (metric tons)
839

Co-Benefits

-Reduce reliance on fossil fuels

-Decrease local air pollution

-Decrease energy costs

Geothermalgenius.org Banner

Success Stories

-The new net-zero Skaneateles Village Hall uses solar PV to capture energy from the sun, as well as geothermal heating and cooling, a geothermal water heater, Energy Star appliances, occupancy sensors, and Solatube light wells.[207]

4. Home Weatherization

Strategy Description:

Low-income earners and older homes are often poorly insulated. Weatherization programs seal cracks around windows and doors, add insulation, and sometimes replace inefficient appliances, reducing energy-use-related GHG emissions and lowering utility bills. There are federal and state programs to provide weatherization assistance (sometimes administered by local governments), but funding is limited and often insufficient for the number of homes requiring retrofitting. There is an opportunity for additional local programs to implement cost-effective energy saving measures that reduce emissions while benefiting low-income individuals and families.

The NYS Weatherization Assistance Program (WAP) assists income-eligible families and individuals by reducing their heating/cooling costs and improving the safety of their homes through energy efficiency measures. Energy efficiency measures performed through the program include air sealing (weatherstripping, caulking), wall and ceiling insulation, heating system improvements or replacement, efficiency improvements in lighting, hot water tank and pipe insulation, and refrigerator replacements with highly efficient Energy Star rated units. Both single-family and multi-family buildings are assisted. Household energy use reductions and resultant energy cost savings are significant, with an average savings in excess of 20%. Individual households apply by contacting the provider that serves their area. Households with incomes at or below 60% of state median income are eligible for assistance. Program services are available to both homeowners and renters, with priority given to senior citizens, families with children and persons with disabilities.

Methodology:

- Number of homes weatherized
  - 151 (10% of occupied homes in the Town of Cazenovia) [208]
- Price of electricity
  - $0.1250 per kWh [209]
- Price of natural gas
  - $1.30 per therm [210]
- Price of fuel oil
  - $4.22 per gallon [211]
- Percentage of homes heated with natural gas
  - 29% [212]
- Percentage of homes heated with fuel oil
  - 29% [213]
- Average electrical energy used for heating per household
  - 6,725 [214]
- Average electrical energy (kWh) used for heating per household

        - 1,514 total homes in 2010 used 16,971,000 kWh electricity total = 11,209 kWh used per home [215] * 60% used for heating = 6,725 kWh Average natural gas used for heating per household [216]
    - Average natural gas energy (therms) used for heating per household
        - 1,514 total homes in 2010 used 801,010 therms total = 539 therms used per home [217] * 60% used for heating = 323 therms
    - Typical household fuel oil use
        - Total household fuel oil use in Town in 2010 = 50,832 mmBTU [218]
        - Total households heating with fuel oil in Town = 454-15 (Village) = 439[219]
        - 50,832 mmBTU / 439 = 115.79 mmBTU per household per year
        - 115.79 mmBTU = 834 gallons per home per year [220]
    - Percent savings of energy used for heating (kWh)
        - 15% [221]
    - Percent savings of energy used for heating (therms)
        - 15%[222]
    - Percent savings of energy used for heating (fuel oil)
        - 15%[223]
    - Program cost ($/home)
    - $4,900 per home[224]
    - An average of $4,900 to weatherize a single unit in September 2011[225]

Community

151	Homes Weatherized

Community

$0.1250	Price of Electricity ($ per kWh)
$1.30	Price of Natural Gas ($ per therm)
$4.22	Price of Fuel Oil ($ per gallon)
39	Percentage of Homes Heated with Gas
29	Percentage of Households Using Fuel Oil
6,725	Average Electrical Energy (kWh) Used for Heating per Household
323	Average Natural Gas Energy (Therms) Used for Heating per Household
834	Typical Household Fuel Oil Use (gallons)
15	Percent Savings of Energy Used for Heating (kWh)
15	Percent Savings of Energy Used for Heating (therms)
15	Percent Savings of Energy Used for Heating (Fuel Oil)
$4,900	Program Cost ($ per home)
48,743	Total Annual Electricity Savings (kWh)
2,853	Total Annual Natural Gas Savings (therms)
5,478	Total Annual Fuel Oil (gallons)
$218	Annual Cost Savings per Household
$32,920	Total Annual Cost Savings

22	Simple Payback (years)

Community

CO2e (metric tons)
99

GHG Emissions:
While low-income earners generally have smaller houses and fewer appliances than higher-income earners, their homes are often older and poorly insulated. Low-income weatherization programs seal cracks around windows and doors, add insulation, and sometimes replace inefficient appliances, reducing energy-use-related GHG emissions and lowering utility bills. There are federal and state programs to provide weatherization assistance (sometimes administered by local governments), but funding is limited and often insufficient for the number of homes requiring retrofitting. There is an opportunity for additional local programs to implement cost-effective energy saving measures that reduce emissions while benefiting low-income individuals and families.[226]

Criteria Air Pollutants:
Improving the energy efficiency of a large housing block can help reduce criteria air pollutants by reducing energy use. Depending on the fuel sources of the local electrical grid, criteria air pollutants may be reduced along with greenhouse gas emissions.[227]

Benefits:
By making improvements to local housing, weatherization programs can increase property values and improve community pride and aesthetics. Helping low-income households save money on bills can help improve residents' quality of life as well as stimulate the local economy by providing residents extra money to spend on education, leisure, or savings. [228]

Co-Benefits

-Lower utility bills

-Improving energy efficiency

-Increase property values

-Stimulate local economy through energy savings for low-income households

Success Stories

-Energy Star Home Performance Program: over 275,000 homes weatherized since 2002, lowering energy bills and improving comfort and indoor air quality.[229]

3. Install Residential Solar Photovoltaic (PV) Energy

Strategy Description:

Solar photovoltaic (PV) energy production harnesses the sun's energy to produce electricity. GHG emissions reductions from this strategy are equal to the emissions that would have been produced if the electricity was supplied through fossil fuel based sources by the local utility because electricity generated from PV systems displaces electricity demand, which would ordinarily be supplied by the local utility. Putting solar panels on city buildings is a good way to increase the visibility of solar energy in the community, while providing clean energy for building use. Contrary to popular belief solar power has been shown to be viable in a wide variety of climates that are not thought of as "sunny". Local governments can borrow money at low interest rates through bond issues, making solar more economical than it is for individuals or businesses. Some cities have combined solar energy with efficiency measures, with the shorter payback period of the efficiency measures helping to pay for the solar.

Many residents or businesses would like to use solar power, but the large up-front cost is an obstacle. Local governments can help overcome this barrier by paying a portion of system costs, offering low-interest loans, or organizing group-buying programs to negotiate lower prices such as the Solarize Madison program in Madison County. These programs are an effective way of combining public and private funds for renewable energy. The New York State Energy Research and Development Authority (NYSERDA) provides incentives for the installation of Solar PV based on system size. Additionally there are state and federal tax credits for residential and commercial Solar PV installations. Educational and technical assistance programs can also promote solar power. Local governments can offer information clearinghouses and connect consumers with solar installers.

An increasingly popular way for a local government to overcome the financial hurdles of installing a photovoltaic system is through the "solar services model" also known as a Power Purchase Agreement (PPA). Through this type of arrangement the owner of a property can provide the space for a power producer to install the system. The property owner then agrees to buy the power produced from that system at a set rate that is competitive with grid electricity. Since the power producer retains ownership of the equipment, there are no installation and maintenance costs to the consumer of the electricity produced. This is particularly attractive to government entities that are unable to take advantage of tax based incentives for renewable energy.

Methodology:

- Number of kW installed: 1065 kW – Broken down into 1,981 owner occupied homes in Town - 561 in Village = 1,420. [230]

- 1,420*25% (typical amount of homes suitable for solar)= 355 homes. Assume 50% (177.5 homes) install 6 kW = **1,065 kW residential solar installed**
- Price of electricity
  - $0.125 per kWh [231]
- Sun hours per day
  - 3 hours [232]
- Community - Residential: Cost of PV installation ($ per kW)
  - $2,000 [233]

Community

1,065	kW of PV Installed

Community

$0.1250	Price of Electricity ($ per kWh)
3.0	Sun Hours per Day
$2,000	Cost of PV installation ($ per kW)
1,166,175	Annual Energy Production (kWh)
$145,772	Annual Cost Savings
15	Simple Payback (years)

Community

CO2e (metric tons)
265

Benefits:

If homeowners installed 1,065 kW of PV, the community would save 265 $MTCO_2e$, saving them $145,772 annually, with a simple payback of 15 years. 1,166,175 kWh of electricity would be generated on average annually.

