Sustainable Bethlehem

BETHLEHEM, NEW YORK

Sustainable Bethlehem Program

Since 2009, when the Town adopted the New York State Climate Smart Communities Pledge, Bethlehem has been working towards improving energy efficiency and becoming a more sustainable community. The Town now has an active bicycle and pedestrian committee (PaTHs 4 Bethlehem) and is moving forward on improving its bicycle and pedestrian infrastructure. Many energy efficiency improvements to the Town's facilities have already been made; even more have been identified and will be executed in the near future. The Town has completed a greenhouse gas emissions inventory and has participated in staff energy trainings. Bethlehem has also undergone an energy and land use review in order to identify sustainable development opportunities. These efforts, in addition to others, have come to together under Sustainable Bethlehem.

This CD represents the result of the work completed for Bethlehem by VHB Engineering, Surveying and Landscape Architecture, P.C. (VHB) under a contract with Bethlehem for Energy Management, Greenhouse Gas Emissions Inventory, and Bicycle/Pedestrian Program Initiatives. With the help from VHB, the Town established Sustainable Bethlehem as a means to pull all of their sustainability related initiatives under one comprehensive effort. The goal is for the overall program to perpetuate beyond existing efforts and personnel. The CD includes digital copies of the documents presented to Town in the Sustainable Bethlehem Binder, as well as supporting documents, tools and data. Town staff will now be able to access these documents and continue to carry the initiative to the next stage, whatever that may be.

Sustainable Bethlehem

BETHLEHEM, NEW YORK

Sustainable Bethlehem Program

CD Contents

CD Contents (continued)

Full Report

Methodology

Inventory Spreadsheets

Data Calculation Workbooks

- Community
- Government

Raw Data

- Community
- Government

Energy Project Prioritization

List of Key Facilities

Final Report

Bicycle and Pedestrian Program

PaTHs 4 Bethlehem Committee Vision, Mission, Goals

Bicycle Education and Outreach

- Brochure PDF and Supporting Files
  - Brochure PDF
  - Brochure Word Doc
  - Brochure InDesign file
  - Supporting Files
- Bicycle Month Event Preparation Guide
- Annual Event Calendar

Walk and Bicycle Friendly Applications

- League of American Bicyclists Bicycle Friendly Community
  - League of American Bicyclists Bicycle Friendly Community Application, Spring 2012
  - Bicycle Friendly Community Scoring Guidelines for Local Reviewers Spring 2012
- Walk Friendly Communities
  - Walk Friendly Communities Application
  - Walk Friendly Community Assessment Tool Nov 2011
- Route Plans and Proposals
  - Delmar Pilot Bicycle Route
  - Glenmont Pilot Bicycle Route
  - Delaware Avenue Sharrows NYSDOT Proposal

CD Contents (continued)

Bicycle Prioritization Projects with Linear Foot Costs

- Bicycle Improvement Unit Costs
- Sidewalk Improvement Unit Costs
- Potential Bicycle Project Costs
- Bicycle Project Score Sheet
- Pedestrian Project Score Sheet

Operations and Maintenance Guides

- Bicycle and Pedestrian Annual Operations Budget Recommendations
- Bicycle and Pedestrian Budget and Funding Spreadsheets
- Bicycle and Pedestrian Infrastructure Maintenance Manual
- Bicycle and Pedestrian Infrastructure Maintenance Manual

Community Workshop on the Benefits of a Walkable & Bikeable Community

- Meeting Agenda
- Presentation with Keypad Polling Results
- Community Workshop Small Group Discussion Notes and Keypad Polling Raw Data

Greenhouse Gas Emissions Reduction from Proposed On-Street Bikeways

Energy and Land Use Review

Recommendations Report

Appendices

- A -Summary Matrix of Best Practices
- B, C & D

Public Awareness and Communications Strategy

Sustainable Bethlehem Goals

Sustainable Bethlehem Website Content

Sustainable Bethlehem

Sustainable Bethlehem Program

Vision for the Town of Bethlehem (from Comp Plan)

> *__In the Year 2020__, *the Town of Bethlehem is a community of attractive residential neighborhoods, vibrant hamlets, successful mixed-use commercial centers, modern industrial facilities, and productive rural lands. These are well connected by regional highways and local streets, adequately serviced by public transportation, and linked by a network of sidewalks and trails. Situated at the heart of the Capital District, Bethlehem offers convenient access to all that the region has to offer. It is recognized for the excellence of its schools, the quality of its public safety and community services, the abundance of its recreational opportunities, the productivity of its local businesses, ten miles of Hudson River waterfront, and the beauty and health of its natural environment. This exceptional quality of life contributes to the economic growth and prosperity of the town and the region, assuring that the community can continue to meet the increasingly diverse needs and expectations of its residents in a fiscally sustainable manner.*

Sustainable Bethlehem Goals

The Town of Bethlehem has made a commitment to become a more sustainable community and has established an initiative- ***Sustainable Bethlehem***- to meet its long term goals in this area. The goals of Sustainable Bethlehem are listed below.

- Town government leads by example through improving energy efficiency and reducing greenhouse gas emissions in its operations and by actively promoting its own sustainability successes and informing residents of available resources to become more sustainable at home and work
- Foster a prosperous business environment for both local and new businesses focused on delivering products and services that meet the current and future needs of Bethlehem and the region
- Enhance Bethlehem's character to incorporate more mixed use options creating a live, work play environment
- Support a safe and accessible network of bicycle and pedestrian infrastructure that is well maintained, and extensively utilized for commuting, recreation, and daily trips
- Conserve open space and protect natural areas through effective land use policies
- Provide diverse, affordable, and energy efficient housing options

Content for Bethlehem Website

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- Conserve open space and protect natural areas through effective land use policies
- Provide diverse, affordable, and energy efficient housing options

Through Sustainable Bethlehem, the Town is leading by example to create a pathway to sustainability that will ensure a balance exists between the needs and resources available to support economic, social, and environmental activity in Bethlehem.

Accomplishments to Date

Sustainable Bethlehem activities began in 2009 when the Town adopted the New York State Climate Smart Communities Pledge. With the adoption of this pledge, the Town made a public commitment to reduce greenhouse gas (GHG) emissions and prepare for unavoidable climate change. As an official Climate Smart Community, Bethlehem is eligible for additional services and funding opportunities from the State. For more information on this pledge, please visit http://www.dec.ny.gov/energy/50845.html.

Since 2009, Bethlehem has made significant upgrades to its facilities in order to save money, become more efficient, and reduce GHG emissions. The Town has participated in multiple NYSERDA programs to identify energy efficiency and hydroelectric opportunities in the Town's wastewater treatment and water treatment facilities. Bethlehem has improved the aeration system at the municipal wastewater

treatment plant, saving 460,000 kWh of electricity annually. Most recently, the Town received funding to install a 30 kW solar photovoltaic system at the Elm Avenue Park Administration Building.

In March of 2009, the PaTHs 4 Bethlehem (Pathways to Homes, Hamlets and Healthy Hearts) Committee was established with the mission of providing a resource that effectively uses a 5E approach *(Engineering, Education & Enforcement, and Engagement & Encouragement)* to advise the Town, educate the community, and advocate for opportunities to improve mobility and connectivity for bicyclists and pedestrians. It consists of 11 members including residents, representatives from the Planning, Engineering, Parks & Recreation, and Highway Departments, and a Bethlehem Central School District Liaison. The Committee holds monthly meetings on the fourth Tuesday of the month at 6:30PM in Town Hall Room 101.

To date, the PaTHs Committee has been very active in supporting Sustainable Bethlehem and the Town's mobility goal from the Comprehensive Plan:

> *"Improve mobility—the ability of people, regardless of age and status, to engage in desired activities at moderate cost to themselves and society—throughout the town. This includes strategic investments in needed highway infrastructure, improved access to public transportation and development that is supportive of public transportation, and significant enhancements to the safety and attractiveness of non-motorized modes of travel."*

The PaTHs Committee has worked to achieve the following milestones:

- Pass a complete streets resolution in August 2009
- Facilitate a bicycle skills stations at the Town Bike Expo
- Create a bicycle and pedestrian priority network
- Create an evaluation process for new pathway investment
- Create and distribute bicycle and pedestrian safety tip palm cards
- Participate in the CDTA/CDTC Bike Rack Program and were awarded 23 new bicycle racks for the Town

Many other Bicycle and Pedestrian projects are currently underway including two new bicycle route projects, new education and encouragement materials, and a sidewalk maintenance manual to assist the Town's Public Works Department in keeping its pedestrian infrastructure well-maintained and up to ADA (Americans with Disabilities Act) standards . The Town is also pursuing a Bicycle and Walk Friendly Community Designation.

Climate Change & Bethlehem

The Science of Climate Change

In 2007, the world's foremost authority on climate change, the Intergovernmental Panel on Climate Change (IPCC), declared that the "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level" and that "human influence is very likely the leading cause of global warming."

Recognizing the dangers of unchecked climate Change, the Town of Bethlehem has committed itself to supporting sustainable development practices. In April of 2011, Bethlehem adopted the Climate Smart Communities Pledge and began work on a Greenhouse Gas Emission Inventory and Climate Action Plan.

Regional Impact

According to the draft ClimAID report released by the New York State Energy and Research Development Authority (NYSERDA) in 2010, Bethlehem and the upstate New York region are predicted to be impacted by climate change through:

- Increased average temperatures
- Increased frequency of extreme heat days (days over 90^0 F)
- Increased average annual precipitation, and changes to the annual precipitation patterns
- Increased frequency of extreme precipitation events (days with over 1" of precipitation)
- Increase in the frequency and severity of storms
- Sea level rise along the tidal Hudson River

The effects of climate change to human health, infrastructure and the economy in the region are significant. With higher temperatures, residents would experience higher cooling costs and increased risks of heat stroke, especially for at risk populations such as seniors and low income families. Higher annual temperatures and more frequent extreme heat days result in poor air quality which increases the risk of respiratory illness, especially for those who suffer from in asthma and allergies. Warmer temperatures are also more hospitable for mosquitoes and bacteria, leading to higher incidences of vector-borne diseases. Changes to precipitation are likely to result in more rain and snowfall in winter and droughts in summer. More of the precipitation will come as heavy downpours, which could lead to more flooding, sewer overflows, power outages, and damages to property and infrastructure.

As the region's climate changes, local ecosystems will also be impacted. Spruce, fir, hemlock and maples would die off and migrate to northern climes. Pests previously controlled by cold winters would proliferate and destroy urban street trees as well as large swathes of forest. Fisheries and wildlife would die or migrate to colder climates. Non native species would replace native species. These impacts would change the economy and character of the region.

Due to the significant amount of greenhouse gases already in the atmosphere and the inertia of the system, some level of change is inevitable, despite efforts to reduce emissions. Therefore, it is important for the town and the region to prepare for climate change and enhance resiliency to a wide range of

impacts. Once completed, Bethlehem's GHG Inventory and Climate Action Plan will help the Town prepare for the projected impacts and effects of a changing climate.

Resources

- New York Climate Smart Communities Program
- New York State Climate Action Council
- Sea Level Rise Task Force Report
- ICLEI – Local Governments for Sustainability
- EPA's Climate Change Website
- EPA Household Emissions Calculator
- The Intergovernmental Panel on Climate Change

What is My Carbon Footprint?

Carbon Footprint Calculators

Have you ever wondered how much carbon dioxide (CO_2) you release into the environment? There are a number of calculators online that can help estimate your personal carbon footprint. These calculators will ask you to fill in a wide range of data, such as where you live, what you eat, and what transportation modes you use. They may also ask you how much you spend per month on energy; this data is used to calculate your usage based on national or regional average energy prices. Based upon the data given, the calculators then estimate your total CO_2 emissions.

Some calculators are more complex or focus on different parameters than others. Listed below are a few of the more user-friendly carbon footprint calculators available to consumers.

- Carbon Footprint Ltd
- The Nature Conservancy Carbon Calculator
- Global Footprint Network: Footprint Calculator
- U.S. EPA Household Emissions Calculator

Tips for a Sustainable Lifestyle

There are a lot of simple things you can do to live more sustainably and decrease your carbon footprint without impacting your lifestyle. Many of these tips are free or low-cost, and may even save you money

in the long-term. Reducing your energy usage will help decrease greenhouse gas emissions, which helps our entire community. Start saving today!

Waste Reduction

Recycling

The Town of Bethlehem has a mandatory recycling law in place for all residents and businesses. Some of the Town's waste haulers offer single stream recycling, though others do not so be sure to check with your hauler before you combine your recyclables in one bin. A full list of all mandatory recyclables can be found on the Town's website. Additionally, the Town also holds Hazardous and Special Waste Collection Events (adobe .pdf) periodically for residents to drop off items that should not be included in the normal waste stream.

Backyard & Town Composting

As much as one third of waste sent to our nation's landfill is organic waste that decomposes into methane gas (a greenhouse gas 20 times more potent than carbon dioxide). Grass clippings, weeds, and a variety of green kitchen waste (vegetables, egg shells and coffee grounds) can be composted in small-scale, backyard compost heaps. After the natural cycle of decomposition, the waste is turned into rich, fertile soil that can be used in flower gardens or for growing your own produce. The Capital Region Recycling Partnership has a useful guide on backyard composting (Adobe PDF) for beginners and seasoned veterans.

The Town also provides yard waste pickup by the Highway Department, which hauls the material to the Town's Compost and Wood Chipping Facility. Yard waste should be deposited into a reusable container or paper bag not in excess of 50 lbs., while brush can be stacked neatly near the curb. Paper bags can be purchased at a number of locations. DO NOT PLACE YARD WASTE IN PLASTIC BAGS. Town residents and businesses can purchase the compost from the town for a small fee at the Compost Facility located on Feura Bush Road. Visit the Town's Compost Facility website for more details or to find out when your pickup day is.

Large-scale Composting

Composting at large institution can be very challenging; but it can result in big savings in tipping fees at the landfill and prevent harmful methane emissions. Institutions with large land holdings can choose to compost organic waste onsite, the most economical option. Smaller institutions can look to partner with other institutions in the Town or neighboring municipalities to have their organic waste transported to an industrial composting facility for processing.

Transportation Alternatives

Biking

Biking releases no emissions and is great exercise and recreation. Bethlehem has been promoting its PaTHs 4 Bethlehem Committee (Pathways To Hamlets, Homes & Healthy Hearts), which is designed to increase bicycle safety, awareness, and ridership throughout the Town. Additional signs and bike lanes are raising awareness and making it considerably easier for commuters to give up their cars and ride a bike. More information can be found on the PaTHs 4 Bethlehem website.

Mass Transit

The Capital District Transportation Authority (CDTA) operates buses throughout the Capital Region. Using the tools on their website you can search for routes for your commute and find time tables. Using mass transit saves you money on parking, gas and the hassle of driving through traffic. CDTA buses also have bike racks on the front so that people can transport their bikes between destinations.

Carpool

Carpooling reduces the number of vehicles on the road, helping lower our greenhouse gas emissions and save on fuel costs. Ipool2 is an excellent resource for finding carpools in the Capital Region. Members can sign up (for free!) to find others who share their commute, as well as other options including Park & Ride locations, how to form a vanpools, and other transportation options.

Capital Moves

Capital Moves is a new website designed to help Capital Region residents find alternative transportation options throughout the region. The site consolidates information found on CDTA's, iPool2's, and Amtrak's websites, offering visitors a wealth of information all in one place. Capital Moves also offers assistance to employers in the area on how they can encourage their employees to adopt alternative modes of transport for their daily commutes.

Resources for Residents and Business Owners

NYSERDA, National Grid, NYSEG, and the Federal Government all offer a multitude of programs to residents and businesses to help them reduce their GHG emissions and increase their energy efficiency. The following programs provide funding or technical assistance for eligible energy customers. If you are aware of any other programs that we may have missed, feel free to email Brian Kise at bkise@townofbethlehem.org.

Federal Tax Credits for Renewable Energy

If you buy or have recently installed a solar thermal, solar photovoltaic, geothermal, or small wind turbine system, you may be eligible for a 2012 federal tax credit. 30% of the cost of the system is

covered under the program with no upper limit. Both existing structures and new construction applicants are eligible through December 31, 2016. For a complete list of eligible systems and how to apply, visit the ENERGY STAR website.

Home Performance with ENERGY STAR

ENERGY STAR is teaming up with the state of New York to reduce the price of comprehensive home assessments (CHA) for lower income residents. Owners of 1-4 unit residences that are at or below the 200% - 400% median income level are eligible for a free or reduced cost CHA. The Home Performance program works with home improvement contractors accredited by the Building Performance Institute. Contractors individually inspect each home and make recommendations for improvements. For more information on how you can get started, visit the Home Performance website.

Residential High-Efficiency Natural Gas Heating Rebate Program

National Grid's High Efficiency Natural Gas Heating Rebate Program was a huge success in 2011 and has returned in 2012 with more funding for New York residents. A variety of boilers, furnaces, and water heaters qualify for rebates of up to $560, depending on the model and efficiency rating. New equipment installed between 1/1/12 to 12/31/12 are eligible for a rebate contingent upon availability of funds. National Grid has a useful guide on how you can apply. Be sure to check the program website to see if there is funding available before applying.

Commercial and Industrial Rebate Program

New York State Electric & Gas Corporation (NYSEG) and Rochester Gas & Electric (RG&E) commercial, industrial, and institutional customers that pay a System Benefits Charge are eligible for rebates for energy efficiency upgrades such as lighting improvements, heating upgrades, and HVAC system improvements. For more information on eligibility and rebate offers, check out the program websites: NYSEG, RG&E.

Demand Response Programs

Commercial and industrial customers that use large amounts of electricity can put the electrical grid under stress, increasing the likelihood of outages if demand from these customers is too high. The New York Independent System Operator (NYISO) is working with businesses to help them manage their energy usage during peak electricity demand. In return, utilities pay these businesses for reducing their electricity use and subsequently relieving stress from the grid. To register your business for these programs or for more details, visit the NYISO website. Both National Grid and NYSEG offer similar programs. Visit their respective websites for more details.

Existing Facilities Program

NYSERDA's Existing Facilities Program offers incentives for a variety of energy projects at existing commercial and industrial facilities. Pre-Qualified Incentives encourage applicants to purchase and install more energy-efficient equipment for small-sized energy projects and equipment replacement projects and range up to $30,000. Performance-Based incentives offer incentives to customers or energy service companies who are working on large-scale energy efficiency projects, up to $5 million. These incentives are typically higher than the Pre-Qualified Measures. Commercial and industrial facilities that pay a System Benefits Charge (SBC) are eligible. Visit the Existing Facilities Program website for details and instructions on how to apply.