Co-Benefits

-Renewable energy
-Local energy
-Produces no air pollutants

Home in Danby, NY with 24 solar panels

Success Stories

- This 5,520 W (5.52 kW) grid-connected solar electric (PV, photovoltaic) system was installed as a roof-mounted array of twenty-four (24) SunPower 230 W solar modules mounted on the garage roof.[234]

4. Energy Efficiency Improvements: Residential

Strategy Description:
Several programs in New York offer low annual percentage rates for loans used in home energy efficiency improvements. An Energy Efficient Mortgage (EEM) is a mortgage that credits a home's energy efficiency in the mortgage itself. EEMs give borrowers the opportunity to finance cost-effective, energy-saving measures as part of a single mortgage and stretch debt-to-income qualifying ratios on loans thereby allowing borrowers to qualify for a larger loan amount and a better, more energy-efficient home. [235] [236]

To get an EEM a borrower typically has to have a home energy rater conduct a home energy rating before financing is approved. This rating verifies for the lender that the home is energy-efficient. [237]

EEMs are typically used to purchase a new home that is already energy efficient such as an ENERGY STAR certified home. The term EEM is commonly used to refer to all types of energy mortgages including Energy Improvement Mortgages (EIMs), which are used to purchase existing homes that will have energy efficiency improvements made to them. EIMs allow borrowers to include the cost of energy-efficiency improvements to an existing home in the mortgage without increasing the down payment. EIMs allow the borrower to use the money saved in utility bills to finance energy improvements. Both EEMs and EIMs typically require a home energy rating to provide the lender with the estimated monthly energy savings and the value of the energy efficiency measures — known as the Energy Savings Value. EEMs (and EIMs) are sponsored by federally insured mortgage programs (FHA and VA), and the conventional, secondary mortgage market. Lenders can offer conventional EEMs, FHA EEMs, or VA EEMs.[238]

Conventional EEMs increase the purchasing power of buying an energy efficient home by allowing the lender to increase the borrower's income by a dollar amount equal to the estimated energy savings. While Freddie Mac does not offer EEMS, they do allow underwriting flexibilities for energy efficient improvements with all of their offerings.[239]

FHA Energy Efficient Mortgages:
The mortgage loan amount for an FHA EEM can be increased by the cost of effective energy improvements. The maximum amount of the portion of the EEM for energy efficient improvements is the lesser of 5% of:

- the value of the property, or
- 115% of the median area price of a single family dwelling, or
- 150% of the conforming Freddie Mac limit.

For more information on FHA EEM loan limits refer to FHA Mortgagee Letter 2009-18. No additional down payment is required, and the FHA loan limits won't interfere with the process of obtaining the EEM. FHA EEMs are available for site-built as well as for manufactured homes. Applications for an FHA EEM may be submitted to the local HUD Field Office through an FHA-approved lending institution. HUD has a searchable list of approved lenders. Information about the FHA EEM can be found on FHA's web site. Additional information is available from

HUD's Office of Single Family Housing by calling (800) 569-4287. There is also a fact sheet about FHA's EEM. The Systems Building Research Alliance has information about FHA EEMs for ENERGY STAR certified manufactured homes. [240]

NYSERDA's Home Performance with ENERGY STAR program also offers low-interest financing and a 10% cashback incentive to help homeowners save on the cost of energy upgrades and pay for them without stretching their budget. Additionally, the Green Jobs Green NY (GJGNY) program provides free* comprehensive energy assessments to all 1-4 family households in NYS.

Methodology:

- Number of homes
  - 151 homes (10% of occupied homes in the Town of Cazenovia) [241]
- Price of electricity
  - $0.1250 per kWh [242]
- Price of natural gas
  - $1.30 per therm [243]
- Price of fuel oil
  - $4.22 per gallon [244]
- Typical household electricity use
  - 6,725 kWh [245]
- Typical household natural gas use
  - 323 therms [246]
- Typical household fuel oil use
  - 834 gallons [247]
- Percentage of households using natural gas
  - 39% [248]
- Percentage of households using fuel oil
  - 29% [249]
- Percentage of electricity savings compared to existing code
  - 15%[250]
- Percent natural gas savings compared to existing code
  - 15%[251]
- Percent fuel oil savings compared to existing code
  - 15%[252]
- Retrofit cost per household[253]
  - In New York the average cost of projects ranges from $5,600 to $8,500, so use an average of $7,050[254]
  - NYSERDA offers a 10% cash back incentive when you complete energy efficiency upgrades throughout the Home Performance with ENERGY STAR program [255]
  - $7,050 * 10% = $705; $7,050 - $705 = $6,345

Community

151	Homes Retrofitted

Community

$0.1250	Price of Electricity ($ per kWh)
$1.30	Price of Natural Gas ($ per therm)
$4.22	Price of Fuel Oil ($ per gallon)
6,725	Typical Household Electricity Use (kWh)
323	Typical Household Natural Gas Use (therms)
834	Typical Household Fuel Oil Use (gallons)
39	Percentage of Households Using Natural Gas
29	Percentage of Households Using Fuel Oil
15	Percent Electricity Savings Compared to Existing Code
15	Percent Natural Gas Savings Compared to Existing Code
15	Percent Fuel Oil Savings Compared to Existing Code
$6,345	Retrofit Cost ($ per household)
48,743	Total Annual Electricity Savings (kWh)
2,853	Total Annual Natural Gas Savings (therms)
5,478	Total Annual Fuel Oil Savings (gallons)
$218	Cost Savings per Household
$32,920	Annual Cost Savings
29.1	Simple Payback (years)

Community

CO2e (metric tons)
99

Co-Benefits

-Energy and water cost savings

-Reduced criteria air pollutants by reducing energy use

NYSERDA
New York State Energy Research and Development Authority

Success Stories

-NYSERDA Residential Loan Fund Program- offers loans up to 4% less than typical loans, up to $20,000.[256]

5. Promote Energy conservation through campaigns targeted at Residential homes

Strategy Description:

Educational programs targeted at residents can provide information to residents about energy saving measures they can take in their homes, such as replacing appliances with energy efficient ones, sealing leaks and increasing insulation, or turning the thermostat down in cold weather and up in hot weather. Specifically, the CNY Energy Challenge Team Program teaches participants these and other techniques to reduce household energy usage. The program has seen a 29% reduction in energy usage for participants, thus reducing GHG emissions and energy costs significantly. The NYSERDA Home Performance with ENERGY STAR program provides incentives for 1-4 unit residential properties to improve building energy efficiency. Additionally, the Green Jobs Green NY (GJGNY) program provides free* comprehensive energy assessments to all 1-4 family households in NYS.

It is also recommended that energy efficiency education programs/curriculum be developed for all grade levels in the Cazenovia Central School District to encourage energy efficiency literacy at a young age.

Methodology:

- Assume 10% of resident homes.
  - Total homes (Total- village= Community homes) = 2,484– 970 (Village homes) = 1,514. 10% = 152 homes participating
- There may be costs to the homeowner themselves based on the actions they choose to take because of the program.
  - Current Cost of program set at base→ $0, (per household)
- Price of electricity
  - $0.1250 per kWh [257]
- Price of natural gas
  - $1.30 per therm[258]
- Typical household electricity use
  - 1,514 total homes in 2010 used 16,971,000 kWh electricity total = 11,209 kWh used per home [259]
- Typical household natural gas use
  - 1,514 total homes in 2010 used 801,010 therms total = 539 therms used per home [260]
- Percent Electricity Savings
  - Percent energy savings total = 5%[261]
- Percent natural gas Savings
  - Percent energy savings total = 5%[262]
- Cost of program
  - This program is free for residents to participate. Any other programs after will include a costs are based on actions that homeowners may choose to take. [263]

Community

152	Number of Households Targeted

Community

$0.1250	Price of Electricity ($ per kWh)
$1.30	Price of Natural Gas ($ per therm)
11,209	Typical Household Electricity Use (kWh)
539	Typical Household Natural Gas Use (therms)
5	Percent Electricity Savings
5	Percent Natural Gas Savings
$0	Cost of Program ($ per household)
85,188	Total Annual Electricity Savings (kWh)
4,096	Total Annual Natural Gas Savings (therms)
$105	Annual Cost Savings per Household
$15,974	Total Annual Cost Savings
0.0	Simple Payback (years)

Community

CO2e (metric tons)
42

Benefits:

With 10% of residential homes participating in this program, the annual savings are significant. The total annual energy savings could be 170,377 kwh and 8,193 therms. The program is free to homeowners, and any cost incurred by the homeowner depends on additional steps they choose to take.

Co-Benefits

-Save on electricity bills

Success Stories

-29% savings in pilot study of CNY Energy Challenge Team Program.

6. Equipment Retrofit

Refrigerators: Buy Energy Star refrigerators

Strategy Description

"ENERGY STAR is a partnership between the U.S. Environmental Protection Agency and industry to voluntarily label products that meet certain energy efficiency criteria. ENERGY STAR products include home electronic appliances, office equipment, and light fixtures and bulbs. ENERGY STAR also certifies buildings for energy efficiency and provides energy management strategies for business and government agencies. Switching to efficient refrigerators will have a negligible effect on local air quality as a stand-alone action. However, when efficient refrigerators are purchased as a part of a broader green procurement or energy efficiency program, a significant reduction in electricity and natural gas use can be realized. Communities with fossil fuel power plants within their air shed could contribute to the reduction of criteria air pollutants created from electricity generation through such a program. Refrigerators are usually the single biggest electricity user in a home. This may also be true at the workplace. ENERGY STAR refrigerators use half the energy of those made before 1993, 40% less than refrigerators made in 2001, and 15% less than required by federal regulation in 2007. Local governments can encourage the use of ENERGY STAR refrigerators by providing rebates or paying for older inefficient, refrigerators that are turned in." [264] Incentive/reward program→ provide a cash reward of $100 to get rid of old refrigerator.

Methodology:

- Refrigerators replaced
  - Assume 188[265]
- Price of electricity
  - 0.1250 [266]
- Annual energy savings of one refrigerator
  - 464 kWh [267]
- Cost to purchase refrigerator
  - $900 [268]

Community

188	Refrigerators replaced with ENERGY STAR Refrigerators

Community

$0.1250	Price of Electricity ($ per kWh)
464	Annual Energy Savings of one ENERGY STAR Refrigerator (kWh)
$900	Incremental Cost to Purchase an ENERGY STAR Refrigerator ($)
87,232	Total Annual Energy Savings (kWh)
$10,904	Annual Cost Savings
15.5	Simple Payback (years)

Community

CO2e (metric tons)
20

Printer: Buy Energy Star printers

Strategy Description:
Computer monitors consume large amounts of energy. Energy Star is a partnership between the U.S. Environmental Protection Agency and industry to voluntarily label products that meet certain energy efficiency criteria. Converting to Energy Star computers is a beneficial switch. Energy Star products include home electronic appliances, office equipment, and light fixtures. For example switching to efficient monitors uses 20-60% less energy than other monitors.

Methodology:

- Number of printers replaced
  - Assume 188[269]
- Price of electricity
  - $0.1250 per kWh [270]

188	Printers replaced with ENERGY STAR Printers

$ 0.1250	Price of Electricity ($ per kWh)
33	Percent of Printers < 10 ppm[271]
34	Percent of Printers 10-30 ppm[272]
33	Percent of Printers >30 ppm[273]
229	Annual Energy Savings of one ENERGY STAR Printer <10 ppm (kWh) [274]
316	Annual Energy Savings of one ENERGY STAR Printer 10-30 ppm (kWh) [275]
569	Annual Energy Savings of one ENERGY STAR Printer >30 cpm (kWh) [276]
$10	Incremental Cost to Purchase an ENERGY STAR Printer ($)[277]
69,707	Total Annual Energy Savings (kWh)
$8,713	Annual Cost Savings
0.2	Simple Payback (years)

Community

CO2e (metric tons)
16

Computers: Buy Energy Star computers

Strategy Description:
Computers consume large amounts of energy. Energy Star is a partnership between the U.S. Environmental Protection Agency and industry to voluntarily label products that meet certain energy efficiency criteria. Converting to Energy Star computers is a beneficial switch. Energy Star products include home electronic appliances, office equipment, and light fixtures. For example switching to efficient monitors uses 20-60% less energy than other monitors.

Methodology:

- Number of computers replaced
  - Assume 188[278]
- Price of electricity
  - $0.1250 per kWh [279]
- Annual Energy savings of one computers
  - 61 kWh [280]
- Additional cost to purchase a computers
  - $0 [281]

Community

188	computers replaced with ENERGY STAR computers

Community

$0.1250	Price of Electricity ($ per kWh)
201	Annual Energy Savings of one ENERGY STAR computers (kWh)
$0	Incremental Cost to Purchase an ENERGY STAR computers ($)
37,788	Total Annual Energy Savings (kWh)
$4,724	Annual Cost Savings
0.0	Simple Payback (years)

Community

CO2e (metric tons)
9

Monitors: Buy Energy Star monitors

Strategy Description:
Computer monitors consume large amounts of energy. Energy Star is a partnership between the U.S. Environmental Protection Agency and industry to voluntarily label products that meet certain energy efficiency criteria. Converting to Energy Star computers is a beneficial switch.

Energy Star products include home electronic appliances, office equipment, and light fixtures. For example switching to efficient monitors uses 20-60% less energy than other monitors.

Methodology:

- Number of monitors replaced
  - Assume 188[282]
- Price of electricity
  - $0.1250 per kWh [283]
- Annual Energy savings of one monitor
  - 61 kWh [284]
- Additional cost to purchase a monitor
  - $0 [285]

Community

188	Monitors replaced with ENERGY STAR Monitors

Community

$0.1250	Price of Electricity ($ per kWh)
61	Annual Energy Savings of one ENERGY STAR monitor (kWh)
$0	Incremental Cost to Purchase an ENERGY STAR monitor ($)
11468	Total Annual Energy Savings (kWh)
$1,434	Annual Cost Savings
0.0	Simple Payback (years)

Community

CO2e (metric tons)
3

Co-Benefits

-Utility bill savings

Success Stories

-Between 2007-2009, TIAA-CREF implemented a set of strategic energy management initiatives, including purchasing Energy Star qualified appliances, to more than 40 multifamily properties that reduced its communities' common area energy consumption by 9.1%, leading to energy cost savings of about $500,000 each year. [286]

7. Installing Efficient Toilets and Faucets

Toilets:

Strategy:
Switching to more efficient toilets will have a negligible effect on local air quality as a stand-alone action. When toilets are purchased as a part of a broader water conservation program, a significant reduction in water use can be achieved. Water pumping, purification, and wastewater treatment can represent a large portion of municipal energy use. Communities with fossil fuel power plants within their airshed could contribute to the reduction of criteria air pollutants created from electricity generation through such a program. [287]

Methodology:

- Toilets/urinals replaced- assume 375[288]
- Price of water
  - $0.0025 per gallon[289]
- Gallons per flush saved per toilet
  - 2.2 gallons [290]
- Flushes per toilet per day
  - 10 flushes [291]
- Energy use per gallon of water
  - 0.0054 kWh [292]
- Cost per toilet
  - $448 [293]

Community

375	Toilets or Urinals Replaced

Community

$0.0025	Price of Water ($ per gallon)
2.2	Gallons per Flush Saved per Toilet
10.0	Flushes per Toilet per Day
0.0054	Energy Use per Gallon of Water (kWh)
$448	Cost per Toilet
2,150,893	Total Annual Water Savings (gallons)
11,615	Total Annual Electricity Savings (kWh)
$5,377	Annual Cost Savings
31.2	Simple Payback (years)

Community

CO2e (metric tons)
3

Faucets:

Strategy Description:

"Switching to more efficient faucets will have a negligible effect on local air quality as a stand-alone action. When faucets are purchased as a part of a broader water and energy conservation program, a significant reduction in water use can be achieved. Water pumping, purification, and wastewater treatment can represent a large portion of municipal energy use. Communities with fossil fuel power plants within their air shed could contribute to the reduction of criteria air pollutants created from electricity generation through such a program." [294]

Methodology:

- Faucets replaced - assume 375[295]
- Price of water($ per gallon)
  - $0.0025 per gallon [296]
- Price of Electricity ($ per kWh)
  - $0.1250 per kWh [297]
- Price of Natural Gas ($ per therm)
  - $1.30 per therm[298]
- Annual Water Savings per Faucet
  - 270 [299]
- Percent Hot Water
  - 70%[300]
- Energy Use per Gallon of Water (kWh)
  - 0.0054kWh[301]
- Energy Use to Heat Gallon of Hot Water (kWh)
  - 0.19 kWh[302]
- Energy Use Heat Gallons of Hot Water (Therms)
  - 0.0098 therms[303]
- Percent of Homes with Electric Water Heaters
  - 42%[304]
- Cost Per Faucet
  - $8[305]

Community

375	Faucets Replaced

Community

$0.0025	Price of Water ($ per gallon)
$0.1250	Price of Electricity ($ per kWh)
$1.30	Price of Natural Gas ($ per therm)
270	Annual Water Savings per Faucet
70	Percent Hot Water
0.0054	Energy Use per Gallon of Water (kWh)

0.19	Energy Use to Heat Gallon of Hot Water (kWh)
0.0098	Energy Use to Heat Gallon of Hot Water (therms)
42	Percent of Homes with Electric Water Heaters
$8	Cost per Faucet
101,250	Total Annual Water Savings (gallons)
70,875	Total Annual Hot Water Savings (gallons)
6,203	Total Annual Electricity Savings (kWh)
403	Total Annual Natural Gas Savings (therms)
$1,484	Annual Cost Savings
1.9	Simple Payback (years)

Community

CO2e (metric tons)
4

Lower Bills, with Low-Flow Faucets :

306

Low-flow showerheads and faucets cost $10 and upward, and they can reduce your water use by 30 percent to 50 percent. Resulting savings in water use and hot water heating can be $50 to $90 or more a year, just by installing a couple of water-saving fixtures.

Commercial Energy Use

1. Install Commercial Solar Photovoltaic (PV) Energy (User Defined 1)

Strategy Description:
Solar photovoltaic (PV) energy production harnesses the sun's energy to produce electricity. GHG emissions reductions from this strategy are equal to the emissions that would have been produced if the electricity was supplied through fossil fuel based sources by the local utility because electricity generated from PV systems displaces electricity demand which would ordinarily be supplied by the local utility. Putting solar panels on city buildings is a good way to increase the visibility of solar energy in the community, while providing clean energy for building use. Contrary to popular belief solar power has been shown to be viable in a wide variety of climates that are not thought of as "sunny". Local governments can borrow money at low interest rates through bond issues, making solar more economical than it is for individuals or businesses. Some cities have combined solar energy with efficiency measures, with the shorter payback period of the efficiency measures helping to pay for the solar.

Many residents or businesses would like to use solar power, but the large up-front cost is an obstacle. Local governments can help overcome this barrier by paying a portion of system costs, offering low-interest loans, or organizing group-buying programs to negotiate lower prices such as the Solarize Madison program in Madison County. These programs are an effective way of combining public and private funds for renewable energy. The New York State Energy Research and Development Authority (NYSERDA) provides incentives for the installation of Solar PV based on system size. Additionally there are state and federal tax credits for residential and commercial Solar PV installations. Educational and technical assistance programs can also promote solar power. Local governments can offer information clearinghouses and connect consumers with solar installers.