Energy Audit Program

Small businesses and non-profits are eligible for a free comprehensive energy assessment through NYSERDA. Businesses and organizations with an average electric demand of 100kW or less are eligible to apply. A trained energy auditor will inspect your facility, looking for ways to reduce energy costs by reducing drafts, increasing ventilation, and controlling humidity. This program does not fund the recommended upgrades. However, completing the audit will identify economically viable improvements that yield substantial annual energy savings. Visit the NYSERDA Energy Audit Program website for more information and how to apply.

FlexTech Program

NYSERDA's FlexTech Program provides facility managers with detailed, objective, and customized information to help them make informed energy decisions. Consultants are available to help ensure maximum returns on energy investment. Cost-sharing incentives are available for certain projects and studies. FlexTech's goal is to increase the economic competitiveness of participating facilities by identifying and encouraging the implementation of cost-effective energy efficiency, carbon reduction measures, peak-load curtailment, and combined heat & power, and renewable generation projects. Only commercial, industrial, and institutional, and not-for-profit facilities greater than 50,000 sq/ft that pay into the System Benefits Charge are eligible. Visit NYSERDA FlexTech Program webpage for details.

New Construction Program (NCP)

The New Construction Program (NCP), offered through NYSERDA, provides assistance for incorporating energy-efficiency measures into the design, construction, and operation of new and substantially renovated buildings. The program is available to all types of new building construction. Technical assistance is available to help design and construct buildings to meet modern energy efficiency standards. Supplemental funding can also be obtained to offset the costs associated with installing energy efficient products. Further information about the program or how your business can apply can be found at the NCP website.

Small Business Energy Efficiency Program

NYSEG business customers with demand of less than 100 kilowatts (kW) are eligible to receive free

energy assessments and up to 70% of the cost of recommended lighting upgrades through the Small Business Energy Efficiency Program. For more information on how your business can enroll, visit the program's website or call (877) 359-9814. National Grid also offers a similar program for its customers.

ENERGY STAR has provided an excellent guide (Adobe PDF) for small businesses on how to increase efficiency and reduce costs.

Staff Trainings

Staff Training Memo

Project Overview: Presentation to Town Department Heads

Meeting Attendance List

Sustainable Bethlehem

MEMO

TO: **Brian Kise, Stormwater Management Program Coordinator, Engineering Division, Town of Bethlehem**
FROM: **Kim Lundgren, Climate & Energy Practice Leader, VHB Engineering, Surveying and Landscape Architecture, P.C.**
DATE: **December 19, 2011**
RE: **Staff Training Task Proposal**

As outlined in the scope of work, VHB Engineering, Surveying and Landscape Architecture, P.C. (VHB) will work with the Town staff to assess, design, and deliver training on climate, energy and sustainability issues. This memo represents the completion of the first component of this task- the needs assessment. A number of factors have gone into the development of this proposal to the Town, including conversations with Town staff during the project kick off meeting held on September 28, 2011; the interviews and engagement of various staff through the implementation of other tasks, including the energy project prioritization task by Novus Engineering; and by the tight timeline the Town has on its contract with NYSERDA. Based on these factors, VHB is proposing two trainings:

- An overall climate, energy, and sustainability awareness training for the department head level staff
- A technical energy management training for the operational level staff

The overall awareness training will involve an overview of greenhouse gas and sustainability issues and opportunities for local governments, a detailed description of the current VHB project tasks, and a short visioning session on defining the path forward for the Town's sustainability program. Each participant will be provided a copy of the presentation, a summary of the results of the visioning session, and a set of recommendations for moving sustainability programs forward in the Town. This training is proposed for two hours for approximately 10-15 people and will be led by Kim Lundgren.

The energy management training will provide a detailed overview of energy management best practices, with a specific focus on the current operations of the Town. The training will include a discussion on fuel pricing and utility tracking; an overview of energy management opportunities within facilities, including a review of mechanical systems, control features, weatherization measures, and lighting improvements; a brief discussion of implementation assistance opportunities, including utility and NYSERDA incentive programs; and general best practices in operations and maintenance. The energy management training will be designed in accordance with international instructional design standards and will qualify for continuing education units for engineers. The energy management training will be approximately one half day and will be led by Mark Bagdon and Dave Scheffer of Novus Engineering. It is expected that approximately 20 people will attend this training.

Your requested adjustments or approval of these proposed trainings is requested to me at klundgren@vhb.com no later than December 30th, 2011. We are looking forward to offering this service to Bethlehem.

Thank you!

Sustainable Bethlehem



Sustainable Bethlehem

Project Overview Presentation to Town of Bethlehem Department Heads
February 29, 2012

TOWN of BETHLEHEM, N.Y.
1609
HENRY HUDSON
FOUNDED MARCH 12, 1793

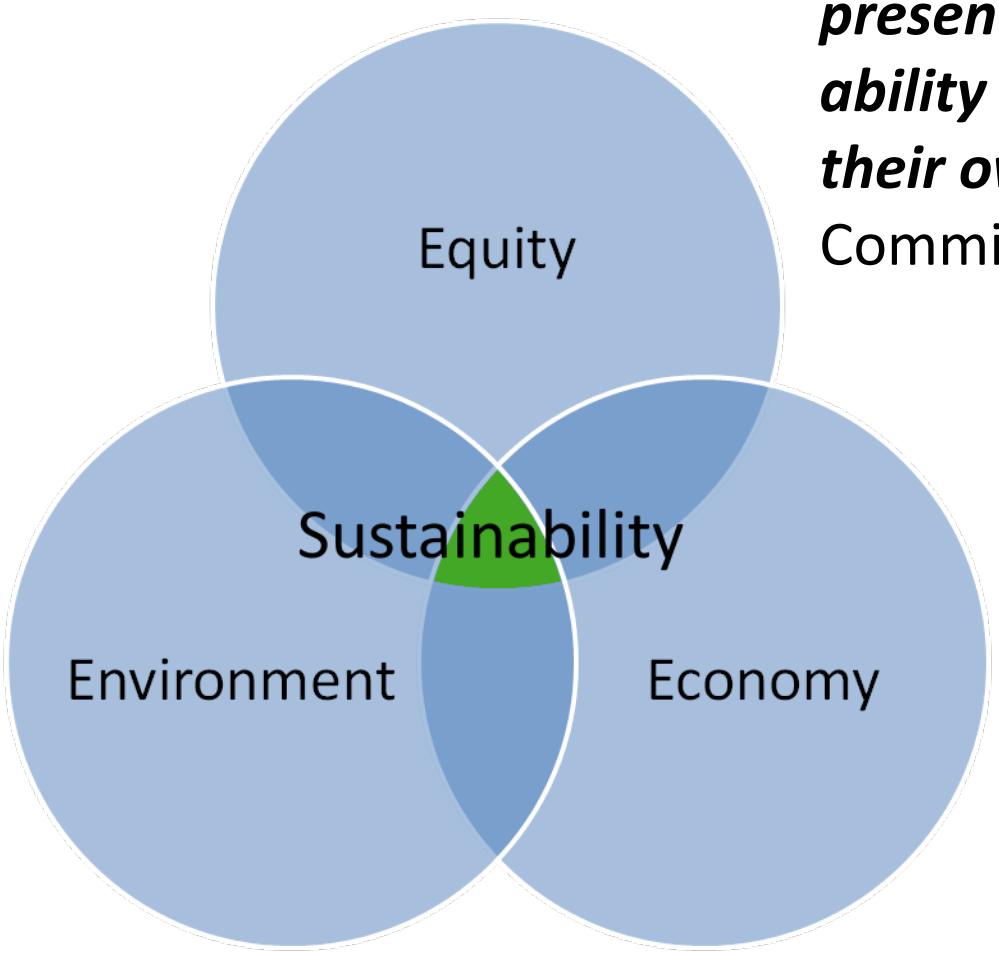


Agenda

- Introduction to sustainability
- Opportunities for Bethlehem
- Current project tasks
- Goal Setting Exercise



What is Sustainability?



The ability to ***"meet the needs of the present without compromising the ability of future generations to meet their own needs"*** – The Brundtland Commission, United Nations

What is Unsustainable?

- Pollution
- Greenhouse gas emissions (climate change)
- High unemployment rates
- Unaffordable housing, energy and food
- Using up resources faster than they can be reproduced
- Automobile Congestion



Opportunities for Bethlehem

- Reduce greenhouse gas emissions
- Save taxpayer dollars by reducing energy bills
- Increase funding opportunities
- Lower energy bills community wide
- Improve air and water quality
- Conserve open space
- Become more walkable and bikeable
- Adapt to a changing climate

Linking with Regional, State and National Efforts

- Climate Smart Communities
- Regional Economic Development Councils
- Cleaner, Greener Communities
  - Regional Sustainability Plan
- Over 1,000 Top Elected Officials- Mayors' Climate Protection Agreement
- 600+ local governments members of ICLEI

$$$



The Project

- Greenhouse gas (GHG) inventory
- Public Awareness and Communications Strategy
- Energy Project Prioritization
- Bike and Pedestrian Program
- Bicycle Pilot Project
- Energy & Land Use Review

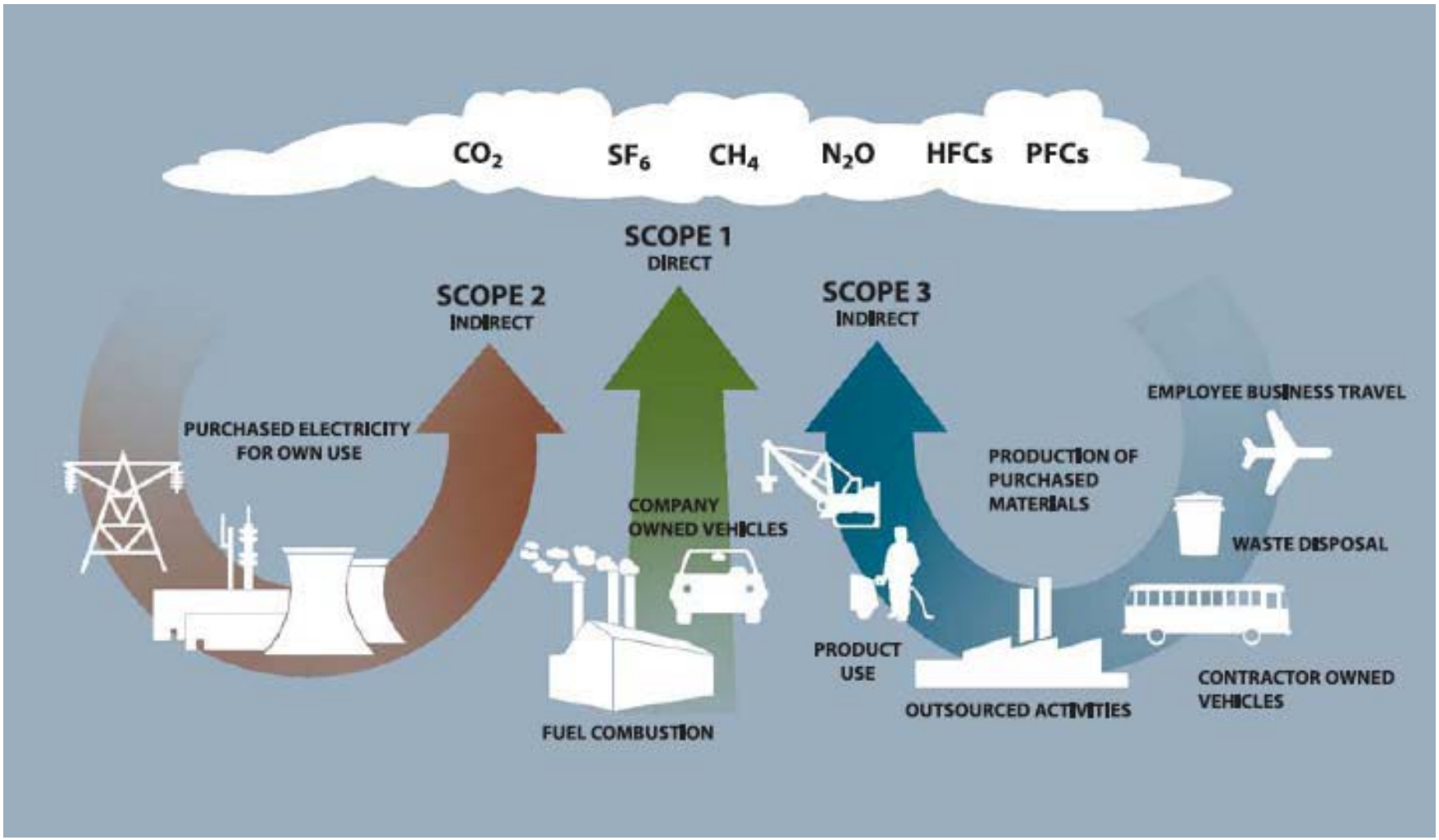
Sustainable Bethlehem

What is a GHG Inventory?

A greenhouse gas (GHG) emissions inventory is an assessment of…

- Energy consumption
- Leaks or releases of GHGs (for example, leaked refrigerants or deployed fire suppressants)
- Biological and chemical processes
- Solid waste disposal

….and the resulting GHG emissions


CO_2 SF_6 CH_4 N_2O HFCs PFCs
SCOPE 1
DIRECT
SCOPE 2
INDIRECT
SCOPE 3
INDIRECT
PURCHASED ELECTRICITY FOR OWN USE
COMPANY OWNED VEHICLES
FUEL COMBUSTION
PRODUCT USE
PRODUCTION OF PURCHASED MATERIALS
OUTSOURCED ACTIVITIES
EMPLOYEE BUSINESS TRAVEL
WASTE DISPOSAL
CONTRACTOR OWNED VEHICLES



Types of GHG Inventories

Community Inventory

- GHGs emitted within the geographical boundary of the Town

Government Operations Inventory

- GHGs from municipal operations only
- Subset of community inventory, but GHGs are calculated separately

Bethlehem Government GHG Inventory

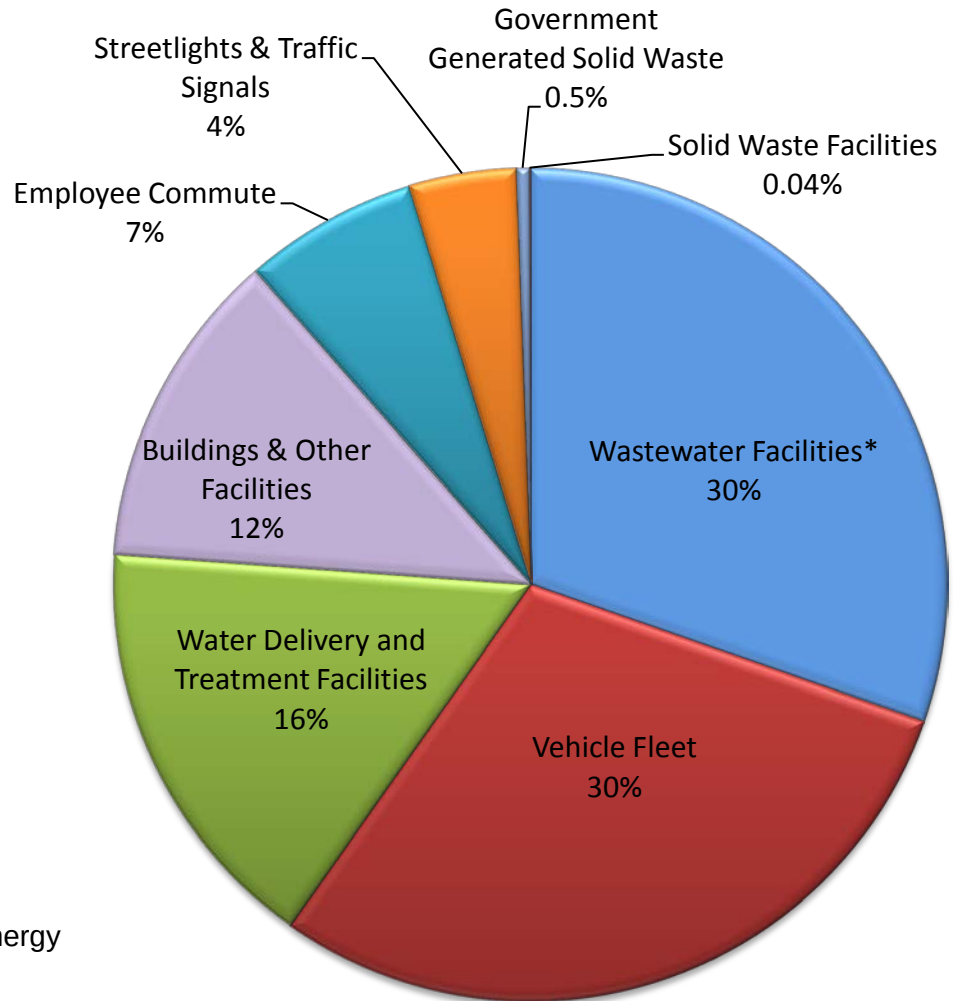
- GHG emissions calculated using the Local Government Operations Protocol (LGOP)
  - National standard
  - Defines GHG sources, methods, and reporting sectors, specifically for local governments
- 2010 selected as baseline year for Bethlehem

Bethlehem 2010 GHG Emissions by Sector

Total GHG Emissions = 5,541 Metric Tons CO_2e

OR

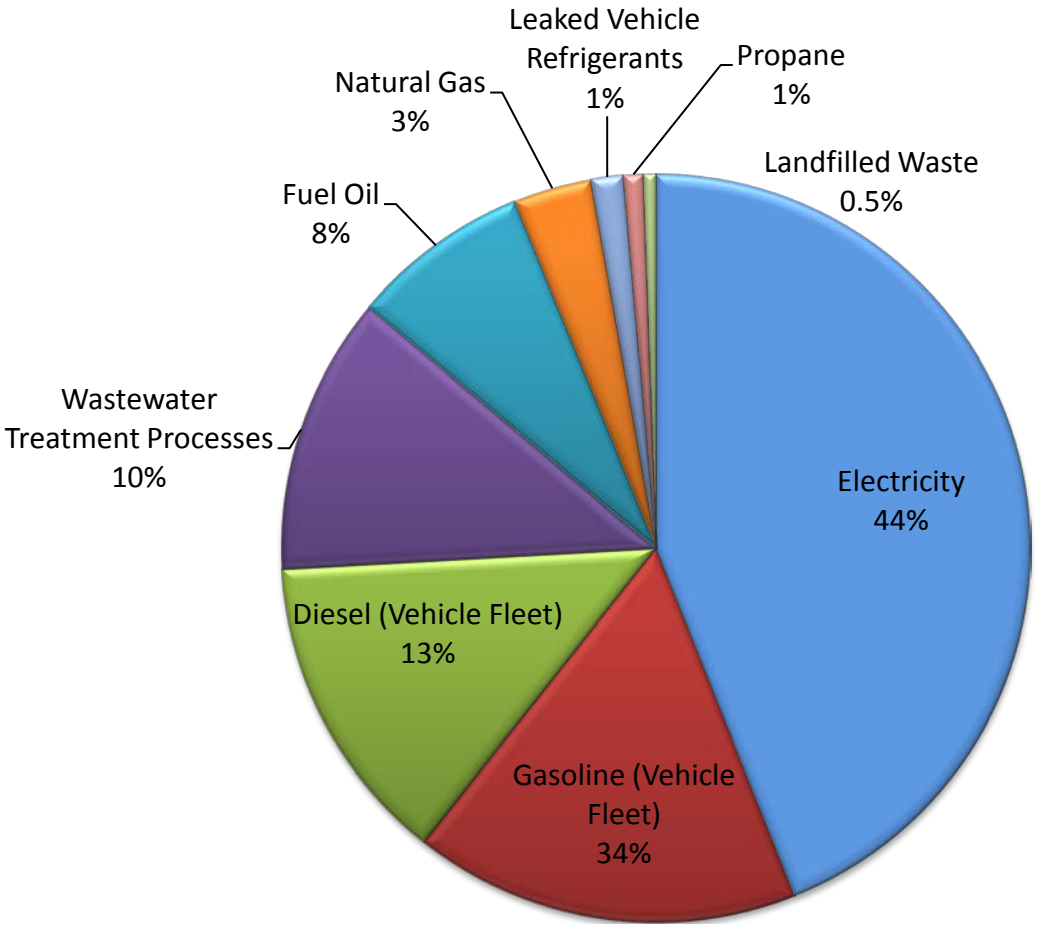
The carbon sequestered by 142,077 tree seedlings grown for 10 years



*The Wastewater Facilities sector includes energy use at wastewater treatment plants and pumps, as well as non-energy GHG emissions from treatment processes.