An increasingly popular way for a local government to overcome the financial hurdles of installing a photovoltaic system is through the "solar services model" also known as a Power Purchase Agreement (PPA). Through this type of arrangement the owner of a property can provide the space for a power producer to install the system. The property owner then agrees to buy the power produced from that system at a set rate that is competitive with grid electricity. Since the power producer retains ownership of the equipment, there are no installation and maintenance costs to the consumer of the electricity produced. This is particularly attractive to government entities that are unable to take advantage of tax based incentives for renewable energy.

Methodology:

- Number of kW installed: 400 kW – Various commercial rooftops in the Town of Cazenovia were analyzed for PV potential, including the Cazenovia Animal Hospital, Dielectric Laboratories, GHD, the New Woodstock Free Library, and the New Woodstock Post Office.[307]
- Price of electricity
  - $0.125 per kWh [308]
- Sun hours per day
  - 3 hours [309]
- Community - Commercial: Cost of PV installation ($ per kW)
  - $1,500 [310]

Commercial

400	kW of PV Installed

Commercial

$0.1250	Price of Electricity ($ per kWh)
3.0	Sun Hours per Day
$1,500	Cost of PV installation ($ per kW)
438,000	Annual Energy Production (kWh)
$54,750	Annual Cost Savings
11	Simple Payback (years)

Commercial

CO2e (metric tons)
99

Benefits:

If the commercial sector installed 400 kW of PV, they would save a combined 99 $MTCO_2e$, saving $54,750 annually, with a simple payback of 11 years. 438,000 kWh of electricity would be generated on average annually.

Co-Benefits

-Renewable energy
-Local energy
-Produces no air pollutants

Solar system in Romulus, NY
Commercial solar system on farm in Romulus, N. System will generate 61 kWh/day.

Success Stories

This 19.2 kW grid-connected solar array of 60 SunPower 320 W solar modules are located on a ground mount system South of the customers large farm barn. This system was installed August 2011. [311]

2. Promote Energy conservation through campaigns targeted at businesses

Strategy Description:

Educational programs targeted at businesses can provide information to business owners about energy saving measures they can take in their businesses, such as replacing appliances with energy efficient ones, sealing leaks and increasing insulation, or turning the thermostat down in cold weather and up in hot weather. These types of educational programs can reduce energy use significantly, therefore reducing GHG emissions.

Methodology:

- Assume 10% of businesses.
  - Total businesses = 231 [312] * 60% (percentage of Town population only [excluding Village population] in total Town population) = 139 businesses total * 10% = 14 businesses participate
- Price of electricity
  - $0.1250 per kWh [313]
- Price of natural gas
  - $1.30 per kWh [314]
- Annual energy savings per business
  - 367 therms [315]
- Annual energy savings per business
  - Use CAPPA info/source – 11,500 kWh assuming 10% savings, 5,750 assuming 5% savings
- Cost of program
  - $1,000 per home[316]

Community

14	Businesses Participating

Community

$0.1250	Price of Electricity ($ per kWh)
$1.30	Price of Natural Gas ($ per therm)
5,750	Annual Energy Savings per Business (kWh)
367	Annual Energy Savings per Business (therms)
$1,000	Cost of Program ($ per business)
80,500	Total Annual Electricity Savings (kWh)
5,138	Total Annual Natural Gas Savings (therms)
$16,742	Annual Cost Savings
0.8	Simple Payback (years)

Community

CO2e (metric tons)
47

Campaign: IDEA: Run an ad showing the percent of wasted energy in the business after hours of operations. This would show the amount of energy they could save, connecting with the lights-out-nights-out policy. Energy efficiency education program targeted at businesses – cost of program: use CAPPA estimates of $1,000 per business costs to business owners will vary depending upon the age and type of building as well as the specific actions taken.

Co-Benefits

-Reductions in energy bills

-Increased comfort in buildings

Success Stories

-Energy Star's Portfolio Manager tool helps commercial buildings track and assess energy and water consumption in existing buildings, identify the best opportunities for improvement, track immediate and cost effective reductions over time and document savings results.[317]

-Flex Your Power (California)- Recognizes businesses showing leadership in energy efficiency and provides information on available incentives and best practices by industry.[318]

3. Power-Down at Night Policy Adoption

Strategy Description:

Many buildings waste a significant amount of energy when lights and other electronics are left on at night when they are not in use. Creating a policy of turning lights and other electronics off throughout buildings at the end of the work day reduces electricity wasted during non-business hours, therefore reducing GHG emissions from buildings and facilities. Lighting is typically the largest electricity user in commercial buildings. A power down at night policy can use a combination of education and technology like timers, power strips, and motion sensors.

Methodology:

- Assume 10% of businesses.
  - 7,474 total square feet of commercial space [319]
    - Assuming 10% of commercial buildings adopt strategy
    - Commercial: 7,474 * 10% = 747 sq. feet space with Power Down at Night Policy
- Price of electricity
  - $0.1250 [320]
- Annual lighting energy use per square foot
  - 6.85kWh [321]
- Percent savings with policy
  - 35% [322]
- Cost of implementation
  - $0.06 per sq. ft. [323]

Commercial

747	Square Feet with Power Down at Night Policy

Commercial

$0.1250	Price of Electricity ($ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
35	Percent Savings With Policy
$0.06	Cost of Implementation ($ per square foot)
1,791	Total Annual Electricity Savings (kWh)
$224	Annual Cost Savings
0.2	Simple Payback (years)

Commercial

CO2e (metric tons)
0.4

Co-Benefits	Success Stories
-Reduces light pollution -Reduces energy bill  	- NYSERDA estimates that power management (turning off underused office equipment or adjusting thermostats, upgrading to energy-efficient equipment, and encouraging changes in employee behavior) can reduce plug load by 40-60%, which would mean a statewide emissions reduction of more than 57,000 tons of CO_2 every year and significant savings on local government energy bills.[324] - Buffalo, NY - A project team found that low-cost/no-cost measures could reduce city government's power consumption by 595,060 kWh annually, saving an estimated $71,000. Measures for city hall include turning off copiers and printers after hours; shortening the period of inactivity before copiers go into "sleep mode" during business hours; reminding staff to shut down personal computers, monitors, and other plug-load equipment during extended daytime absences; replacing inefficient appliances with ENERGY STAR® models; specifying an upcoming new copier lease bid to ensure energy efficient models installed and properly configured.[325] - In 2009, Dunwoody, Georgia implemented a successful “power down” policy, aimed at reducing energy use while buildings are not in use. The municipality found that in order to successfully require businesses and citizens to participate, an ordinance must be constructed.[326]

4. Install Lighting Occupancy Sensors

Strategy Description:

Lighting is typically the largest electricity user in commercial buildings. Lights left on when no one is using them wastes much energy. Installation of lighting occupancy sensors prevent this by using sensors to detect motion in the lighted space and turning lights off if no one is present. Sensors can reduce energy use for lighting by an average of 35%.

Sensors are usually either ultrasonic or infrared. If no motion is detected after a set delay period, the sensor turns off or dims lights. Occupancy sensors are a low-cost way to save energy on lighting, with a typical payback time of less than two years.

More efficient lighting as a stand-alone measure will have a small effect on local air quality, but when efficient lights are purchased as a part of a broader green procurement or energy efficiency program, a significant reduction in electricity use can be realized. Communities with fossil fuel power within their airshed could contribute to the reduction of criteria air pollutants created from electricity generation through such a program.

Methodology:

- Square Feet of Community Occupancy Sensors Installed = 747
  - 7,474 total square feet of commercial space [327]
    - Assuming 10% of commercial buildings adopt strategy
    - Commercial: 7,474 * 10% = 747 sq. feet space installed with occupancy sensors
- Percent Savings with Occupancy Sensors: 35%
  - According to NYSERDA's clean power estimator, an installing lighting occupancy sensors in all government owned municipal buildings save approximately 35% on total energy costs. [328]
- Price of electricity
  - $0.125 per kWh [329]
- Annual Lighting Energy User Per Square Foot (kWh): 6.85 [330]
- Community: Cost of Sensors and Installation ($ per Square Foot)
  - $0.06 [331]

Commercial

747	Square Feet Installed with Occupancy Sensors

Commercial

$0.1250	Price of Electricity ($ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
35	Percent Savings With Occupancy Sensors

$0.06	Cost of Sensors ($ per square foot)
1,791	Total Annual Electricity Savings (kWh)
$224	Annual Cost Savings
0.2	Simple Payback (years)

Commercial

CO2e (metric tons)
0.4

Benefits:

If the government installed lighting occupancy sensors in all of their buildings, the town would save 0.4 $MTCO_2e$, saving the town $224 annually, with a simple payback of 0.2 years.

Co-Benefits

- Security provided by motion sensor lighting

- Work automatically once installed

A typical lighting occupancy sensor

Success Stories

- DeWitt Town Hall installed light sensors in bathrooms, supply rooms, and other rooms where lights might normally be left on.[332]

5. Energy Efficiency Retrofits of Existing Facilities

Strategy Description:
Many of the Town's buildings are not equipped with the most recent energy efficient technologies, causing community members to use more energy than is necessary. Retrofitting existing facilities through measures like replacing appliances with more efficient ones, increasing insulation, and upgrading HVAC systems can greatly improve energy efficiency and therefore reduce emissions from commercial buildings and facilities.