Bethlehem 2010 GHG Emissions by Source

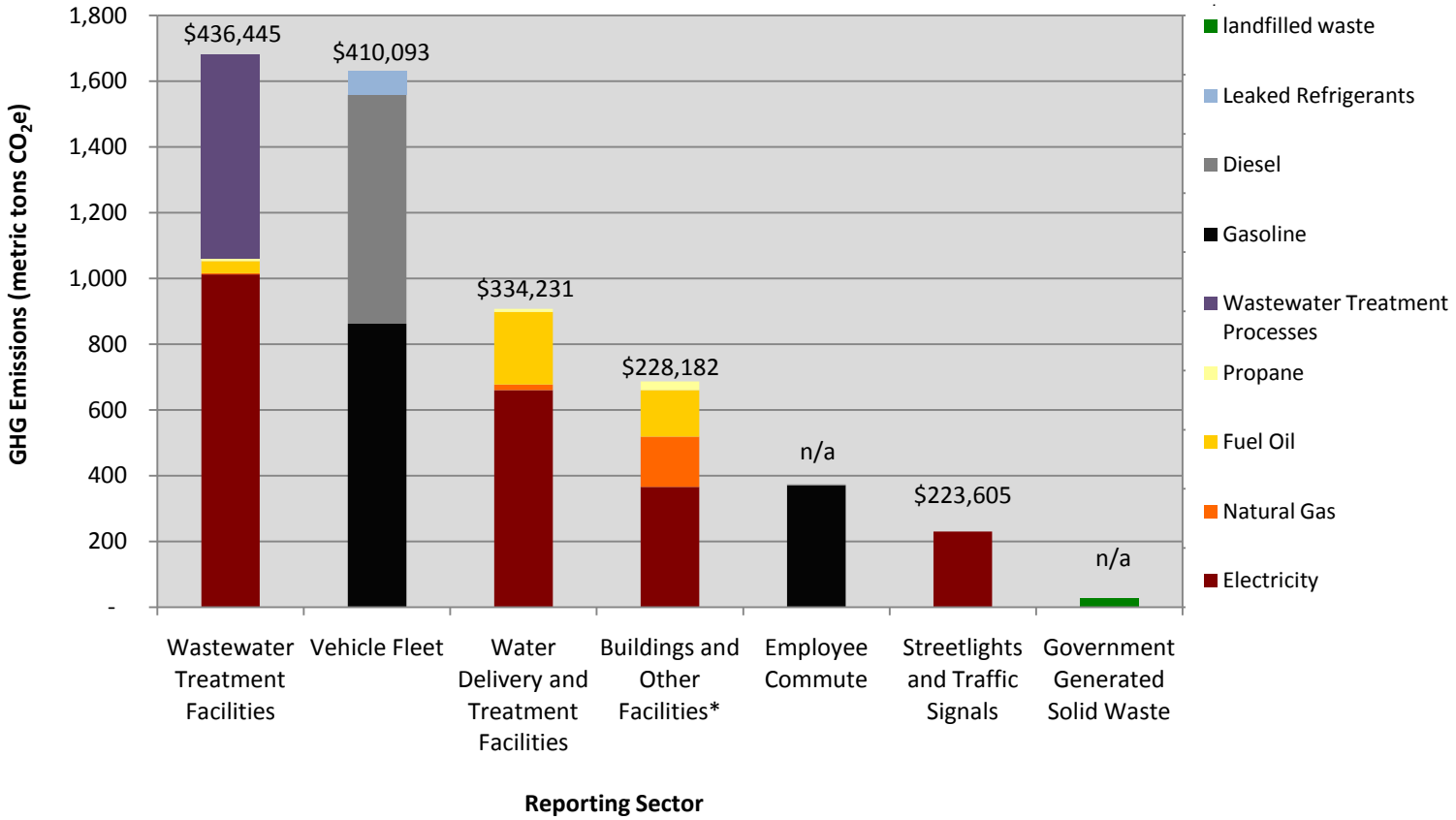


Total GHG Emissions = 5,541 Metric Tons CO_2e

Total Energy Costs = $ 1,633,976

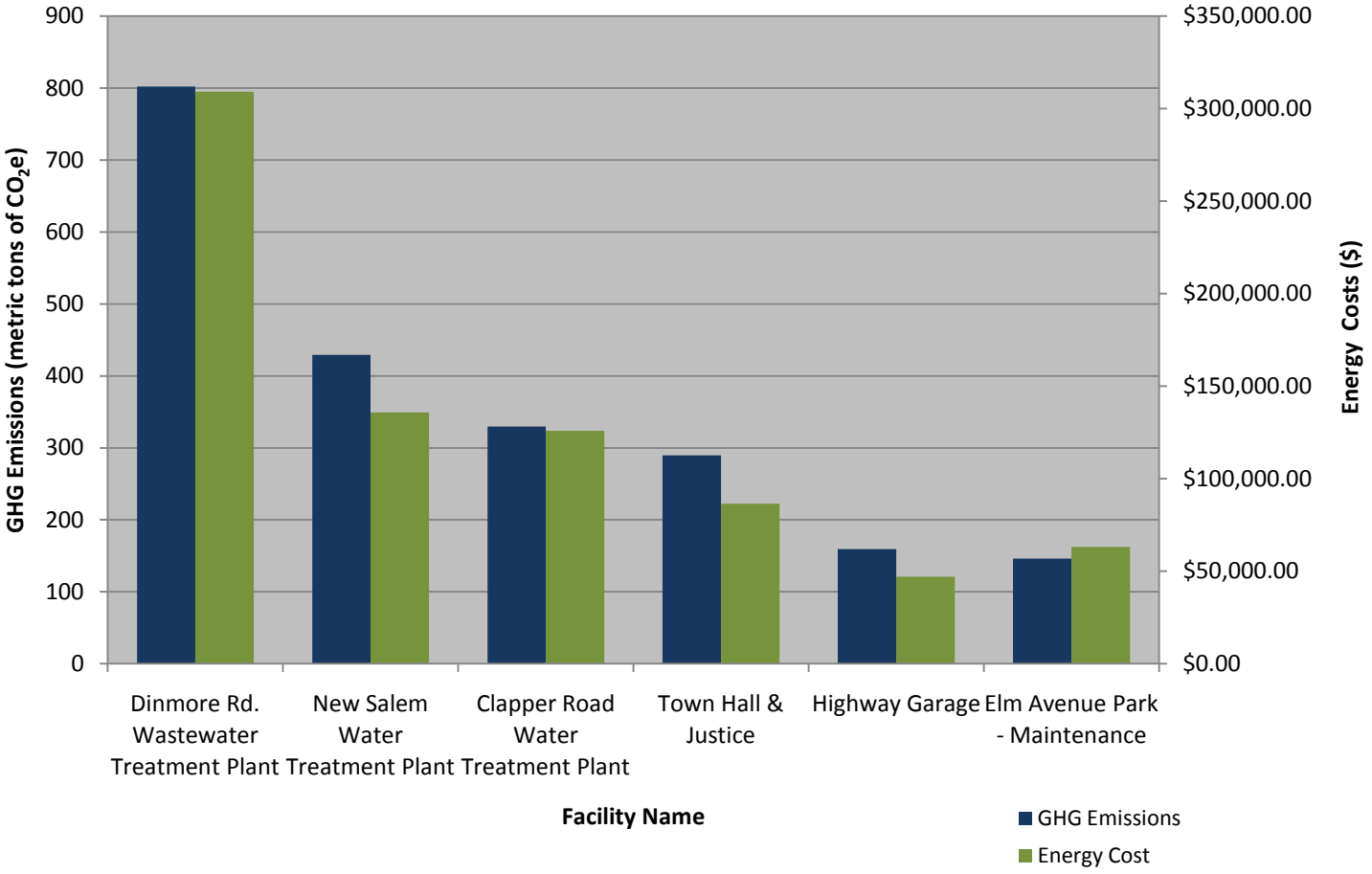


Bethlehem 2010 GHG Emissions by Sector and Source



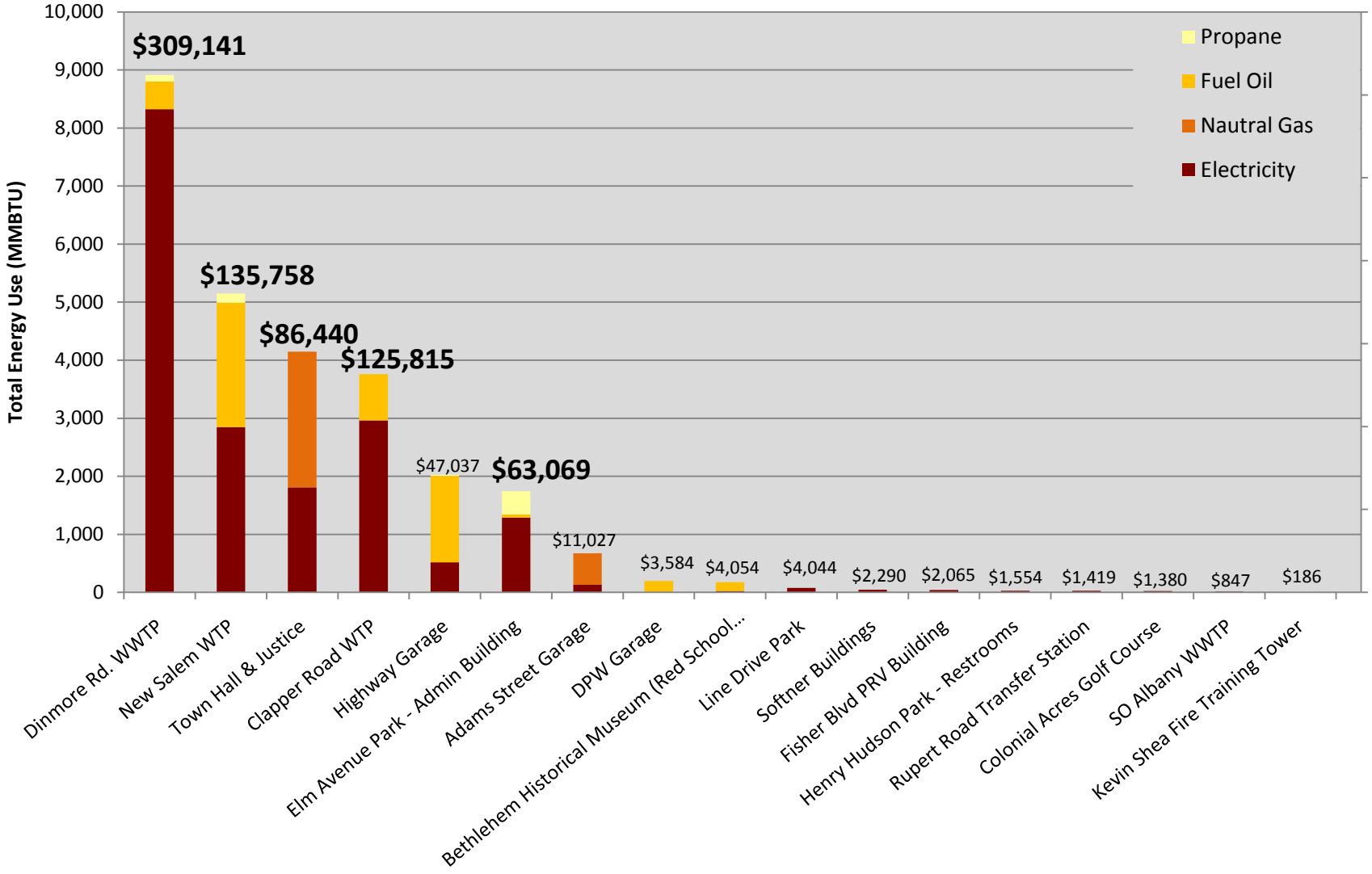


Bethlehem 2010 Facilities by GHG Emissions and Energy Costs



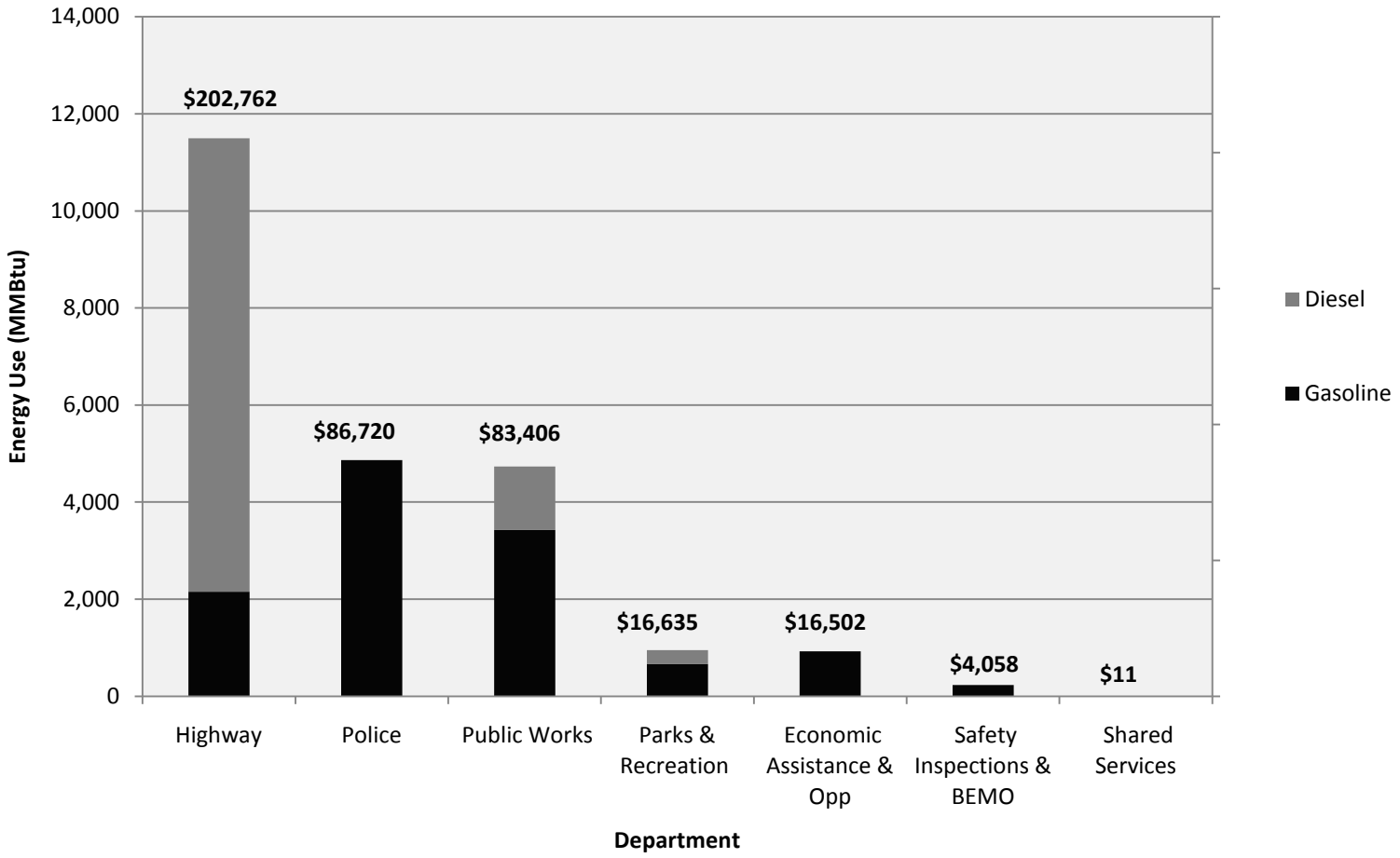


Bethlehem 2010 Energy Use and Costs by Building





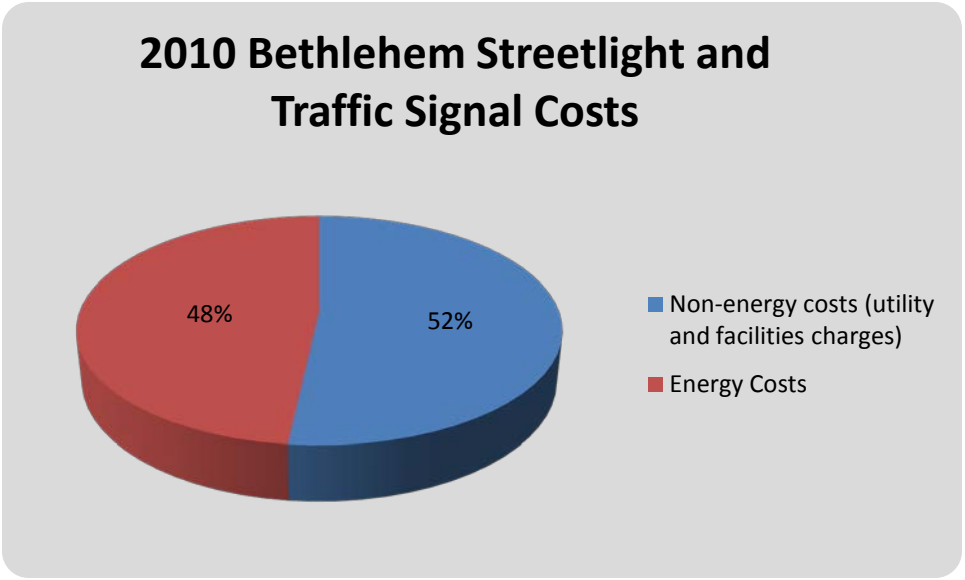
Bethlehem 2010 Vehicle Fleet Energy Use and Costs by Department