Local governments can encourage these efficiency improvements by offering low or zero interest loans to building owners for improvements. The Energy Improvement Corporation (EIC) was created in NYS to offer PACE (Property Assessed Clean Energy) financing to commercial customers in 2012. EIC is seeking municipalities with lean authority from throughout the state to adopt the PACE model and allow for commercial property owners to finance energy efficiency retrofits through their tax bill.

- **Methodology:**
  - Square feet of facilities retrofitted
    - Assume 4,000 square feet[333]
  - Price of electricity
    - $0.125 per kWh [334]
  - Price of natural gas
    - $1.30 per therm[335]
  - Typical new construction annual energy use per square foot (kWh)
    - 12.5[336]
  - Typical new construction annual energy use per square foot (therms)
    - 0.452[337]
  - Percent electricity savings
    - Assume 25%[338]
  - Percent natural gas savings
    - Assume 25%[339]
  - Retrofit cost ($ per square foor)
    - Assume $5[4]

Community

4,000	Square Foot of Facilities Retrofitted

Community

$ 0.125	Price of Electricity ($ per kWh)
$ 1.30	Price of Natural Gas ($ per therm)
12.5	Typical New Construction Annual Energy Use per Square Foot (kWh)
0.45	Typical New Construction Annual Energy Use per Square Foot (therms)
25	Percent Electricity Savings
25	Percent Natural Gas Savings
$5.00	Retrofit Cost ($ per square foot)

[4] Chris Carrick, CNY RPDB. It is important to note that retrofit costs vary widely depending on the age of the building being retrofitted and the measures being implemented.

12,500	Total Annual Electricity Savings (kWh)
450	Total Annual Natural Gas Savings (therms)
$2,148	Annual Cost Savings
9.3	Simple Payback (years)

Community

CO2e (metric tons)
5

Co-Benefits

-Reductions in energy bills

-Increased comfort in buildings

Success Stories

- The Energy Improvement Corporation (EIC) was created in NYS to offer PACE (Property Assessed Clean Energy) financing to commercial customers in 2012. EIC is seeking municipalities with lean authority from throughout the state to adopt the PACE model and allow for commercial property owners to finance energy efficiency retrofits through their tax bill.[340]

Waste

1. Organics (Kitchen) Composting

Strategy Description:
When organic matter like wood, paper, food ad yard wastes is placed in landfills, it decomposes anaerobically, producing methane. Methane is a greenhouse 21 times as powerful as carbon dioxide. About 12% of municipal solid wastes are food scraps and another 12% is yard waste. Collecting and composting this organic waste prevents the emissions it would have produced in the landfill.

Composting produces fertilizer that can be used for farms or gardens, returning nutrients to the soils that were removed with food production. Composting reduces the volume of material sent to landfills, reducing disposal costs.

While many Town members bring compostable materials to the Town's compost pile, most residents to not return to the pile to pick up compost to utilize in home gardens. It is recommended that the Town investigate ways to increase distribution of compost, such as by providing a truck or trailer-hitch to rent to those community members who do not own a truck or a means of transporting compost. The CAP advisory committee also recommends that the Town and Village look into better ways to collect and transfer food waste to the transfer station, especially from the college and school.

Methodology:

- Waste diverted from landfill (lbs./person/year)
  - Food waste = 18.6% total waste [341]
  - Total waste per person = 0.64 tons [342]
  - 1 ton = 2,000 lbs.
  - Therefore, total waste per person = 0.64 * 2,000 = 1,280 lbs. annually
  - 1,280 lbs. * 18.6%= 238 lbs. food waste per person
  - Assume 25% is composted. 238 lbs.* 25% = 60 lbs. per person per year
- City Population
  - 4,251 [343]

Community

60	Waste Diverted from Landfill (lbs/person/yr)

Community

4,251	City Population

20	Life Cycle Emissions Avoided due to Composting (metric tons CO2e)
1	Annual Methane Emission Avoided from Food Waste (metric tons CO2e)
(384)	Change in kWh Generated from Energy Recovery

Community

CO2e (metric tons)
1

Co-Benefits

-Composting creates fertilizer that can be used for farming or gardens instead of fertilizers derived from fossil fuels

-Reduced cost in fertilizers

-Reduced amount of waste treated in landfills

Amboy Compost Site Aerated Static Pile System

Success Stories

-Amboy Compost Site (Camillus, NY) has effectively composted yard and food waste for several years.[344]

-San Francisco's Mandatory Recycling and Composting Ordinance requires residents to separate their recyclables, compostables, and landfill trash. They hope to produce zero waste by 2020. (CAPPA source)[345]

2. Enhance curbside recycling

Strategy description:
When organic matter like wood, paper, food, and yard wastes is placed in landfills, it decomposes anaerobically, producing methane. Methane is a GHG 21 times more powerful than carbon dioxide. Recycling organic materials, like newspapers, other paper, and cardboard, prevents these emissions. Recycling takes less energy than producing products from raw materials, saving emissions from producing that energy. Recycling also reduces demand for limited natural resources used to manufacture products and can create jobs at recycling facilities.

Methodology:

- Waste diverted from landfill (lbs./person/year)
  - Total waste recycled = 771.60 tons [346]
  - Total population = 7086
  - Recycled water per person 771.60/7086 = 0.11 tons
  - Assume each person recycles 10% each year
  - 1 ton = 2000 lbs.
  - Waste diverted from landfill = 22 lbs/person/year
- City population
  - 4,251[347]
- Percent of recycled material aluminum
  - 1% [348]
- Percent of recycled material plastic
  - 3% [349]
- Percent of recycled material steel
  - 8% [350]
- Percent of recycled material glass
  - 5% [351]
- Percent of recycled material paper
  - 36% [352]
- Percent of recycled material cardboard
  - 36% [353]

Community

22	Waste Diverted from Landfill (lbs./person/yr.)

Community

4,251	City Population
1	Percent of Recycled Material Aluminum
3	Percent of Recycled Material Plastic
8	Percent of Recycled Material Steel
5	Percent of Recycled Material Glass
36	Percent of Recycled Material Paper

36	Percent of Recycled Material Cardboard
7	Life Cycle Emissions Avoided for Aluminum (metric tons CO2e)
2	Life Cycle Emissions Avoided for Plastic (metric tons CO2e)
7	Life Cycle Emissions Avoided for Steel (metric tons CO2e)
1	Life Cycle Emissions Avoided for Glass (metric tons CO2e)
46	Life Cycle Emissions Avoided for Paper (metric tons CO2e)
39	Life Cycle Emissions Avoided for Cardboard (metric tons CO2e)
0	Annual Landfill Methane Emissions Avoided - Paper (metric tons CO2e)
0	Annual Landfill Methane Emissions Avoided - Cardboard (metric tons CO2e)
(148)	Change in kWh Generated from Energy Recovery

Community

CO2e (metric tons)
0.3

3. Expand Yard Compositing

Strategy description:

When organic matter like wood, paper, food and yard wastes is placed in landfills, it decomposes anaerobically, producing methane. Methane is a greenhouse gas 21 times as powerful as carbon dioxide. About 21% of municipal solid waste is food scraps, and another 12% is yard waste. Collection and composting this organic waste preventions the emissions it would have produced in the landfill.

Composting produces fertilizer that can be used for farms or gardens, returning nutrients to the soils that were removed with food production. Composting reduces the volume of material sent to landfills, reducing disposal costs.

Methodology:

- Waste diverted from landfill (lbs./person/yr.)
  - Grass, Leaves, Branches = 7.1% total waste [354]
  - Total waste per person = 0.64 tons [355]
  - 1 ton = 2,000 lbs.
  - Therefore, total waste per person = 0.64 * 2,000 = 1,280 lbs. annually
  - 1,280 lbs. * 7.1% = 91 lbs. yard waste per person
  - Assume 25% is composted. 91 lbs. * 25% = 23 lbs. per person per year
- City Population
  - 4,251 [356]

Community

23	Waste Diverted from Landfill (lbs/person/yr)

Community

4,251	City Population
-26	Life Cycle Emissions due to Composting (metric tons CO2e)
0	Annual Methane Emission Avoided from Yard Waste (metric tons CO2e)
-79	Change in kWh Generated from Energy Recovery

Community

CO2e (metric tons)
0.1

Co-Benefits

-Composting creates fertilizer that can be used for farming or gardens instead of fertilizers derived from fossil fuels

-Reduced cost in fertilizers

-Reduced amount of waste treated in landfills

Amboy Compost Site Aerated Static Pile System

Success Stories

-Amboy Compost Site (Camillus, NY) has effectively composted yard and food waste for several years.[357]

-San Francisco's Mandatory Recycling and Composting Ordinance requires residents to separate their recyclables, compostables, and landfill trash. They hope to produce zero waste by 2020. (CAPPA source)[358]

4. Additional Information on Waste Management

Municipal Waste Service Collection

Recommendation:

The environmental impacts of waste are far-reaching. In addition to affecting soil, water and air quality, waste management practices have impacts on energy consumption. Improper waste management also increases greenhouse gas (GHG) emissions, which contribute to climate change. In 2003, the United States generated just over 236 million tons of municipal solid waste (MSW) (EPA, 2002)[359]. If this waste was managed with energy implications in mind, significant energy savings could be achieved. Therefore, planning for and implementing a comprehensive program for waste collection, transport, and disposal—along with activities to prevent or recycle waste—can eliminate these problems.