Bethlehem 2010 Streetlights and Traffic Signals Energy Use and Costs

- Energy Use: 2,522 MMBtu
- Costs: $ 223,605





Public Awareness and Communications Strategy

Goal: Engage the public on Bethlehem's sustainability efforts

Benefits

- Combine discrete projects into one program to further demonstrate progress
- Ease of educating through logo and message
- Highlights the Town's efforts

Sustainable Bethlehem



Energy Project Prioritization

Goal: Be more efficient with energy use in Town facilities

Benefits:

- Save on energy bills
- Operation
- Reduce GHG emissions
- Move forward on projects that are most beneficial and get the biggest ‘bang for your buck’



Bike and Pedestrian Program

Goal: Become a bike-friendly and walkable community

Benefits

- Meet goals of the Comp Plan
- Provides alternative modes of transportation
- Enhances recreational opportunities
- Positive public health implications
- Can reduce VMTs, leading to less air pollution congestion

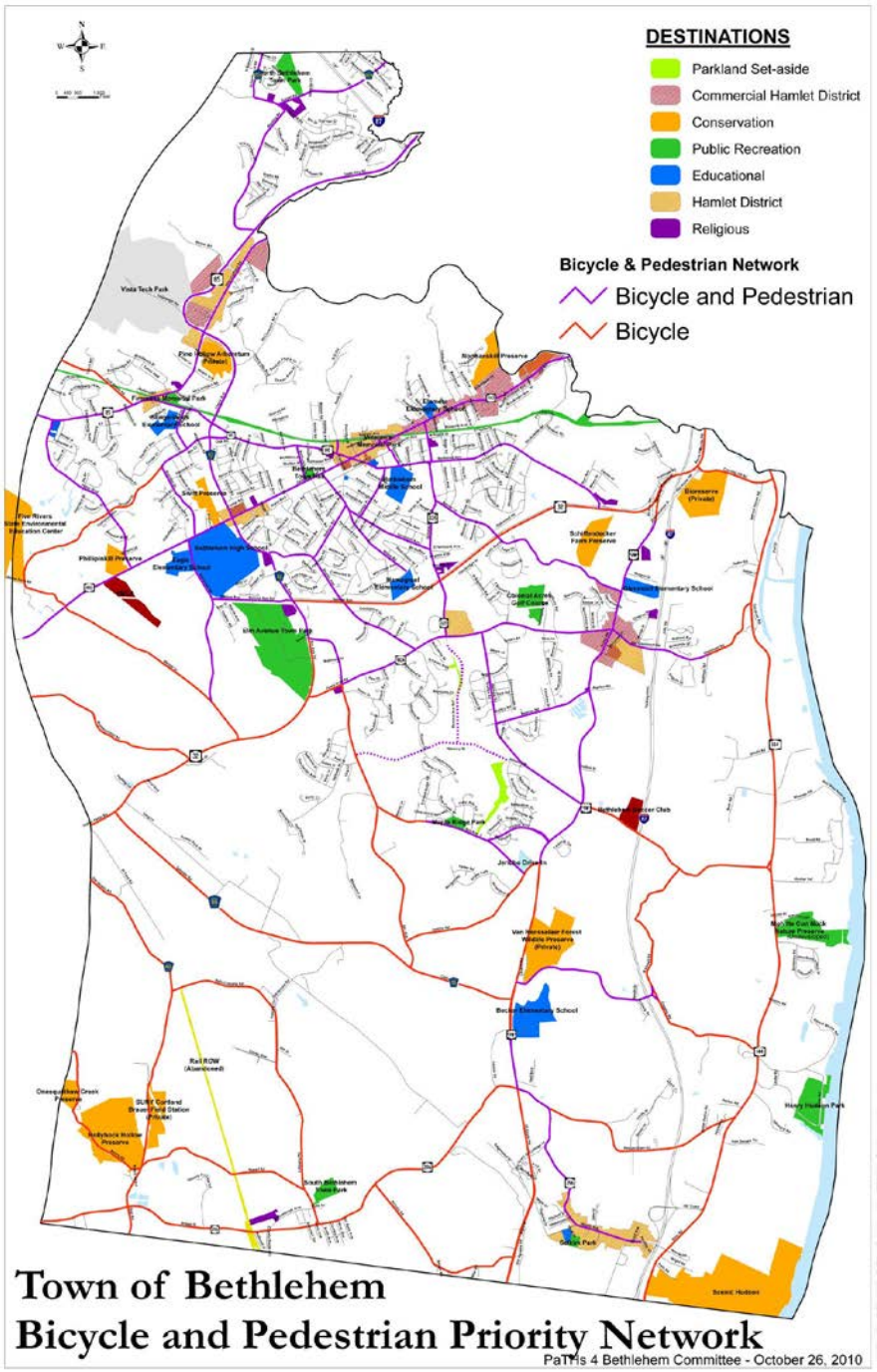


Bicycle Pilot Project

Goal: Demonstrate progress towards Comp Plan goals

Benefits:

- Create new opportunities for bicycling in Bethlehem
- Educate drivers and bikers on appropriate riding and safety





Energy and Land-Use Review

Goal: Review the Town's existing zoning law, building ordinances, and land use regulations to identify sustainable development opportunities

Benefits

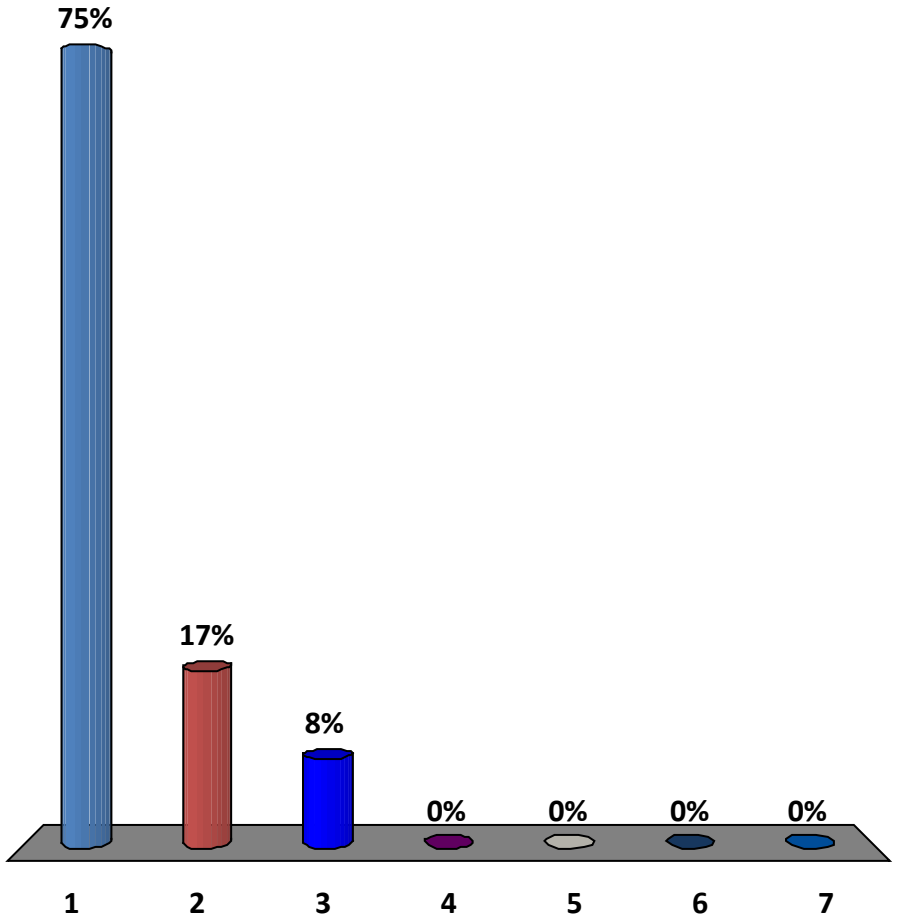
- Encourage more energy efficient construction
- Open Space Preservation
- Reduce sprawl
- Reduce cost in infrastructure maintenance



Goal Setting

What is the most successful type of "sustainable" activity/program that the Town is currently implementing?

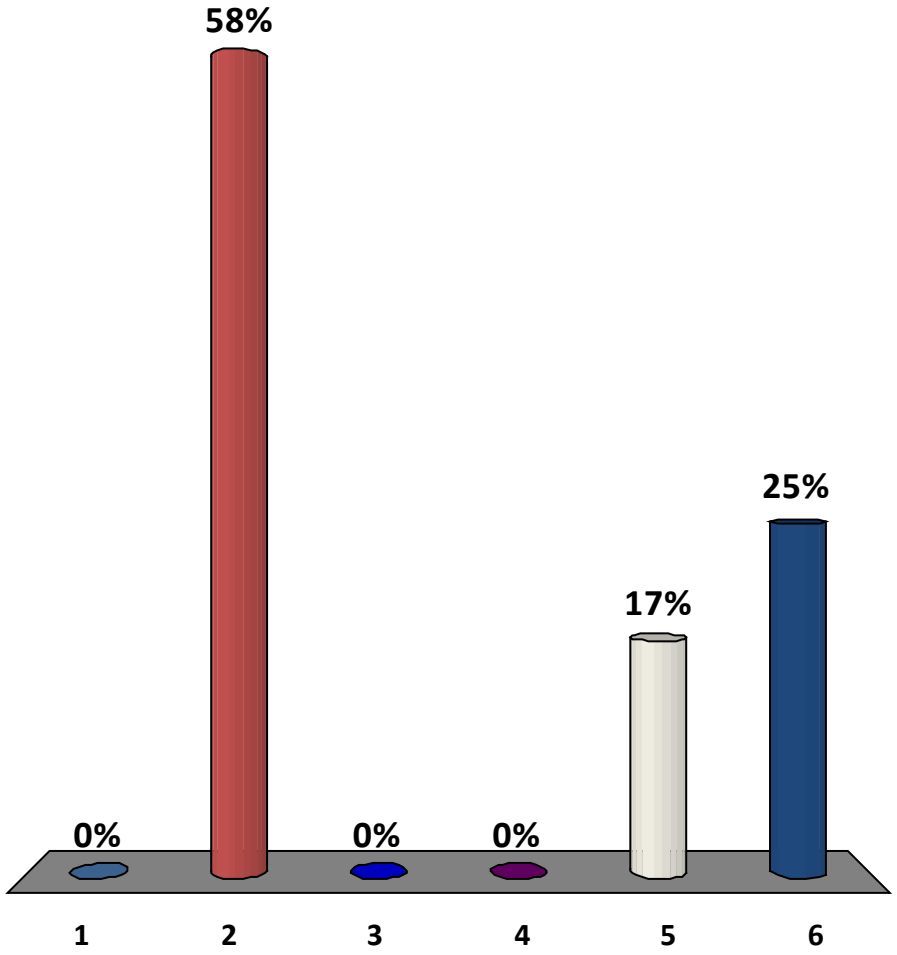
1. Bike/Ped (PaTHs)
2. Stormwater mgmt
3. Land use policies/Conservation easements
4. Energy efficiency/facility audits
5. Parks and open space
6. Waste related
7. Other





What area would you like to see the Town doing more with regards to sustainability?

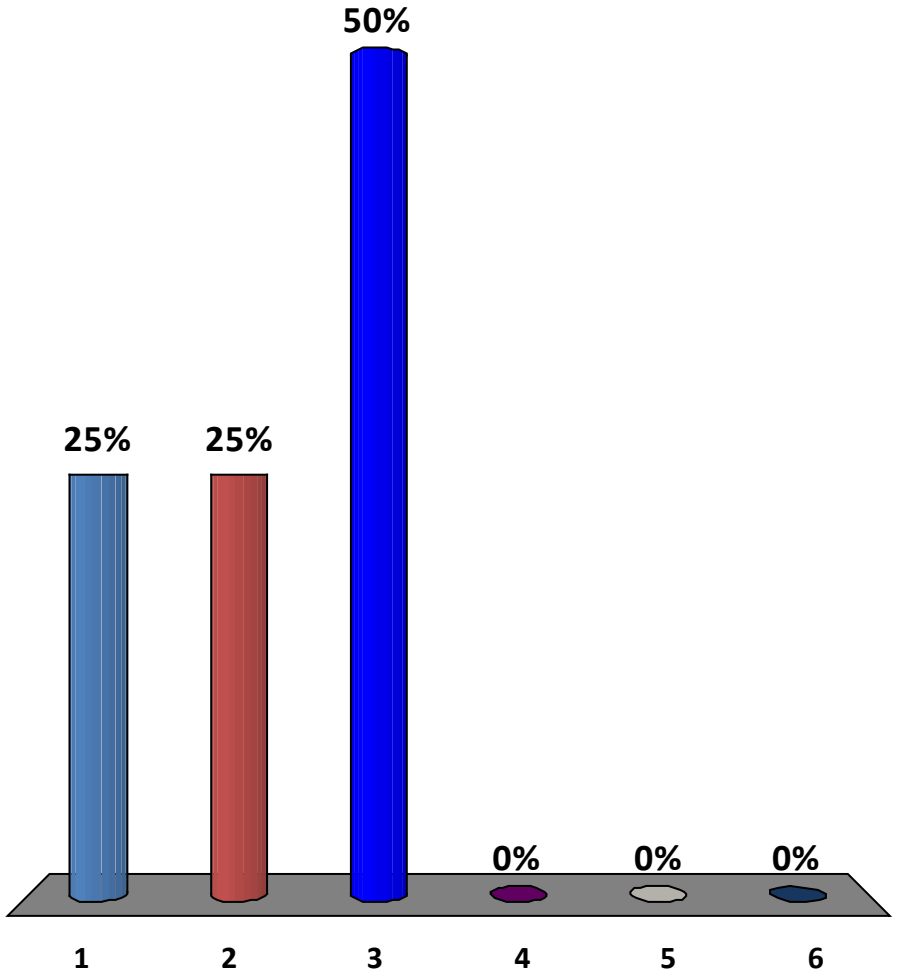
1. Recycling/Solid Waste mgmt
2. Energy Efficiency in facilities
3. Limiting Sprawl
4. Access to open space
5. Multi-modal options
6. Preparing for climate change/climate resiliency





Of the following, which should be the primary characteristic of a Sustainable Town government?

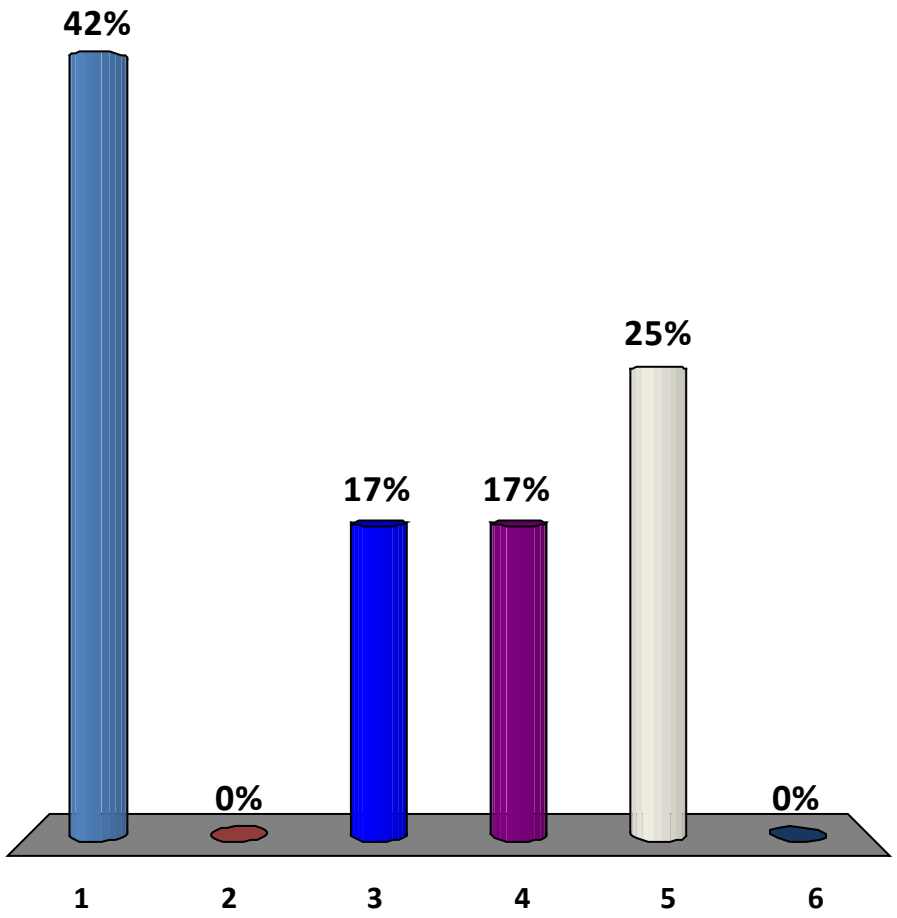
1. Lower energy bills
2. Utilization of renewable energy sources/energy independence
3. Encouraging economic growth from clean industries
4. Zero waste
5. Alternative fuel vehicles
6. Engaging municipal staff to walk/bike to work





What is the most important characteristic of a "Sustainable Bethlehem?"

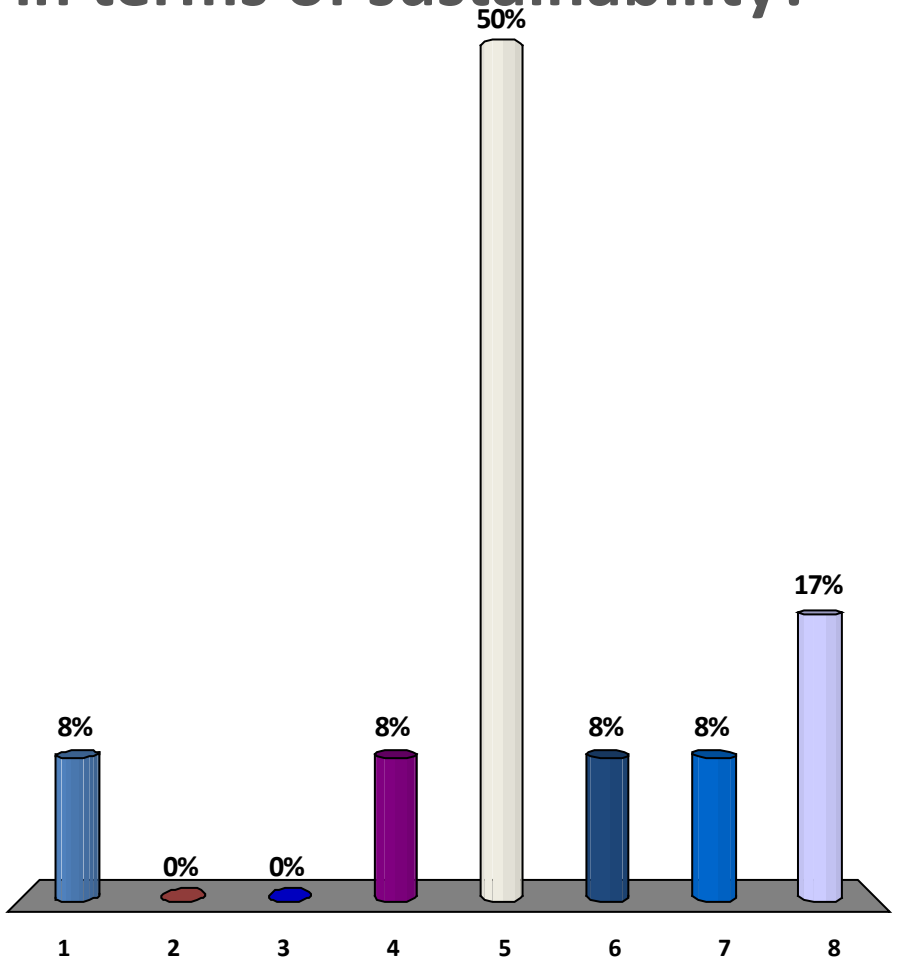
1. Thriving economy
2. Active biker/walker community
3. Multi-modal transportation options
4. A clean environment
5. An affordable and reliable energy system
6. Plentiful and accessible open space





What is the number one issue facing Bethlehem and its residents and businesses today in terms of sustainability?

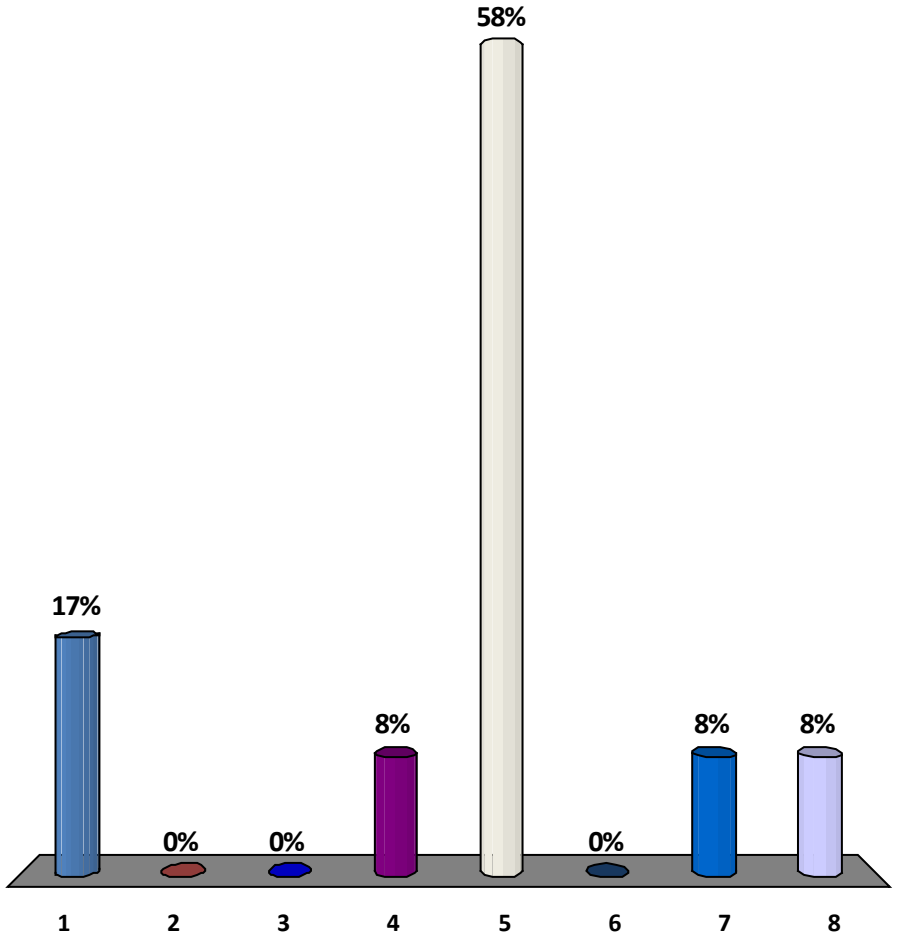
1. Unemployment
2. Educational opportunities
3. Clean air and water
4. Public transit
5. Energy costs
6. Bike/Ped safety
7. Energy efficient construction
8. Sprawl





What issue will be the most challenging for the Town to address?

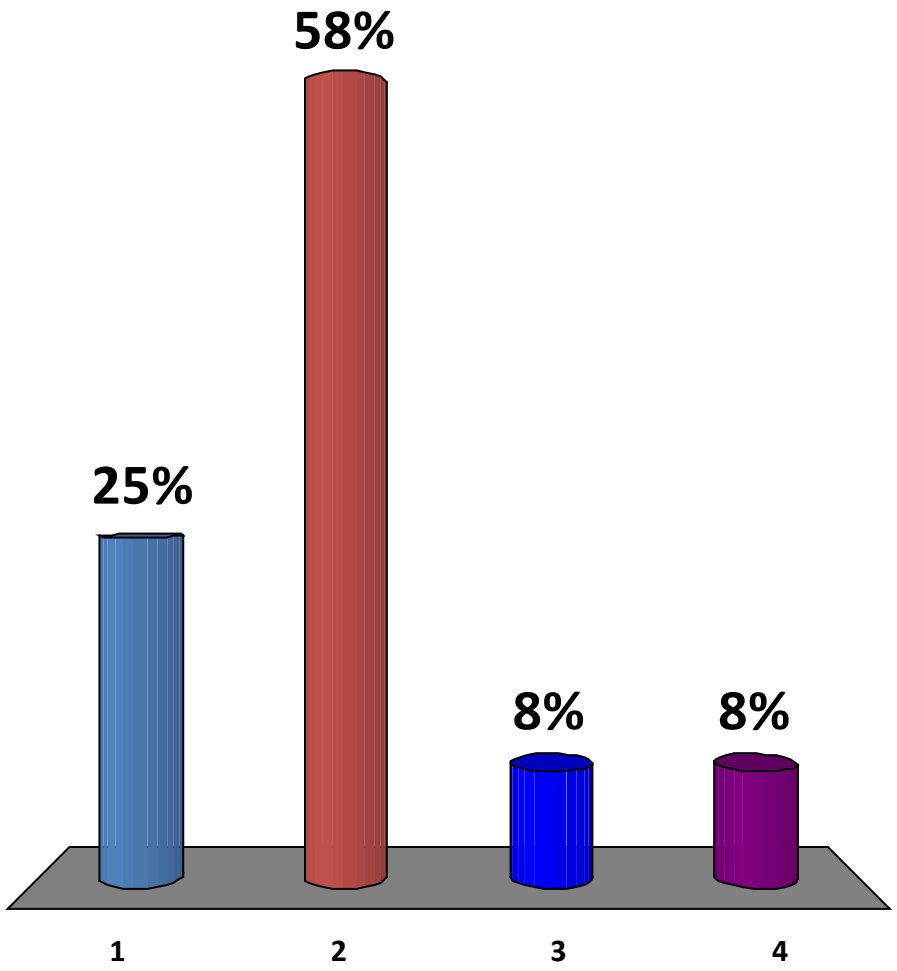
1. Unemployment
2. Educational opportunities
3. Clean air and water
4. Public transit
5. Energy costs
6. Bike/Ped safety
7. Energy efficient construction
8. Sprawl





What is the greatest issue facing Bethlehem's natural environment?

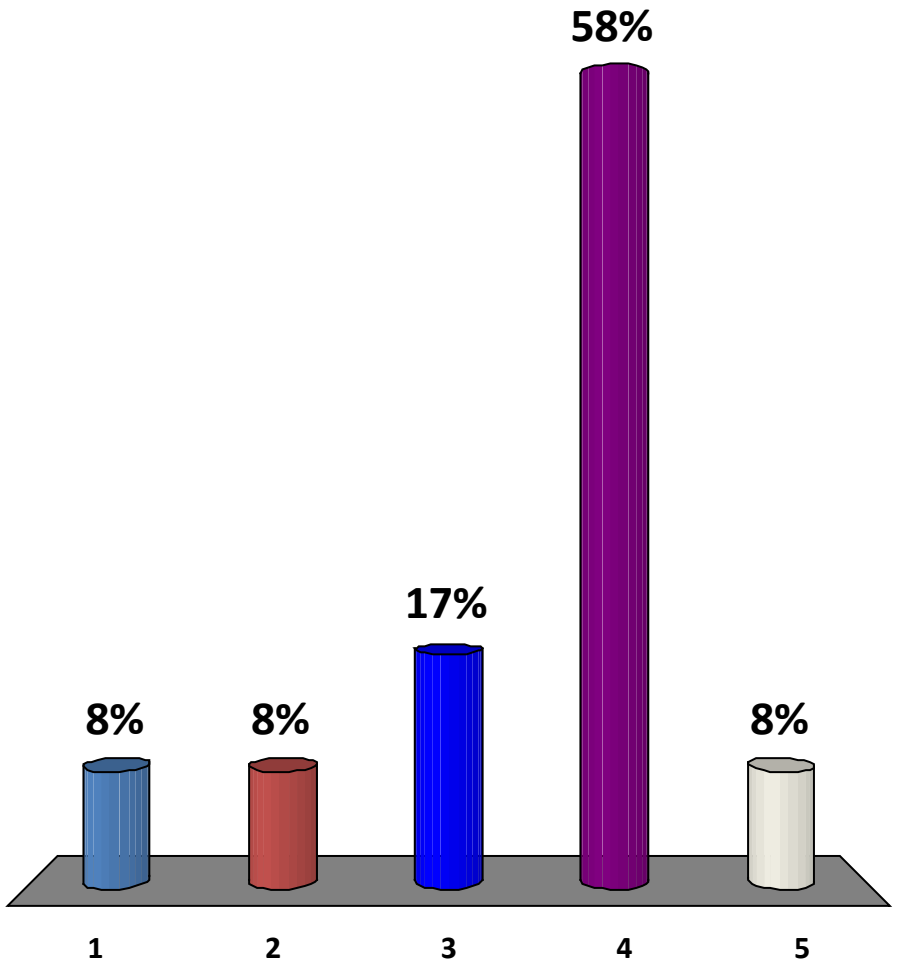
1. Water quality
2. Loss of open space and natural areas to sprawl
3. Air quality
4. Tree canopy





What is the most promising aspect of Bethlehem's economy?

1. Overall availability of local, quality jobs
2. Jobs that match the skills of the unemployed
3. Housing affordability
4. Local businesses
5. Productive agricultural lands



Greenhouse Gas Inventory

Government and Community Executive Summaries

Full Report

Methodology

Sustainable Bethlehem

Sustainable Bethlehem

TOWN OF BETHLEHEM
2010 Greenhouse Gas Emissions Inventory

The Town of Bethlehem launched Sustainable Bethlehem in July 2011. Sustainable Bethlehem is a Town led initiative to promote a healthy, sustainable, and energy secure community. To help launch this program, the Town secured funding from NYSERDA to develop a greenhouse gas (GHG) emissions inventory, review local land use regulations, and enhance the Town's existing bicycle and pedestrian program. This Executive Summary is an overview of the Town's 2010 GHG emissions inventory—an analysis of energy use, costs, and GHG emissions from municipal operations. A parallel GHG inventory for the entire community was also completed and is summarized in a separate report.

The GHG emissions inventory will help Bethlehem identify additional energy and GHG reduction opportunities. It also provides a baseline against which reduction targets can be set, and future progress towards achieving those targets can be measured.

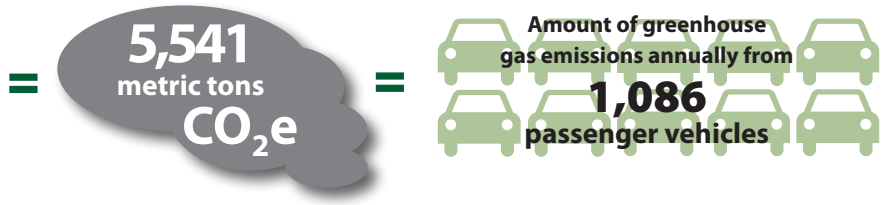
Sustainability Accomplishments to Date

- Adopted the New York State Climate Smart Communities Pledge in 2009
- Participated in multiple NYSERDA programs to identify energy efficiency and hydroelectric opportunities in the Town's wastewater treatment and water treatment facilities
- Improved the aeration system at the Town wastewater treatment plant, saving 460,000 kWh of electricity annually
- Received funding to install a 30 kW solar photovoltaic system at the Town's Elm Avenue Park Administration Building (to be installed April 2012)

Inventory Results
GOVERNMENT OPERATIONS

In 2010, The Town of Bethlehem's municipal operations were responsible for the emission of 5,541 metric tons of carbon dioxide equivalent (metric tons CO_2e). This is equivalent to the annual greenhouse gas (GHG) emissions from 1,086 passenger vehicles.[1] The breakdown of GHG emissions by sector is listed in **Table 1**. The Wastewater Facilities, Vehicle Fleet, and Water Delivery and Treatment Facilities sectors accounted for the largest portion of the Town's GHG emissions. The Town has already implemented energy saving measures throughout its water and wastewater assets. Continuing to pursue energy saving strategies in those sectors, along with identifying alternative energy or energy efficiency opportunities in the Vehicle Fleet sector, could have a significant impact on the Town's municipal GHG emissions.

2010 Municipal Operations Emissions



The Town of Bethlehem spent $ 1,633,976 on energy use throughout government operations in 2010. The Wastewater Facilities, Vehicle Fleet, and Water Treatment and Delivery Facilities collectively accounted for 72 percent of the Town's energy costs. Even though electricity consumption from the Streetlight and Traffic Signals sector only produced four percent of the Town's GHG emissions, it accounted for 14 percent of energy costs. This apparent imbalance has been identified as a concern in other Capital District communities as well. In Bethlehem's case, 50 percent of electricity costs were "facilities" charges, or charges paid to use the streetlight poles, lighting fixtures, and other infrastructure.

[1] U.S. Environmental Protection Agency. Greenhouse Gas Equivalencies Calculator. 21 June 2011. 9 February 2012 http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

TABLE 1 | 2010 GOVERNMENT GHG EMISSIONS AND ENERGY COSTS BY SECTOR

SECTOR	GHG EMISSIONS (METRIC TONS CO_2e)	ENERGY USE (MMBtu)	ENERGY COST ($)
Wastewater Facilities	1,681	11,774	$436,445.26
Vehicle Fleet	1,631	23,209	$410,093.48
Water Delivery and Treatment Facilities	908	10,683	$334,231.23
Buildings & Other Facilities	687	9,218	$228,182.39
Employee Commute	374	5,185	Not applicable
Streetlights & Traffic Signals	230	2,522	$223,604.98
Government Generated Solid Waste[2]	28	Not applicable	Not applicable
Solid Waste Facilities[2]	2	26	$1,418.78
TOTAL	**5,541**	**62,616**	**$1,633,976.12**

As is expected for municipalities that operate wastewater treatment (WWT) infrastructure, the Wastewater Facilities sector was one of Bethlehem's largest sources of GHG emissions, accounting for 30 percent. The Wastewater Facilities sector includes emissions from energy used to power WWT plants and infrastructure as well as GHG emissions from biological and chemical treatment processes. While it is difficult to compare GHG inventories between two different communities, Bethlehem's emissions in the Wastewater Facilities sector are fairly consistent with other New York towns that operate WWT facilities. For example, the Town of Ithaca (population 19,807[3]) determined that GHG emissions from WWT facilities comprised 20 percent of municipal emissions in 2009 or 0.04 metric tons CO_2e per person[4]. Bethlehem's per capita GHG emissions from the Wastewater Facilities sector were slightly higher, at 0.05 metric tons CO_2e per person. Possible reasons for the difference in per capita emissions could be industrial contributions of wastewater, energy efficiency, or volume of wastewater treated.

The Vehicle Fleet sector is also typically a large source of GHG emissions in government operations. In 2010, the Vehicle Fleet sector accounted for 30 percent of municipal emissions in Bethlehem. This is similar to the City of Albany's Vehicle Fleet, which contributed 35 percent of municipal GHG emissions in 2009. However, Albany (population 93,849[5]) had a fleet that was three times the size of the Bethlehem fleet (576 vehicles compared to 185) and emitted four times as many GHG emissions.[6,7]

[2] The Government Generated Solid Waste sector accounts for methane produced by the decomposition of landfilled waste generated by the Town's government operations but disposed of at facilities that were not operated by the Town. The Solid Waste Facilities sector calculates GHG emissions from energy consumption at the Town's Rupert Road Transfer Station.

[3] U.S. Census Bureau, 2008-2010 American Community Survey

[4] Town of Ithaca, "Baseline 2009: Greenhouse Gas Emissions Inventory Report - Government," Spring 2011.

[5] U.S. Census Bureau, 2009 American Community Survey

[6] City of Albany, NY, Mayor's Office of Energy & Sustainability, "City of Albany 2009 Greenhouse Gas Emissions Inventory," Winter 2011.

[7] The relative difference in vehicle fleet sizes and GHG emissions may be due to off-road vehicles and mobile equipment.

FIGURE 1
2010 Government Energy Costs by Sector

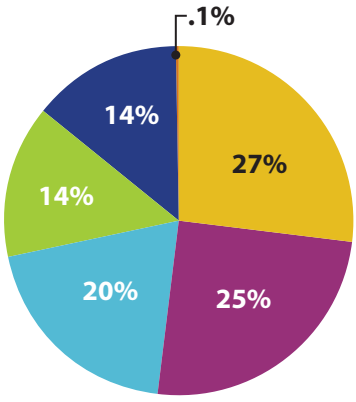
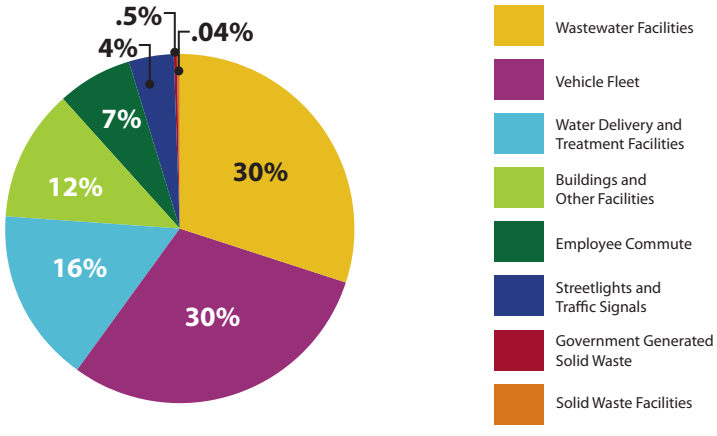


FIGURE 2
2010 Government GHG Emissions by Sector



As is often the case in towns like Bethlehem, electricity consumption was the largest source of GHG emissions for government operations, accounting for 44 percent of the Town's overall emissions. The Town also spent over two-thirds of its energy budget on electricity. **Table 2** below shows GHG emissions and energy costs by source.