The town of Cazenovia has a population of 4,251 (Census Report, 2010)[360] and generates 1,370.87 tons of waste a year (Madison County Landfill report, 2011)[361]. There are several programs that have been established by Cazenovia for waste management, such as *recycling* (771.60 tons), *yard and kitchen composting* (less than 1% of the total waste is diverted for composting) and *Pay as You Throw Program*. The remaining waste is sent to the Madison County Landfill for ultimate disposal. Waste management programs therefore reduce the volume of waste that has to be transported to the landfill.

The Town does not currently have a municipal waste collection service. The residents have to drive to the transfer station for their waste disposal or contract private haulers. This results in high GHG emissions due to the vehicle miles travelled by each person and by private haulers disposing of solid waste.

A possible solution to this problem is for the Town to implement Integrated Solid Waste Management (ISWM). Effective ISWM considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment (EPA, 2002)[362]. Part of the solution can focus on collection and transportation services.

To increase the efficiency of waste collection services and reduce costs, it is important to reduce the frequency of collection, which can be possible in Cazenovia by reducing trips by personal vehicles and private haulers. This is crucial because almost 4% (9.8 million tons) of the New York's State GHG emissions are primarily from transportation and handling of solid waste (DEC, 2011)[363].

Agriculture

General information about farms in Cazenovia [364]

- Agriculture Environmental Management (AEM) is an incentive-based program that helps farmers make cost-effective and science-based decisions to meet business objectives while protecting and conserving natural resources.

  AEM is administered by the county Soil and Water Districts (SWCD). Over 12,000 farms in NYS participate in the program, including farmers in Cazenovia (approximately 50% of farms in Cazenovia participate in the AEM program). AEM is a partnership of farmers, SWCD, local, state and federal agencies, and the private sector that focus on conservation farming. Through AEM, the SWCD works with the agricultural community to develop science-based "Comprehensive Nutrient Management Plans" that are designed to control runoff, conserve soil, and recycle nutrients. SWCD and the farming community have recently expanded the AEM program to include projects that produce renewable energy and reduce greenhouse gas emissions.[365]

  All types and sizes of farms participate in the AEM program throughout NYS, ranging from farms with 4 horses to farms with 700-800 cows. In Cazenovia, a wide variety of sizes and types of farms also participate in the program.

- Farmers in Cazenovia participate in the following conservation activities:
  - Nutrient management
  - Prescribed grazing
  - Animal waste structures (manure storages, etc.)
  - Riparian buffers
  - Conservation tillage (minimum till, no-till) – reduce GHG emissions
  - EQIP (environmental quality incentives program)
  - Wetland protections/abatements
  - CAFO regulations (many farms in S. Cazenovia in Susquehanna/Chesapeake Bay watershed

- Gianforte farm has wind installation, Critz Farm has solar installation

1. **Information item: Investigate Various Soil Management Practices**

Strategy Description:
Soil management practices, such as conservation tilling or no-till practices, manure application, and cover cropping, have the potential to reduce GHG emissions caused by agriculture. These practices allow additional carbon to be stored in the soil instead of released into the atmosphere as carbon dioxide, and "if proper soil management is not maintained, all of the additional organic carbon sequestered in the soil will be released back into the atmosphere as carbon dioxide." [366]

Tilling agricultural land turns soil over, releasing carbon stored in the soil into the atmosphere. Reducing tillage practices can therefore reduce the amount of carbon released from the ground into the atmosphere as carbon dioxide. Reduced tillage also eliminates the number of tractor passes through fields by over 50%, therefore reducing emissions from farm vehicles as well.[367]

Manure application reduces the need for synthetic fertilizer use, therefore reducing the amount of GHG emissions caused by the application of the fertilizers (nitrous oxide emissions).

Cover cropping increases soil fertility by increasing amount of carbon and nitrogen stored in the soil. Therefore, cover cropping reduces the amount of carbon released into the atmosphere as carbon dioxide and GHG emissions caused by the application of synthetic fertilizers.

Cazenovia College already recycles horse manure from their Equine facility through a third party so that the horse manure can be used to benefit agricultural soils.

- **Benefits / Case Study**
  - Based on US average crop inputs, no-till emitted less CO_2 from agricultural operations than did conventional tillage, with 137 and 168 kg C ha−1 per year, respectively. Changing from conventional tillage to no-till is therefore estimated to both enhance C sequestration and decrease CO_2 emissions[368]
  - According to a 2009 California agricultural study conducted by the University of California, "The emissions reductions due to winter cover cropping, manure application or conservation tillage alone were modest and between −0.2 and −0.6 (metric ton carbon dioxide equivalents per acre per year (MtCO2e/acre/yr) or −0.5 and −1.4 metric tons carbon dioxide equivalents per hectare per year (MtCO2e/ha/yr). However, by combining these individual practices, larger emissions reductions are possible. Most markedly, combining manure application with winter cover cropping seems to be an efficient option for curbing greenhouse-gas emissions. Although combining all three alternative practices has the greatest potential, this does not seem feasible from a farmer's practical standpoint. Excluding this option, potential reductions in greenhouse-gas emissions ranged from −0.28 to −1.05 MtCO2e/acre/yr (−0.7 to −2.6 MtCO2e/ha/yr) for the Sacramento Valley, and from −0.2 to −0.77 MtCO2e/acre/yr (− 0.5 to −1.9 MtCO2e/ha/yr) for the San Joaquin Valley."[369]
- **Co-Benefits**
  - Reduced tillage equipment usage reduces fuel costs
  - Reduces reliance on foreign fuels

- Reduces synthetic fertilizer costs
- Cover crops like legumes can be used as forage or sold for profit
- Enhanced soil productivity
- Cover crops reduce wind and water erosion and farmstead run-off

HOWEVER: According to some studies, there is no clear scientific evidence confirming whether or to what extent no-till stimulates carbon sequestration in agricultural soils globally.[370]

2. **Information item: Investigate Nitrogen Management Practices**

Nationwide, agricultural activities are the single largest source of all nitrous oxide (N_2O) emissions, contributing almost 68% of all N_2O.[371]

Strategy Description:
Many agricultural practices, such as the application of synthetic fertilizers, emit nitrous oxide, a greenhouse gas. There are, however, many techniques that can be utilized to reduce nitrous oxide emissions from farms, such as:

1. Changes in the timing and method of fertilizer application,[372] for example using split applications or soil injections[373] - allows nitrogen to be absorbed by plants with less Nitrogen wasted into the atmosphere[374]
2. Conservation Tillage – reduces nitrogen run-off, therefore reducing nitrogen application load[375]
3. Crop rotations – increase soil fertility without the need for synthetic fertilizers[376]
4. Take credit for nitrogen applied as manure, irrigation water, atmospheric decomposition, and fixed by legumes in rotation[377]
5. Soil testing – determines plant nitrogen, residual soil, and water so that crop inputs are minimized[378]
6. Conservation buffers – reduces run-off and nitrous oxide emissions as nitrogen is taken up by buffer vegetation[379]

- **Benefits / Case-Study**
    - US Conservation Reserve Program (CRP): Administered by the Farm Service Agency with the goal of re-establishing valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. [380] The CRP encourages practices such as vegetative buffers and filter strips to achieve these goals. In 2011, CRP resulted in the equivalent of a 51 million metric ton net reduction in carbon dioxide from CO2 sequestration, reduced fuel use, and nitrous oxide emissions avoided from not applying fertilizer.[381]
- **Co-Benefits**
    - Reduced water loss
    - Reduced water pollution from agricultural run-off
    - Reduced fertilizer costs
    - Increases wildlife habitat
    - Enhances soil productivity

3. **Information Item: Agricultural Strategies from Town of Cazenovia Agricultural & Farmland Protection Plan, p. 53**[382]

"**Sustainable Energy Opportunities**

Some farm operations and related businesses may benefit from the installation of wind, solar, biomass, or anaerobic digesters to replace conventional sources of energy. The use of sustainable energy sources has the potential to reduce long-range energy costs and lower greenhouse gas emissions.

- Agriculture/Renewable Energy Park in Lincoln intended to support renewable energy as well as agricultural processing projects, including the use of methane gas to generate electricity for an on-site business. The proposed Johnson Brothers Lumber project would utilize heat generated from the methane at the landfill to dry lumber. A greenhouse is another potential use of the methane gas.
- Cellulosic ethanol – demonstration farm in Nelson operated by Morrisville College
- Solar panels funded by USDA Rural Energy Assistance Program grant
- Wind energy for on-site use
- Anaerobic digesters can convert manure into electricity
- New net-metering legislation allows energy producers to sell excess electricity to the utility
    - USDA REAP, NYSERDA grants
    - Morrisville demonstration projects
    - Agriculture/Energy Park in Lincoln"

4. **Information Item: Agricultural Strategies and Funding Information from the New York Agricultural Landowner Guide (Appendix F to Town of Cazenovia Agricultural & Farmland Protection Plan)** [383]

- List of financial incentives and programs to help farmers tap into new energy opportunities (page 17), and descriptions of each program in the pages that follow.
    - Examples of emissions reduction strategies that may be funded:
        - producing biomass
        - participation in environmental services markets
        - on-farm renewable energy production
        - installation of anaerobic digester gas-to-electricity systems

Natural Resources

1. Increase Urban Forest

Strategy Description:
This measure considers the effects that trees have in reducing the urban heat island effect, and in extracting CO2 from the air. All trees newly planted in an urban area should be reported in this measure. Trees planted to shade buildings can also directly decrease the energy use of those buildings, and should be reported in the measure *Plant Trees to Shade Buildings*, as well as in this measure[384].