[8] Gasoline and diesel energy use, costs, and GHG emissions exclude those from the personal vehicles of Town employees.

[9] Electricity costs include $111,014 from facilities charges on streetlights and traffic signals.

TABLE 2 | 2010 GOVERNMENT GHG EMISSIONS AND ENERGY COSTS BY SOURCE[8]

SOURCE	METRIC TONS CO_2e	ENERGY USE (MMBtu)	ENERGY COST ($)
Electricity[9]	2,271	24,882	$1,087,753.87
Gasoline (Vehicle Fleet)	862	12,264	$218,023.02
Diesel (Vehicle Fleet)	696	10,944	$192,070.46
Wastewater Treatment Processes (non-energy)	621	Not applicable	Not applicable
Fuel Oil	399	5,358	$88,854.45
Natural Gas	174	3,276	$31,653.43
Leaked Vehicle Refrigerants	73	Not applicable	Not applicable
Propane	43	707	$15,620.89
Landfilled Waste	28	Not applicable	Not applicable

FIGURE 3
2010 Government GHG Emissions by Source[8]

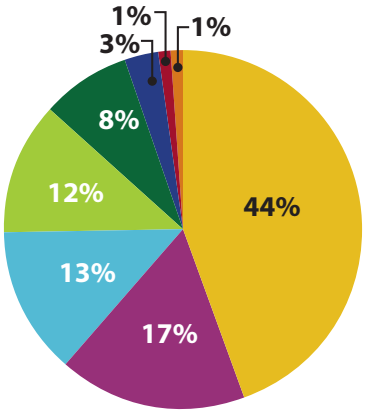
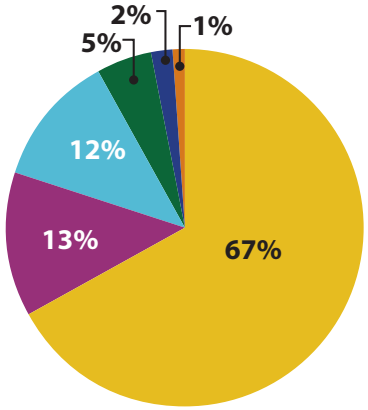
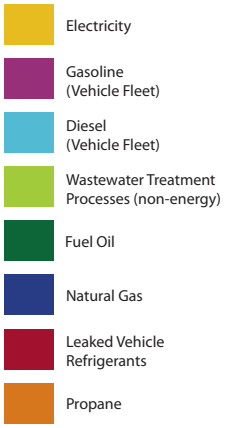


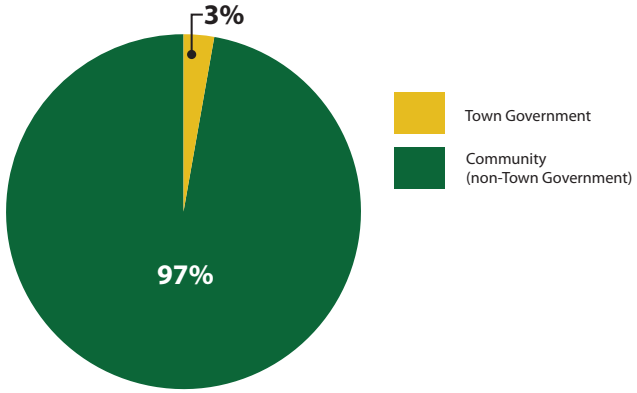
FIGURE 4
2010 Energy Costs by Source[8]





As is typical for a Town the size of Bethlehem, government GHG emissions are a small percentage of those from the larger Bethlehem community. As shown in **Figure 5**, Town municipal operations comprised only three percent of community-wide GHG emissions. To achieve significant reductions in GHG emissions, the Town will need to engage community partners to also take action.

FIGURE 5
2010 Government and Community Emissions



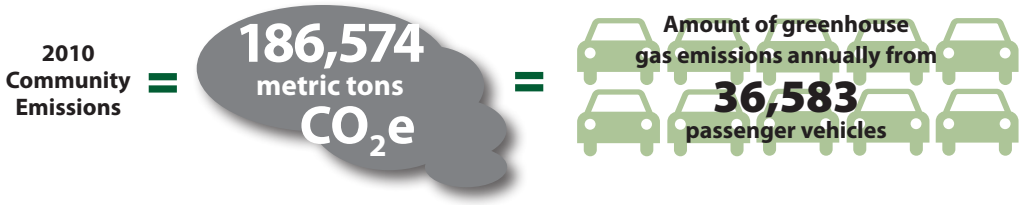
Sustainable Bethlehem

TOWN OF BETHLEHEM
2010 Greenhouse Gas Emissions Inventory

Inventory Results
COMMUNITY

The Town of Bethlehem launched Sustainable Bethlehem in July 2011. Sustainable Bethlehem is a Town led initiative to promote a healthy, sustainable, and energy secure community. To help launch this program, the Town secured funding from NYSERDA to develop a greenhouse gas (GHG) emissions inventory, review local land use regulations, and enhance the Town's existing bicycle and pedestrian program. This Executive Summary is an overview of Bethlehem's community-scale 2010 GHG emissions inventory—an analysis of energy use and GHG emissions from the entire Bethlehem community. The GHG emissions inventory will help Bethlehem identify opportunities to create a more sustainable community through programs that reduce energy use and GHG emissions. It also provides a baseline against which reduction targets can be set, and future progress towards achieving those targets can be measured.

The community inventory includes GHG emissions generated by residences, businesses, government operations, and vehicles traveling within Bethlehem's boundaries. The sources of these emissions include consumption of electricity, natural gas, heating fuels, diesel and gasoline, wastewater treatment processes, and solid waste disposal. Community-wide GHG emissions from Bethlehem in 2010 totaled 186,574 metric tons of carbon dioxide equivalent (metric tons CO_2e). This is equivalent to the annual GHG emissions from 36,583 passenger vehicles.[1]



As indicated in **Table 1** and **Figure 1**, the Transportation sector was responsible for the largest share of emissions, 48 percent or 88,957 metric tons CO_2e. It is worth noting that over 20 percent of the vehicle miles traveled in Bethlehem during 2010 were on urban interstate roads, such as I-87, and include GHG emissions from vehicles that do not belong to town residents and businesses. The Town will have limited control over highway vehicle emissions, especially trips beginning outside of its boundaries. However, Bethlehem can use this information to work with regional and state level partners to develop strategies for addressing emissions from the Transportation sector. On the local level, the Town's bicycle and pedestrian program will aim to reduce GHG emissions from local vehicles. GHG emissions from energy use in the Residential sector accounted for 31 percent of total emissions, or 58,000 metric tons CO_2e. Commercial, Industrial, and Government facilities accounted for 18 percent of Bethlehem's 2010 emissions. The community, under the leadership of Town government, will benefit from prioritizing energy efficiency and conservation within the Residential, Commercial, Industrial, and Government Building sectors.

[1] U.S. Environmental Protection Agency. Greenhouse Gas Equivalencies Calculator. 21 June 2011. 9 February 2012 http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

FIGURE 1
Bethlehem 2010 Community GHG Emissions by Sector

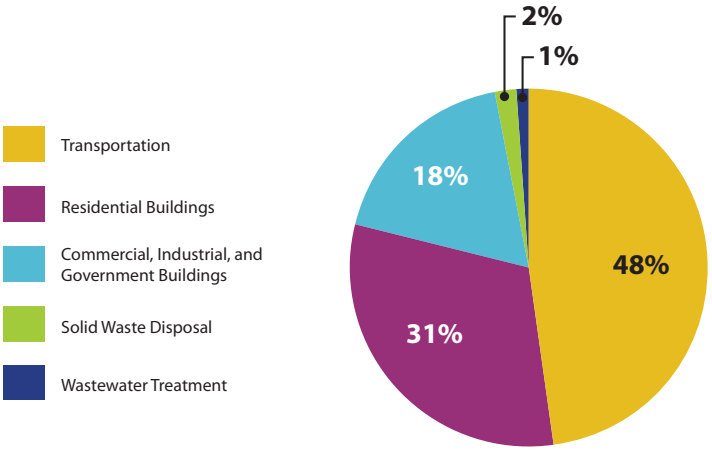


FIGURE 2
Bethlehem 2010 Community GHG Emissions by Source

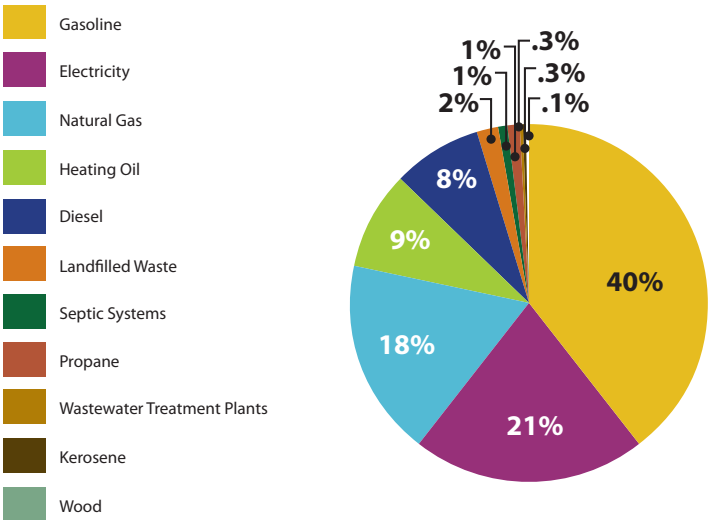


FIGURE 3
Bethlehem 2010 Government and Community GHG Emissions

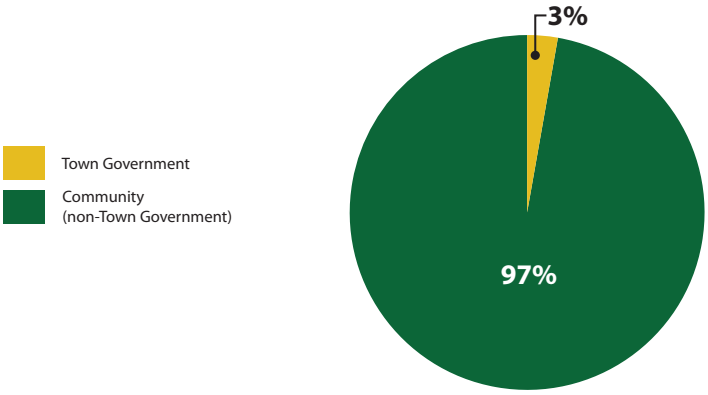


TABLE 1
Bethlehem 2010 Community GHG Emissions by Sector

SECTOR	GHG EMISSIONS (METRIC TONS CO_2e)
Transportation	88,957
Residential Buildings	58,000
Commercial, Industrial, and Government Buildings*	33,220
Solid Waste Disposal	3,922
Wastewater Treatment	2,475
Total	**186,574**

**Also includes GHG emissions from lighting and other infrastructure that may not be considered a "building."*

GHG emissions from gasoline combustion in the Transportation sector was the largest source of emissions, followed by electricity use from the Residential, Commercial, Industrial, and Government Buildings sectors. Natural gas and heating oil were significant sources as well, while non-energy sources of emissions were less significant within the town. **Table 2** and **Figure 2** illustrate the breakdown of community emissions by their source.

TABLE 2
Bethlehem 2010 Community GHG Emissions by Source

SOURCE	GHG EMISSIONS (METRIC TONS CO_2e)
Gasoline	74,862
Electricity	39,675
Natural Gas	33,874
Heating Oil	16,075
Diesel	14,095
Landfilled Waste	3,922
Septic Systems	1,854
Propane	982
Wastewater Treatment Plants	621
Kerosene	497
Wood	117
Total	**186,574**

Figure 3 demonstrates the portion of total community-wide emissions which are attributable to the Town government operations. The Town government was responsible for only three percent of overall emissions in the community. It will be important for the Town to engage businesses and residents in efforts to reduce energy and GHG emissions to have a large scale impact.

For more information contact:
Town of Bethlehem | 445 Delaware Avenue, Delmar, NY 12054 | 518-439-4955

Sustainable Bethlehem

BETHLEHEM, NEW YORK

2010 Greenhouse Gas Emissions Inventory

Full Report

Sustainable Bethlehem

Table of Contents

Sustainable Bethlehem

BETHLEHEM, NEW YORK

2010 Greenhouse Gas Emissions Inventory

The Town of Bethlehem launched Sustainable Bethlehem in July 2011. Sustainable Bethlehem is a Town led initiative to promote a healthy, sustainable, and energy secure community. To help launch this program, the Town received funding from the New York State Energy Research and Development Authority (NYSERDA) to develop a greenhouse gas (GHG) emissions inventory, review local land use regulations, and enhance the Town's existing bicycle and pedestrian program. This report details the Town's 2010[1] GHG Emissions Inventory—an analysis of energy use, costs, and GHG emissions from municipal operations as well as from the entire Bethlehem community. It is important to recognize the actions the Town has already taken to reduce energy use, costs, and GHG emissions, including:

1 The baseline year of 2010 was selected due to the availability of data and consistency with other GHG emissions inventories in the Capital District region.

- Adopted the New York State Climate Smart Communities Pledge in 2009,
- Participated in multiple NYSERDA programs to identify energy efficiency and hydroelectric opportunities in the Town's wastewater treatment and water treatment facilities,
- Improved the aeration system at the Town's wastewater treatment plant, saving 460,000 kWh of electricity annually,
- Received funding to install a 30 kW solar photovoltaic system at the Town's Elm Avenue Park Administration Building (to be installed April 2012).

The GHG Emissions Inventory will help the Town of Bethlehem and its community members identify additional energy and GHG reduction opportunities. It also provides a baseline against which reduction targets can be set, and future progress towards achieving those targets can be measured.

Government Inventory

The government operations inventory was completed according to the accounting and reporting methodologies outlined in the Local Government Operations Protocol, Version 1.1 (LGOP). The inventory includes the Town's GHG emissions from three "Scopes" as defined by the WRI/WBCSD[2] *GHG Protocol Corporate Standard* and assesses the emission of all six internationally recognized greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Scope 1: Direct GHG emissions from Town vehicle fuel combustion and leaking refrigerants as well as from combustion of natural gas, propane, and heating oil in Town buildings.

Scope 2: Indirect GHG emissions associated with purchased electricity. These emissions occur at an electric power plant that is not owned by the Town, but are the result of electricity consumption occurring within Town government operations.

Scope 3: All other indirect GHG emissions (those associated with Town government activities but do not occur in Town-owned facilities or vehicles). Two sources of Scope 3 emissions were included in this GHG inventory—government generated solid waste disposal and employee commuting.

As recommended in the LGOP, this inventory includes all Scope 1 and Scope 2 GHG emissions, as well as Scope 3 emissions from government generated solid waste and employee commuting, that fall within the Town of Bethlehem's operational control.[3] This includes buildings, vehicles, streetlights, solid waste disposal, wastewater treatment, and employee commuting.

To report emissions in a way that is relevant to the Town's budget, operations, and planning strategies, GHGs were reported according to the following sectors established in the LGOP:

- Buildings and Other Facilities[4]
- Solid Waste Facilities[5]
- Streetlights and Traffic Signals[6]
- Wastewater Facilities[7]
- Water Delivery and Treatment Facilities[8]

2 World Resources Institute/World Business Council for Sustainable Development

3 "A local government has operational control over an operation if the local government has the full authority to introduce and implement its operating policies at the operation." Local Government Operations Protocol, Version 1.1, p. 14. See Chapters 3 and 4 of the LGOP (Version 1.1 released May 2010) for information on defining operational and organizational boundaries.

4 The Buildings & Other Facilities sector includes GHG emissions and energy costs from buildings (except for the Rupert Road Transfer Station and Water and Wastewater Treatment plants), facilities, and outdoor lighting associated with particular buildings/facilities.

5 The Solid Waste Facilities sector includes GHG emissions from energy consumption at the Town's Rupert Road Transfer Station.

6 The Streetlights and Traffic Signals sector includes emissions from electricity used by Town-operated streetlights and traffic signals.

7 The Wastewater Facilities sector includes GHG emissions from wastewater treatment plants and sewer pumping stations, as well as non-energy related GHG emissions from wastewater treatment processes.

8 The Water Delivery and Treatment Facilities sector includes GHG emissions from energy use only at water treatment and delivery facilities (including pumps and other distribution equipment). Per the LGOP, any GHG emissions from water treatment processes are not included in municipal inventories.

- Vehicle Fleet[9]
- Employee Commute (Scope 3)[10]
- Government Generated Solid Waste (Scope 3)[11]

Results

In 2010, The Town of Bethlehem's municipal operations were responsible for the emission of 5,541 metric tons of carbon dioxide equivalent (metric tons CO_2e). This is equivalent to the annual GHG emissions from 1,086 passenger vehicles.[12] The breakdown of emissions by sector is illustrated in **Table 1** and **Figure 1**. The majority of GHG emissions were the result of energy use and treatment processes in the Wastewater Facilities sector. This was followed closely by emissions from fuel use in the Vehicle Fleet sector. Energy use in the Water Delivery and Treatment Facilities and the Buildings and Other Facilities sectors also accounted for a combined 28 percent of emissions. In addition to the GHG emissions produced, energy consumption in Town operations totaled $1,633,976 in energy costs in 2010.

Figure 1:
Bethlehem 2010 Government GHG Emissions by Sector

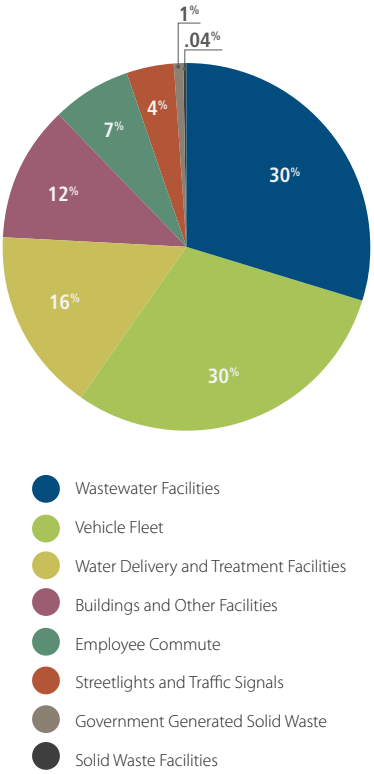


Table 1: Bethlehem 2010 Government GHG Emissions and Energy Costs by Sector

SECTOR	GHG EMISSIONS (METRIC TONS CO_2e)
Wastewater Facilities	1,681
Vehicle Fleet	1,631
Water Delivery and Treatment Facilities	908
Buildings & Other Facilities	687
Employee Commute	374
Streetlights & Traffic Signals	230
Government Generated Solid Waste	28
Solid Waste Facilities	2
TOTAL	**5,541**

9 The Vehicle Fleet includes GHG emissions and energy costs from fuel consumption in the Town's on-road vehicles, mobile equipment, and off-road vehicles. This sector also includes leaked refrigerants from vehicle air conditioning systems.

10 The Employee Commute sector includes GHG emissions from the personal vehicles commuting to work at Town government facilities.

11 The Government Generated Solid Waste sector accounts for methane produced by the decomposition of landfilled waste generated by the Town's government operations but disposed of at facilities that were not operated by the Town.

12 U.S. Environmental Protection Agency. Greenhouse Gas Equivalencies Calculator. 21 June 2011. 9 February 2012. **http://www.epa.gov/cleanenergy/energy-resources/calculator.html**

Table 2 reports the Town's GHG emissions by Scope, as well as by sector and source. It is important to note that when aggregating GHG emissions across a state or region, only Scope 1 emissions can be added together. For example, the consumption of electricity is a Scope 2 source of GHG emissions for Bethlehem, but would be a Scope 1 source of emissions for the power generation facility producing the electricity. As such, adding electricity GHG emissions from the Town and electric generation facility would result in double counting.

Table 2: Bethlehem 2010 Government GHG Emissions by Scope, Sector, and Source

SECTOR AND SOURCE	GHG EMISSIONS (METRIC TONS CO_2e)
SCOPE 1	**2,868**
Wastewater Facilities	**669**
Wastewater treatment processes (non-energy)	621
Fuel Oil	37
Propane	7
Natural Gas	4
Buildings and Other Facilities	**320**
Natural Gas	153
Fuel Oil	141
Propane	26
Vehicle Fleet	**1,631**
Gasoline	862
Diesel	696
Leaked refrigerant	73
Water Delivery and Treatment Facilities	**248**
Fuel Oil	221
Natural Gas	17
Propane	10
SCOPE 2	**2,271**
Wastewater Facilities	**1,012**
Purchased Electricity	1012
Water Delivery and Treatment Facilities	**660**
Purchased Electricity	660
Buildings and Other Facilities	**366**
Purchased Electricity	366
Streetlights & Traffic Signals	**230**
Purchased Electricity	230
Solid Waste Facilities	**3**
Purchased Electricity	3
SCOPE 3	**402**
Employee Commute	**374**
Gasoline and Diesel	374
Government Generated Solid Waste	**28**
Methane emissions from decomposing waste in landfills	28

Energy Consumption (Scopes 1 and 2)

With the exception of renewable sources such as wind and solar, energy use is closely linked to GHG emissions. Energy consumption from municipal buildings, lighting, vehicles, and water and sewer infrastructure[13] contributed 80 percent of GHG emissions in 2010. **Table 3** provides a summary of Scope 1 and 2 energy use, costs, and GHG emissions by sector and source. Additional breakdowns of data are provided in the following pages.

Table 3: Bethlehem 2010 Government Energy Use, Costs, and GHG Emissions by Sector and Source (Scopes 1 and 2)

SECTOR	ENERGY USE (MMBtu)	ENERGY COST ($)	GHG EMISSIONS (METRIC TONS CO_2e)
Vehicle Fleet*	**23,209**	**$410,093.48**	**1,558**
Gasoline	12,265	$218,023.02	862
Diesel	10,944	$192,070.46	696
Wastewater Facilities**	**11,774**	**$436,445.26**	**1,060**
Electricity	11,088	$423,675.48	1,012
Heating Oil	501	$8,906.91	37
Propane	109	$2,470.08	7
Natural Gas	76	$1,392.79	4
Water Treatment and Delivery Facilities	**10,683**	**$334,231.23**	**908**
Electricity	7,234	$280,141.51	660
Heating Oil	2,965	$46,771.99	221
Natural Gas	321	$3,729.14	17
Propane	163	$3,588.59	10
Buildings and Other Facilities	**9,218**	**$228,182.39**	**687**
Electricity	4,012	$158,913.12	366
Natural Gas	2,878	$26,531.50	153
Heating Oil	1,893	$33,175.55	141
Propane	435	$9,562.22	27
Streetlights and Outdoor Lighting***	**2,522**	**$223,604.98**	**230**
Electricity	2,522	$223,604.98	230
Solid Waste Facilities (Rupert Rd. Transfer Station)	**26**	**$1,418.78**	**2**
Electricity	26	$1,418.78	2
TOTAL	**57,432**	**$1,633,976.12**	**4,445**

* *The Vehicle Fleet sector also produced 73 metric tons of CO2e from refrigerants leaking from vehicle air-conditioning systems. These emissions were estimated based on a default quantity of refrigerant leaked per vehicle as defined in the LGOP. Data on the actual amount of refrigerant leaked from County vehicles were unavailable for 2010.*

** *The Wastewater Facilities sector also produced 621 metric tons of CO_2e from non-energy wastewater treatment process emissions.*

*** *Approximately half of the energy costs shown here ($111,013.80) for streetlights and outdoor lighting were for fees for use of streetlight equipment (poles, fixtures, etc) and not actual electricity consumption.*

13 Water and sewer infrastructure from the Water Treatment and Delivery Facilities and Wastewater Facilities sectors include energy consumption from treatment plants, water and sewer pumping stations, and water storage tanks. The Wastewater Treatment sector also produced non-energy related GHG emissions from wastewater treatment processes. The "Wastewater Facilities (Scopes 1 and 2)" section of this report analyzes this sector in more detail.

Vehicle Fleet

As shown in **Table 3** and **Figure 2**, the Vehicle Fleet sector accounted for 40 percent of energy consumption. This is expected to be a significant source of emissions within municipal operations. This is similar to the City of Albany's Vehicle Fleet, which contributed 35 percent of municipal GHG emissions in 2009. However, Albany (population 93,849[14]) had a fleet that was three times the size of the Bethlehem fleet and emitted four times as many GHG emissions.[15] The Town's vehicle fleet consists of 204 vehicles and 89 pieces of equipment, all of which run on either gasoline or diesel fuel. Finding fuel reduction opportunities for its fleet will be an important component of any energy reduction or sustainability planning for the Town.

Table 4: Bethlehem Vehicle Fleet Summary 2010

FUEL TYPE	GALLONS	ENERGY (MMBtu)	GHG EMISSIONS (METRIC TONS CO_2e)	COST
Gasoline	98,155	12,264	862	$218,023.02
Diesel	79,282	10,944	696	$192,070.46
Total	**177,437**	**23,209**	**1,558**	**$410,093.48**

Figure 3 shows how vehicle energy consumption breaks down by Town Department.

Figure 2:
Bethlehem 2010 Government Energy Use (MMBtu)

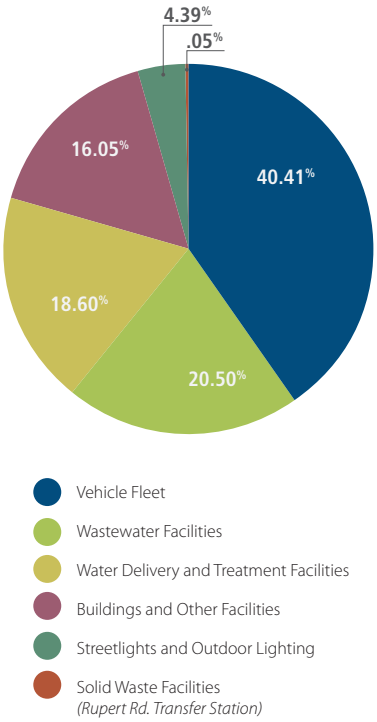
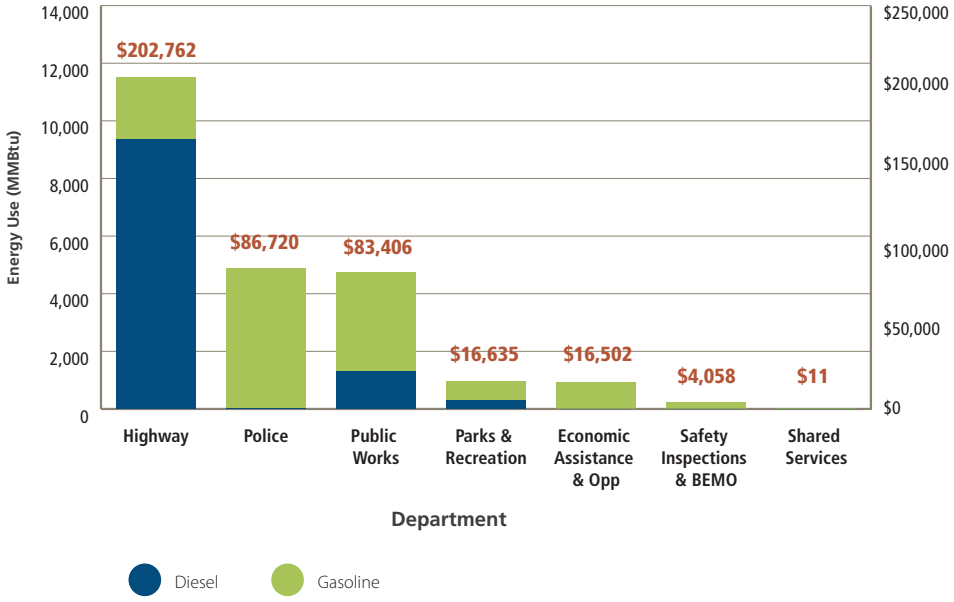


Figure 3: Town of Bethlehem 2010 Fleet Energy Use and Costs, by Department



Water and Wastewater Operations

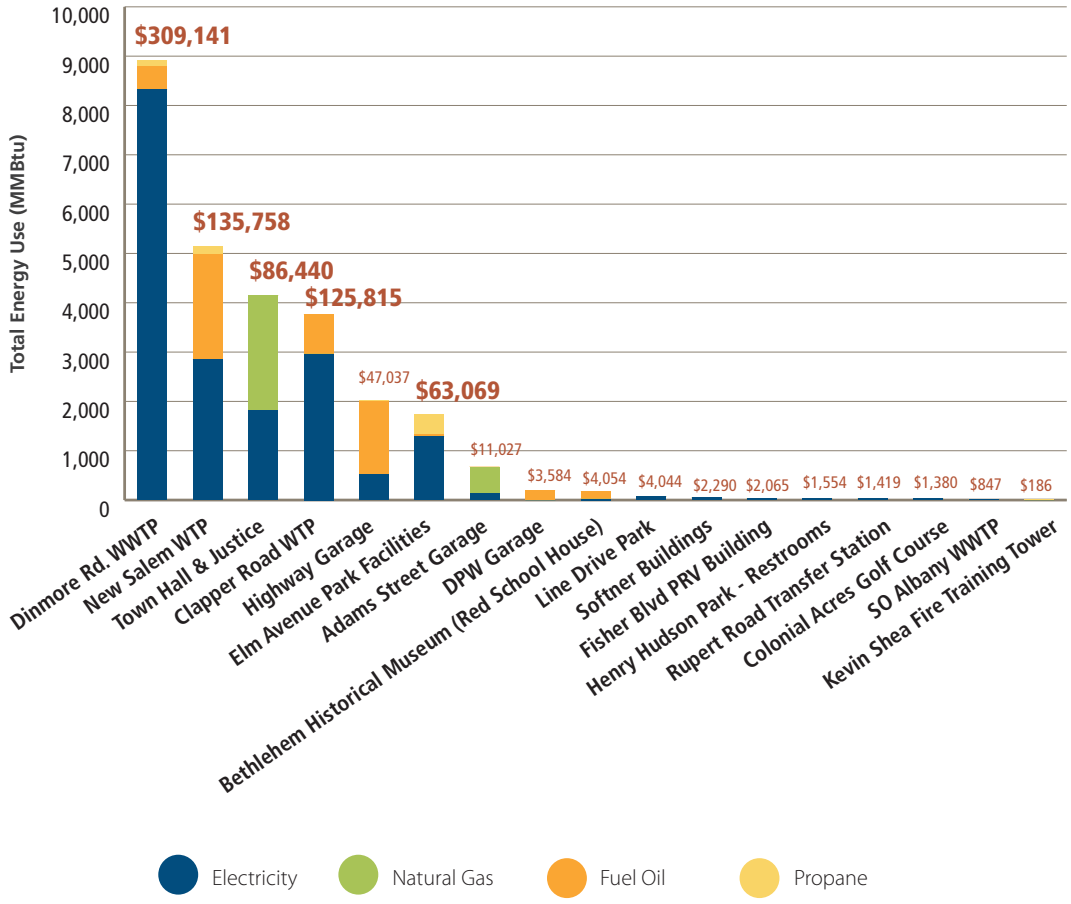
Not surprisingly, since water and wastewater treatment operations require significant energy use, the Water Treatment and Delivery and Wastewater Treatment sectors accounted for a combined 40 percent of energy use. Accordingly, the Town's water and wastewater treatment plants comprised three of the Town's top seven facilities in terms of energy use and GHG emissions. **Figure 4** illustrates energy use, energy costs, and GHG emissions from all Town

14 U.S. Census Bureau, 2009 American Community Survey

15 City of Albany, NY, Mayor's Office of Energy & Sustainability, "City of Albany 2009 Greenhouse Gas Emissions Inventory," Winter 2011.

facilities. The Dinmore Road Wastewater Treatment Plant had the highest energy use, expenditures, and emissions of all Town facilities in 2010. It is important to note, however, that highest usage does not necessarily translate to least efficiency. The Town should track energy performance of its water and wastewater facilities within the Energy Star Portfolio Manager tool and have energy audits of the facilities conducted as appropriate.

Figure 4: Town of Bethlehem 2010 Energy Use and Costs, by Building



Energy Use in Buildings

In addition to completing the GHG inventory for Town operations, this project included a process of developing a profile of all Town buildings, mapping their utility accounts, and calculating energy consumption and costs. The Town provided additional building profile information, including year built, square footage, and space type, that was used to set up a Portfolio Manager account through the EPA's Energy Star program. This free online tool will allow the Town to track energy use and costs within each building over time and monitor changes in consumption and energy performance. Each eligible building will receive an energy performance rating based on national average energy use of comparable building types. This rating will be used to determine a building's eligibility for an Energy Star rating and certification. This data must be maintained regularly to continue to be useful. Building information must be complete, accurate, and energy data must be up to date within 120 days. The Town should designate someone to maintain its Portfolio Manager account and track energy use in buildings. The Town should also closely track its energy consumption for non-building facilities, equipment, and vehicles using other tracking tools, such as those provided as part of this project. As mentioned in the previous section, analysis of overall energy consumption alone does not suffice for providing the information necessary to target energy improvements.

Portfolio Manager and the energy data spreadsheets provided with this report will be important tools for the Town to analyze energy intensity and where efficiency can be improved.

PORTFOLIO MANAGER

Home > My Portfolio > **Town Hall & Justice**

Facility Summary: **Town Hall & Justice**
How do I use this page?

Building ID: 3024243
Level of Access: Building Data Administrator

Electric Distribution Utility: Niagara Mohawk Power Corp [National Grid Plc]
Regional Power Grid: NPCC Upstate NY
Select my Power Generation Plant to calculate my electric emissions rate
Electric Emissions Rate ($kgCO_2e/MBtu$): 91.3 (what is this?)

Generate a Statement of Energy Performance for uses other than applying for the ENERGY STAR.

General Information Edit	
Address: 445 Delaware Avenue , Bethlehem, NY 12054	
Year Built: 1967	
Property Type: Single Facility	
Baseline Rating: 66	**Current Rating: 65**
View Period Ending Dates	
Water Period Ending Dates Current: N/A Baseline: N/A	**Energy Period Ending Dates** Current: December 2011 Baseline: December 2010
Eligibility for the ENERGY STAR	
Not Eligible: Rating must be 75 or above	

Space Use Add Space

Space Name	Space Type	Floor Area (Sq. Ft.)	% Floor Area
Town Hall/Justice Total	Office	49,436	100
Total		49,436	100

Because more than 50% of your building is Office, your building is designated as Office within Portfolio Manager. This building may be eligib into account all of the space types you have listed. If you cannot see a rating for this building, you can be compared to the national average fo

Due to rounding, the % Floor Area Total may not always equal 100%.

Energy Meters Add Meter | Update Multiple Meters | View All Meter Data in Excel

Meter Name	Energy Type
Nat. Grid Acct [redacted]	Electricity - Grid Purchase (kWh (thousand Watt-hours))
Nat. Grid Acct [redacted]	Natural Gas (therms)

No Metering Configuration has been set for this facility. A metering configuration may be established to indicate whether the whole facility en

Snapshot of Bethlehem's Town Hall & Justice building from Portfolio Manager.

Figure 5:
Bethlehem 2010 Government Energy Cost ($)

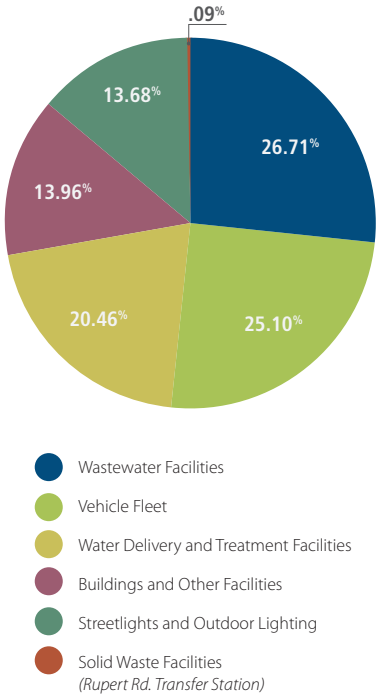


Figure 5 shows the breakout of energy costs across all sectors. Similarly to overall energy use, the Wastewater Treatment, Vehicle Fleet, and Water Treatment and Delivery sectors had the highest portions of energy costs for the Town. Streetlights and Outdoor Lighting had a higher cost percentage than usage percentage due to the costs associated with use of utility-owned fixtures and equipment.