In the past year alone, Cazenovia College planted 41 trees, which if kept consistent could increase potential for tree planting in the Town/Village.

Methodology:

- Number of trees planted
  - 1,514 homes * 50% = 757 trees.
- Price of electricity
  - $0.1250 [385]
- Annual energy savings of one tree
  - An average tree conserves 435–483 kWh of electricity over 25 years post planting [386]
  - Avg. of 435 and 483 = 459 kWh over 25 years
  - 459 / 25 = 18.36 kWh per tree per year
- Annual CO2 absorbed by one mature tree
  - A single mature tree can absorb carbon dioxide at a rate of 48 lbs./year [387]
  - 1 pound = 0.00045359237 metric tons [388]
  - Annual CO_2 absorbed by one mature tree = .02177243376 metric tons
  - ~ .022 metric tons
- Cost of planting tree
  - $11 [389]

Community

757	Trees Planted

Community

$0.1250	Price of Electricity ($ per kWh)
18.36	Annual Energy Savings of one Tree (kWh)
0.22	Annual CO2 Absorbed by one Mature Tree (metric tons)
$11	Cost of Planting Tree
13,899	Total Annual Energy Savings (kWh)

$1,737	Annual Cost Savings
5	Simple Payback (years)

Community

CO2e (metric tons)
170

Benefits:

Trees also reduce storm water runoff, create a more attractive environment, and increase property values. Studies have found that access to trees and natural environments can improve mental and physical health, improve job productivity and reduce crime.

Co-Benefits

-Save on energy bills

-Can reduce storm water runoff

-Can create more attractive environment, increasing property values

A well shaded home, according to the Arbor Day Foundation website.

Success Stories

-The Arbor Day Foundation provides information on its website explaining how to plant trees to conserve energy most effectively.[390]

Reduction Summaries

Government

Measure	CO_2e (metric tons)	% towards goal
Geothermal Heating	98	104.48%
Use Solar Photovoltaic (PV) Energy	46	40.35%
Energy Efficiency Retrofits of Existing Facilites	24	21.05%
Fleet Conversion to Biodiesel	16	14.04%
Lighting Occupancy Sensors	7	3.67%
Power Down at Night Policy	7	3.67%
Indoor Lighting Retrofits	6	3.14%
Energy Efficient Appliances	1	1.16%
Water Saving Faucets and Toilets	0.3	0.15%
Total	206	
Base Year Emissions (2010)	469	
Potential Emissions with Strategy Implementation (2025)	264	
% Reductions from Base Year based on Strategy Implementation Only	43.8%	

Community

Measure	CO_2e (metric tons)	% towards goal
Electric Vehicles	1,586	109.43%
Conversion to higher efficiency vehicles	1,243	85.74%
Geothermal	839	57.87%
Promote telecommuting	827	57.05%
Residential Solar	265	18.27%
Bicycling Paths and Facilities	211	14.59%
Walking Friendly Environments	177	12.18%
Increase Urban Forest	170	11.71%
Home Weatherization	99	6.86%
Loans for energy efficiency retrofits	99	6.86%
Commercial Solar	99	6.86%
Promote Carpooling/Vanpooling	93	6.43%
Energy Efficiency Education: Businesses	47	3.25%
Energy Efficiency Education: Residents	42	2.92%
Electric Vehicle Charging Stations	24	1.66%
Energy Efficient Refrigerators	20	1.37%%

Energy Efficient printers	16	1.09%
Energy Efficient Computers	9	0.59%
Commercial retrofits	5	0.37%
Energy efficient faucets	4	0.25%
Energy efficient monitors	3	0.18%
High Efficiency Toilets	3	0.07%
Organics Composting	1	0.05%
Power Down at Night Policy	0.4	0.03%
Lighting Occupancy Sensors	0.4	0.03%
Establish/Expand Curbside Recycling Programs	0.3	0.02%
Yard Waste Composting	0.1	0.01%
Total	5,883	
Base Year Emissions (2010)	41,092	
Potential Emissions with Strategy Implementation (2025)	35,209	
% Reductions from Base Year based on Strategy Implementation Only	14.3%	

CAFE Standards Emissions Reduction Calculations

Description: New Federal CAFE Standards
The U.S. Congress first enacted Corporate Average Fuel Economy (CAFE) standards in 1975 to reduce energy consumption by increasing the fuel economy of cars and light trucks. In 2011 the United States Environmental Protection Agency (US EPA) and The National Highway Traffic Safety Administration (NHTSA) established new fuel efficiency standards for passenger vehicles to average 34.1 miles per gallon by 2016. NHTSA issued finalized standards for model years 2017 – 2025 in 2012 that will increase fuel economy to the equivalent of 54.5 mpg for cars and light-duty trucks. It is anticipation that U.S. oil consumption with decrease by 12 billion barrels by 2025, saving more than $1.7 trillion dollars.[391] These changes at the national level will impact vehicle-based emissions within the Town, as such the analysis team has attempted to identify the potential impacts of improved fuel economy. The NHTSA has also mandated improvements in medium and heavy-duty vehicle fuel efficiencies; however, we do not have enough information at this time to calculate the emissions reductions that will occur due to these standards.

- **Methodology:**
  - CAPPA tab "Use Smaller Fleet Vehicles"

- Government: 2025
  - Assume no vehicles are replaced by 2016 because all 3 government gasoline-powered vehicles were purchased in 2013 or 2014. Assume all are replaced by 2025.

3	Number of Smaller Vehicles Used

$3.14	Price of Gasoline ($ per gallon)[392]
54.5	Small Vehicle Miles per Gallon
12.3	Miles per Gallon of Vehicle Replaced[393]
15,000	Average Annual Miles per gasoline-powered Vehicle
2,833	Annual Gasoline Savings (gallons)
$8,895	Annual Cost Savings

CO2e (metric tons)
27

- Community: 2016

- Americans keep cars an average of 11.4 years[394], so assume by 2016 half of the Village's passenger vehicles have been changed over since the 2010 inventory.

1,533	Number of Smaller Vehicles Used[395]

$3.463	Price of Gasoline ($ per gallon) [396]
34.1	Small Vehicle Miles per Gallon[397]
23.5	Miles per Gallon of Vehicle Replaced[398]
8,610	Average Annual Miles per Vehicle[399]
174,594	Annual Gasoline Savings (gallons)
$604,618	Annual Cost Savings

CO2e (metric tons)
1,643

- Community: 2025
  - Assume the other half of community vehicles are replaced by 2025.

1,533	Number of Smaller Vehicles Used

$3.463	Price of Gasoline ($ per gallon) [400]
54.5	Small Vehicle Miles per Gallon[401]
23.5	Miles per Gallon of Vehicle Replaced[402]
8,610	Average Annual Miles per Vehicle[403]
319,479	Annual Gasoline Savings (gallons)
$1,106,357	Annual Cost Savings

CO2e (metric tons)
3,007

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[2] US Energy Information Administration
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[14] National Grid, 2012 data from GHG Inventory Report
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[23] c2ip_programadministration_2012_Revised_no_cayuga_CC_5-24-13 excel sheet saved in CNY RPDB Y drive
[24] CAPPA description; Energy efficiency retrofits of existing facilities tab
[25] Crovella, Paul. Lecture notes; Building Efficiency. 8 Nov. 2013.
[26] 2010 Census; Town of Cazenovia Government Facilities
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[29] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
[30] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
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[53] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
[54] CAPPA Input
[55] CAPPA Input
[56] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
[57] CAPPA Input
[58] CAPPA Input
[59] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
[60] CAPPA Input
[61] CAPPA Input

[62] CAPPA Input
[63] CAPPA Input
[64] CAPPA Input
[65] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[66] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
[67] Town energy information provided by Tim Hunt, Town of Cazenovia Highway Superintendent
[68] CAPPA Input
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[83] Phil Hoffmyer
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[133] Interview: Annie McClelland of CCE
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[142] Interview: Annie McClelland of CCE
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[144] Tim Hunt; Town of Cazenovia Highway Superintendent
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[162] [162] Price of Gasoline from US Energy Information Administration
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[163] According to Edmunds.com, a 2013 Hyundai Elandra gets 28 mpg city, 38 mpg highway. Average=30 mpg.
[164] Assume these vehicles are SUVs or pick-ups; according to Edmunds.com, a 2013 Ford F-150 regular cab gets 17mpg city and 23 mpg highway. Average=20 mpg.
[165] 2010 GHG Inventory Report
[166] According to Edmunds.com, 2013 Hyundai Elantra = $17,760 MSRP vs 2013 Ford F-150 = $25,065 MSRP
[167] Assuming 1/3 of VMT is through traffic that does not begin or end in Cazenovia
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http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r10_w.htm
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[211] NYSERDA; CNY home heating oil pricing
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[213] 2010 Census Data
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[215] 2010 Census; 2010 National Grid data
[216] 2010 Census Data
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[221] According to Todd Rogers, ETS, weatherization and retrofit strategies should not exceed 30% energy savings.
[222] According to Todd Rogers, ETS, weatherization and retrofit strategies should not exceed 30% energy savings.
[223] According to Todd Rogers, ETS, weatherization and retrofit strategies should not exceed 30% energy savings.

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[225] http://oversight.house.gov/wp-content/uploads/2012/04/Corrected-Weatherization-Report-Final-2.pdf p.8
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[240] Energystar; home efficiency loans
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[242] Upstate NY average
[243] Upstate NY average
[244] NYSERDA CNY fuel oil data
[245] 2010 Census Data
[246] 2010 Census Data
[247] 2010 Census Data
[248] 2010 Census Data
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[252] According to Todd Rogers, ETS, weatherization and retrofit strategies should not exceed 30% energy savings.
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[257] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[258] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[259] 2010 Census; 2010 National Grid data
[260] 2010 Census; 2010 National Grid data
[261] According to Todd Rogers, ETS
[262] According to Todd Rogers, ETS
[263] CAPPA Input
[264] Used CAPPA description, Section Energy Efficient Refrigerators
[265] Assume 1,200 appliance between the Town and Village total; assume 752 Town and 448 Village; assume 188 of each appliance to Town and 112 of each for Village.
[266] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[267] CAPPA Input
[268] http://www.lowes.com/pd_488403-2251FFHS2611PF_4294857973__?productId=4752221&Ns=p_product_qty_sales_dollar|1&pl=1&currentURL=%3FgoToProdList%3Dtrue%26Ns%3Dp_product_qty_sales_dollar%7C1&facetInfo

[269] Assume 1,200 appliance between the Town and Village total; assume 752 Town and 448 Village; assume 188 of each appliance to Town and 112 of each for Village.
[270] Similar CAPPA Inputs Sheet (Location Dropbox Folder)

[271] CAPPA input
[272] CAPPA input
[273] CAPPA input
[274] CAPPA input
[275] CAPPA input
[276] CAPPA input
[277] CAPPA input
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[279] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
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[283] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[284] CAPPA Input
[285] CAPPA Input
[286] http://www.energystar.gov/ia/business/multifam_housing/TIAA-CREF_MF_Housing_Case_Study.pdf
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[288] Assume 1200 toilets/faucets total between Town and Village, assume 750 total in Town, assume 375 of each.
[289] Similar CAPPA Inputs Sheet (Locations Dropbox Folder)
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[292] CAPPA Input
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[294] CAPPA Input
[295] Assume 1200 toilets/faucets total between Town and Village, assume 750 total in Town, assume 375 of each.
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[297] Similar CAPPA input Sheet (Location Dropbox Folder)
[298] Similar CAPPA Input sheet (location Dropbox Folder)
[299] CAPPA Input
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[301] CAPPA Input
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[305] CAPPA Input
[306] http://www.hgtvremodels.com/interiors/low-flow-faucets/index.html
[307] Assuming a 1 kW system requires about 400 square feet of roof space (Chris Carrick, CNY RPDB) and using http://www.daftlogic.com/projects-google-maps-area-calculator-tool.htm.
[308] National Grid Upstate NY Average
[309] New York State Energy Research and Development Authority. 2011. Clean Power Estimator. Accessed 2014 at: http://nyserda.cleanpowerestimator.com/nyserda.htm. There is a 1218 multiplicative factor between kW installed and annual kWh output (calculated from the results of the NYSERDA Clean Power estimator, which when divided by 365 days per year, is the equivalent of 3.34 capturable sun hours per day. Assuming 10% losses in the equipment, this drops the deliverable sun hours per day to 3.0
[310] Chris Carrick: CNY RPDB; This is the price at which it would make sense for commercial businesses to install solar PV.
[311] http://www.halcoenergy.com/about-us/case-studies/801-192-kw-farm-solar-electric-system-in-romulus-ny.html
[312] 2007 economic census
[313] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[314] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[315] CAPPA Input
[316] CAPPA Input
[317] http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager?c=evaluate_performance.bus_portfoliomanager
[318] http://www.fypower.org/com/
[319] (source: 5.4 square feet per worker in NYS according to EIA's CBECS Table B1; total number of nonfarm workers in Madison County=23,911 according to NYS DOL; 129,119 total commercial floor space in Madison County; Town of Cazenovia

population = 5.79% of total county population; therefore 129,119*5.79%=7,474 square feet commercial space in Town of Cazenovia)
[320] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[321] CAPPA Input
[322] CAPPA Input
[323] CAPPA Input
[324] http://www.dec.ny.gov/energy/64089.html
[325] http://www.dec.ny.gov/energy/64095.html
[326] www.dunwoodyga.com/Libraries/Sustainability
[327] (source: 5.4 square feet per worker in NYS according to EIA's CBECS Table B1; total number of nonfarm workers in Madison County=23,911 according to NYS DOL; 129,119 total commercial floor space in Madison County; Town of Cazenovia population = 5.79% of total county population; therefore 129,119*5.79%=7,474 square feet commercial space in Town of Cazenovia)
[328] New York State Energy Research and Development Authority. 2011. Clean Power Estimator. Accessed 2014 at: http://nyserda.cleanpowerestimator.com/nyserda.htm.
[329] National Grid Upstate NY Average
[330] CAPPA Input
[331] CAPPA Input
[332] Town of DeWitt. 2012. Local Government and Community Greenhouse Gas Emissions Inventory and Analysis:2008 Baseline
[333] Figure decided on by advisory committee
[334] National Grid Upstate NY Average
[335] Similar CAPPA Inputs Sheet (Location Dropbox Folder)
[336] Energy Information Administration. 2003. Commercial Building Energy Consumption Survey (CBECS). End Use Consmumption Tables for All Buildings. http://www.eia.gov/consumption/commercial/data/2003/index.cfm?view=consumption#e1a
[337] Energy Information Administration. 2003. Commercial Building Energy Consumption Survey (CBECS). End Use Consmumption Tables for All Buildings. http://www.eia.gov/consumption/commercial/data/2003/index.cfm?view=consumption#e1a
[338] www.eetd.lbl.gov/news/article/48634/savings-70-percent-or-more-of-energy-use
[339] www.eetd.lbl.gov/news/article/48634/savings-70-percent-or-more-of-energy-use
[340] http://pacenow.org/about-pace/commercial-pace-programs/
[1]1 ICLEI Solid Waste Emission Activities, Appendix E, p. 32
[342] Madison County Landfill 2010 annual report
[343] Census Report, 2010
[344] https://ocrra.org/news/details/38
[345] http://www.sfenvironment.org/zero-waste/recycling-and-composting?ssi=3&ti=6
[346] Madison County Landfill 2010 annual report
[347] Census Report, 2010
[348] CAPPA Input
[349] CAPPA Input
[350] CAPPA Input
[351] CAPPA Input
[352] CAPPA Input
[353] CAPPA Input
[354] ICLEI Solid Waste Emission Activities, Appendix E, p. 32
[355] Madison County Landfill 2010 annual report
[356] Census Report, 2010
[357] https://ocrra.org/news/details/38
[358] http://www.sfenvironment.org/zero-waste/recycling-and-composting?ssi=3&ti=6
[359] www.epa.gov/globalwarming
[360] Census Report, 2010
[361] Madison County Landfill 2010 annual report
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[364] Information provided by Steve Lorraine, Madison County SWCD and Judy Gianforte, Cazenovia Preservation Foundation
[365] http://www.nys-soilandwater.org/aem/
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[385] Upstate NY average
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[391] Press Release: National Highway Transportation Safety Administration. Obama Administration Finalizes Historic 54.5 mpg Fuel Efficiency Standards. August 28, 2012
http://www.nhtsa.gov/About+NHTSA/Press+Releases/2012/Obama+Administration+Finalizes+Historic+54.5+mpg+Fuel+Efficiency+Standards
[392] 2012 fuel costs provided by Tim Hunt, Town Highway Superintendent
[393] Vehicle information provided by Tim Hunt, Town Highway Superintendent
[394] http://www.huffingtonpost.com/reno-charlton/american-drivers-keeping-_b_3718301.html
[395] 4,530 total vehicles in Town – 1,464 total vehicles in Village = 3,066 total vehicles in Town (2010 census); assume 50% = 1,533
[396] EIA, East coast fuel costs
[397] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html
[398] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html
[399] Total community VMT in baseline year: 39,703,390 – 105,000 (government VMT) = 39,598,390 community miles total. Assume 1/3 of miles are through traffic (do not begin or end in Town). 39,598,390*(2/3)= 26,398,927 / 3,066 vehicles in Town = 8,610 annual miles per vehicle
[400] EIA, East coast fuel costs
[401] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html
[402] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html
[403] Total community VMT in baseline year: 39,703,390 – 105,000 (government VMT) = 39,598,390 community miles total. Assume 1/3 of miles are through traffic (do not begin or end in Town). 39,598,390*(2/3)= 26,398,927 / 3,066 vehicles in Town = 8,610 annual miles per vehicle