Wastewater Facilities (Scopes 1 and 2)

This sector includes GHG emissions from energy consumption in the Town's sewer pumping stations and two wastewater treatment plants (WWTPs) – the Dinmore Road WWTP (or Bethlehem WWTP) and the South Albany WWTP[16] - as well as non-energy GHG emissions from the chemical and biological processes used to treat wastewater. As discussed in previous

16 The South Albany WWTP is a small aerobic treatment facility serving a 23 home cluster. It was a minor source of GHG emissions in the Wastewater Facilities sector, contributing less than 1 percent of the sector's GHG emissions.

sections, the Wastewater Facilities sector contributed the highest proportion (along with Vehicle Fleet) of the Town's overall GHG emissions (30 percent or 1,681 MTCDE) and the Dinmore Road WWTP had the highest energy costs and GHG emissions of any Town facility. This breakdown is expected given that the treating of wastewater requires energy-intensive processes.

Figure 6:
Bethlehem Wastewater Facilities GHG Emissions by Type

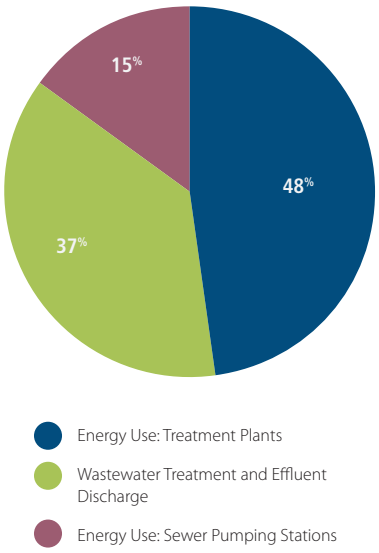


Figure 6 shows the distribution of GHG emissions across the Wastewater Facilities sector. Because both WWTPs used aerobic treatment systems in 2010, it was assumed that neither plant produced methane. Energy use at the Town's WWTPs contributed nearly half of GHG emissions, followed by nitrous oxide emissions from wastewater treatment and effluent discharge (37 percent). Energy use from sewer pumping stations contributed 15 percent to the sector's overall GHG emissions.

Employee Commute (Scope 3)

GHG emissions from municipal employees commuting to work produced approximately 374 metric tons CO_2e in 2010, or six percent of overall emissions. As a Scope 3 source, Employee Commute GHG emissions are only indirectly related to the Town's government operations. The Town can create initiatives to encourage different commuting patterns, but the decision to alter commuting behavior ultimately lies with each employee.

The Employee Commute results were estimated based on federal and state-level transportation statistics from the Bureau of Transportation Statistics as well as a nearby local government employee commute survey distributed in September and October 2011[17]. Assumptions had to be made on the number of individuals employed by the Town in 2010 and the amount of paid time off used by each employee. It was also assumed that employees carpooled to work 5 days a week. As such, the Employee Commute GHG results should be viewed as an approximation, and not an exact calculation, of actual GHG emissions since much of it is based on proxy data as opposed to actual activity data. Further details on the methods applied for this sector can be found in the Methodology report.

Government Generated Solid Waste Disposal (Scope 3)

In 2010, the Town of Bethlehem landfilled approximately 62.7 short tons (tons) of municipal solid waste (MSW)[18] generated by government operations. The Town also landfilled 106.9 tons of sludge from the Town's two WWTPs. All solid waste disposed of by the Town in 2010 was sent to the City of Albany's Rapp Road landfill and is estimated to produce 28 metric tons CO_2e of methane[19]. This equated to less than one percent of the Town of Bethlehem's overall GHG emissions. Government generated solid waste disposal is considered Scope 3 since the GHG emissions occur at landfills that are not operated by the Town. While it is only a small portion of the Town's total emissions, actions to reduce the emissions associated with this sector might include waste reduction policies or improving recycling rates within Town facilities.

17 Information gathered from a survey distributed to Schenectady County employees was used, in part, for estimating emissions from this sector. Further details on the employee commute calculations can be found in the Methodology report.

18 According to the U.S. EPA, municipal solid waste (MSW) is defined as everyday waste produced by a variety of sectors, such as residents, businesses, schools, governments, and homes. Municipal solid waste does not include hazardous or toxic materials, construction and demolition (C&D) waste, or electronic waste. U.S. Environmental Protection Agency. Wastes - Non-Hazardous Waste - Municipal Solid Waste. 27 January 2012. 7 February 2012. **http://www.epa.gov/epawaste/nonhaz/municipal/index.htm**

19 Organic solid waste decomposing a landfill emits methane and carbon dioxide over a lengthy decomposition period. This inventory reports GHG emissions from all of the methane that Town government waste deposited in 2010 will produce over its entire decomposition cycle, even though many of these emissions occur after 2010. Carbon dioxide from organic waste decomposing in the landfill was excluded from the inventory since it is assumed the organic material would have produced carbon dioxide through its natural decomposition cycle. Methane is produced when the organic material decays in landfill and would not normally occur through the natural decomposition process.

Community Inventory

In 2010, the Bethlehem community generated 186,574 metric tons CO_2e. This is equivalent to the annual GHG emissions from 36,583 passenger vehicles.[20] Bethlehem residents produced 1.72 metric tons CO_2e per person in 2010, a per capita GHG emissions rate slightly lower than the 1.78 per capita emissions rate for New York State in 2008.[21] GHG emissions calculated in the community-wide inventory include direct and indirect GHG emissions reported in five sectors:

Buildings: GHG emissions from energy use in buildings, outdoor lighting, and other infrastructure. Sources of energy include: electricity, natural gas, fuel oil, kerosene, propane, and wood. The Buildings sector is further broken down into the Residential Buildings and Commercial, Industrial, and Government Buildings subsectors.

Transportation: GHG emissions from gasoline and diesel vehicles traveling within the geographical boundary of Bethlehem. This sector includes vehicles that do not necessarily belong to Bethlehem businesses and residents, such as vehicles passing through the town on I-87, as well as vehicle trips ending and originating within the town. It excludes GHG emissions from Bethlehem vehicles once those vehicles have left the town boundaries.

Solid Waste Disposal: GHG emissions from disposal of solid waste in a landfill. This inventory quantifies the methane emissions expected to be produced over an entire decomposition cycle from waste generated by Bethlehem residents and businesses landfilled in 2010.[22]

Wastewater: GHG emissions from the processes used to treat wastewater at the Town's two wastewater treatment plants and from private septic systems. This sector only encompasses GHG emissions from biological and chemical treatment processes – it does not include GHG emissions from energy used to operate the treatment facilities. Those emissions are reported in the Commercial, Industrial, and Government Buildings sector.

Industrial Process: Non-energy GHG emissions from manufacturing and industrial practices such as Ammonia, HCFC-22, and adipic acid production. It was assumed that Bethlehem did not have GHG emissions from the Industrial Process sector in 2010. Using a list of Bethlehem industrial entities provided by the Town, it was determined that there were three industrial gas suppliers in Bethlehem potentially producing Industrial Process emissions. However, when contacted, two of the companies said they did not produce chemicals categorized in the Industrial Process sector at their Bethlehem facilities. The third company did not respond to inquiries. For more information on Industrial Process emissions, see the "Community Inventory" section of the Methodology.

20 U.S. Environmental Protection Agency. Greenhouse Gas Equivalencies Calculator. 21 June 2011. 9 February 2012. **http://www.epa.gov/cleanenergy/energy-resources/calculator.html**

21 The 2010 per capita GHG emissions rate for Bethlehem was calculated using GHG emissions from the Residential Buildings sector and the Town's 2010 population according to the 2010 U.S. Census. The New York State per capita emissions rate was calculated using residential GHG emission from fuel combustion in Table 3-1 of the Inventory and Forecast of New York State's Greenhouse Gas Emissions from the New York State Climate Action Council's 2010 Interim Report: **http://www.nyclimatechange.us/ewebeditpro/items/O109F24015.pdf.** State level population data were from the U.S. Census Bureau's 2008 American Community Survey.

22 Organic solid waste decomposing in a landfill emits methane and carbon dioxide over a lengthy decomposition period. This inventory reports GHG emissions from all of the methane that government waste deposited in 2010 will produce over its entire decomposition cycle, even though many of these emissions occur after 2010. Carbon dioxide from organic waste decomposing in the landfill was excluded from the inventory since it is assumed the organic material would have produced carbon dioxide through its natural decomposition cycle. Methane is produced when the organic material decays in landfill and would not normally occur through the natural decomposition process.

Table 1 and **Figures 1 and 2** report community GHG emissions for Bethlehem by sector and source.

Table 1: Bethlehem 2010 Community GHG Emissions by Sector and Source

SECTOR/SOURCE	GHG EMISSIONS (METRIC TONS CO_2e)
Transportation	**88,957**
Gasoline	74,862
Diesel	14,095
Residential Buildings	**58,000**
Natural Gas	27,812
Electricity	19,648
Fuel Oil	9,318
Propane	707
Kerosene	423
Wood	92
Commercial, Industrial, and Government Buildings*	**33,220**
Electricity	20,027
Natural Gas	6,062
Fuel Oil	6,757
Propane	275
Kerosene	74
Wood	25
Solid Waste Disposal	**3,922**
Landfilled Waste	3,922
Wastewater Treatment	**2,475**
Septic Systems	1,854
Treatment Plants	621
Total	**186,574**

* *Also includes GHG emissions from lighting and other infrastructure that may not be considered a "building."*

Figure 1:
Bethlehem 2010 Community GHG Emissions by Sector

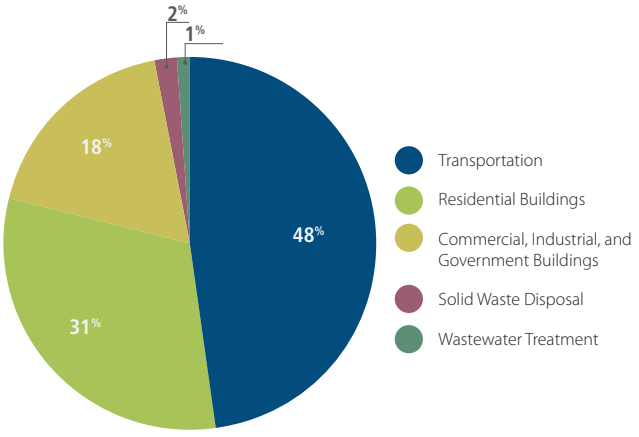
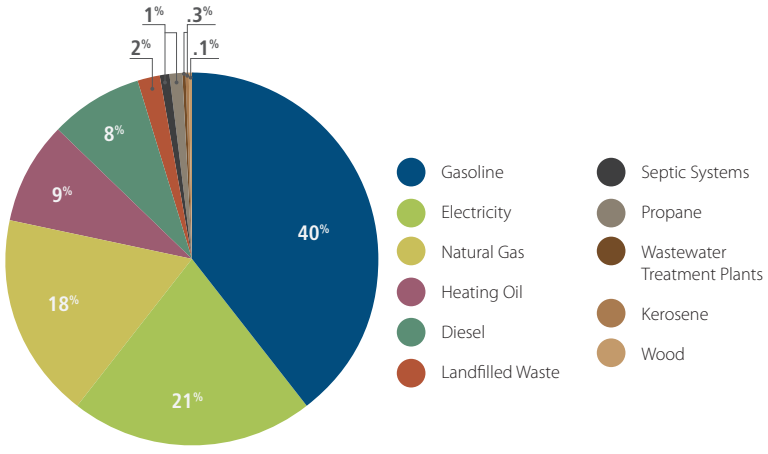
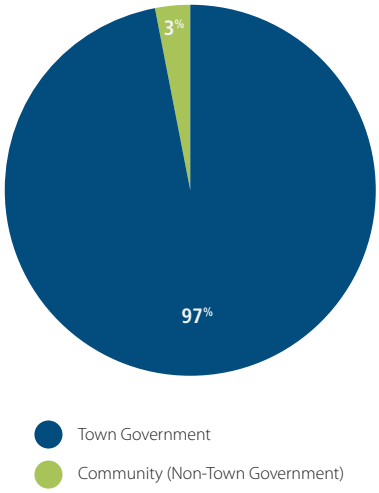


Figure 2:
Bethlehem 2010 Community GHG Emissions by Source*



* *Percentage totals may not add up to exactly 100% due to rounding.*

Figure 3:
Bethlehem 2010 Government and Community GHG Emissions



The following chart demonstrates the portion of total community-wide emissions which are attributable to the Town government operations. As seen below, the Town government is responsible for only three percent of overall emissions in the community. This is a fairly typical breakout of government emissions when viewed in the context of other small communities in New York (Town of Bedford – 3 percent [23], New Rochelle – 2 percent[24], Village of Mamaroneck – 2 percent[25]).

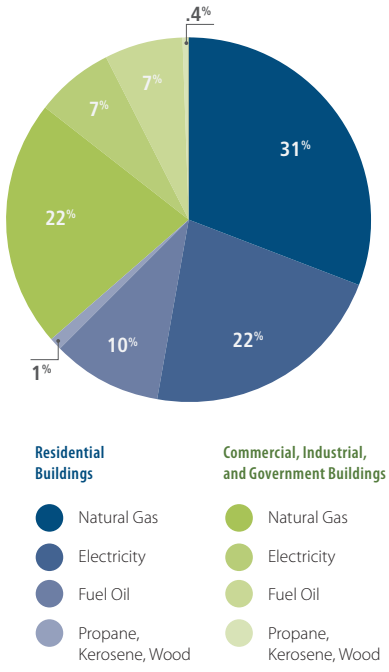
Transportation

The transportation sector was responsible for the largest share of emissions, 48 percent or 88,957 metric tons CO_2e. It is worth noting that twenty-three percent of the 198,409,755 vehicle miles traveled (VMT) in Bethlehem during 2010 were on urban interstate roads, such as I-87, and include GHG emissions from vehicles that do not belong to town residents and businesses. The Town will have limited control over highway vehicle emissions, especially trips beginning outside of its boundaries. However, Bethlehem can use this information to work with regional and state level partners to develop strategies for addressing emissions from the Transportation sector. On the local level, the Town's bicycle and pedestrian program will aim to reduce GHG emissions from local vehicles.

Buildings

Energy use in buildings and other types of infrastructure, such as outdoor lighting and pumping stations, from both the Residential sector as well as the Commercial, Industrial, and Government sector, were responsible for a combined 91,220 metric tons CO_2e or nearly half (49 percent) of overall GHG emissions in 2010. GHG emissions from energy use in the Residential sector accounted for 31 percent of total emissions, or 58,000 metric tons CO_2e. Commercial, Industrial, and Government facilities accounted for 18 percent of Bethlehem's 2010 emissions.[26] The community, under the leadership of Town government, will benefit from prioritizing energy efficiency and conservation within the Residential, Commercial, Industrial, and Government Building sectors. **Figure 4** shows GHG emissions in the Buildings sector by subsector and source.

Figure 4:
Bethlehem 2010 Building GHG Emissions by Subsector and Source



23 Town of Bedford. "Town of Bedford, New York Greenhouse Gas Emissions Analysis 2004 Community Emissions Inventory & 2004 Government Operations Emissions Inventory." 2009. **http://www.bedfordny.info/html/pdf/green/2009%20GHG%20Inventory%20Report.pdf**

24 City of New Rochelle. "New Rochelle's Greenhouse Gas Inventory." 2010. http://ny-newrochelle.civicplus.com/DocumentView.aspx?DID=736

25 Village of Mamaroneck. "Village of Mamaroneck Local Waterfront Revitalization Program Working Draft (September 2011)." 2011. **http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_WebDocs/COMPLETE%20WORKING%20DRAFT.pdf**

26 GHG emissions from power generation facilities located within Bethlehem were partially or fully excluded from this inventory. It was not possible to estimate GHG emissions from power generation separately from those associated with community-wide energy consumption without potentially double counting emissions in the Buildings sector of this inventory. However, GHG emissions data from the power generation facilities located within Bethlehem, such as SABIC Innovative Plastics' combined heat and power (CHP) facility and the Bethlehem Energy Center, can be accessed through the U.S. EPA's Greenhouse Gas Emissions from Large Facilities database: **http://ghgdata.epa.gov/ghgp/main.do**

Solid Waste

Disposal of solid waste generated by Bethlehem residents, businesses, and visitors accounted for two percent of GHG emissions in Bethlehem or 3,922 metric tons CO_2e. Landfilled municipal solid waste (MSW)[27] was responsible for 99 percent of GHG emissions in this sector. **Table 2** and **Figure 5** show solid waste disposal tonnages and GHG emission by waste type for Bethlehem in 2010.

Figure 5:
Bethlehem 2010 Solid Waste GHG Emissions by Waste Type

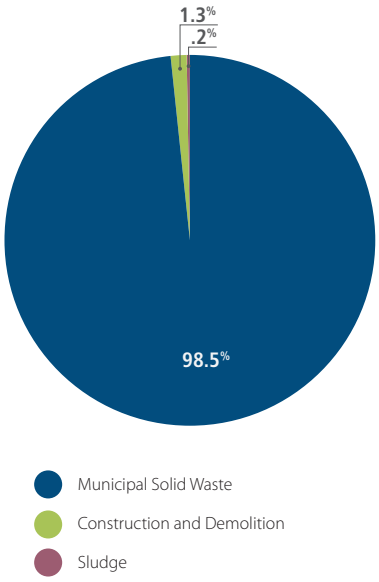


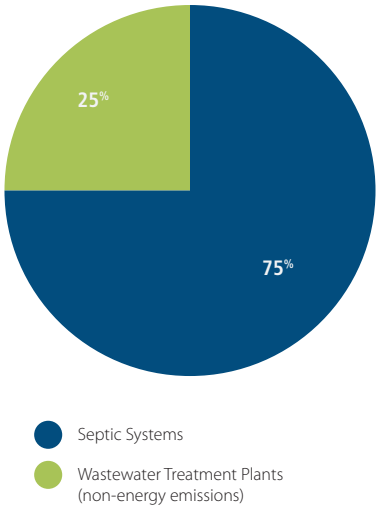
Table 2: Solid Waste and GHG Emissions by Waste Type

WASTE TYPE	WASTE LANDFILLED (TONS)	GHG EMISSIONS (METRIC TONS CO_2e)
Municipal Solid Waste	11,908	3,862
Construction and Demolition	953	53
Sludge	63	7
TOTAL	**12,924**	**3,922**

Wastewater

Wastewater was the smallest sector, contributing only one percent, 2,475 metric tons CO_2e, of overall GHG emissions in Bethlehem. Wastewater was treated at Town-operated wastewater treatment plants (WWTPs) – the Dinmore Rd. (Bethlehem) WWTP and the South Albany WWTP – and by private septic systems. An estimated 24,702 residents (9,877 households) were served by WWTPs and another 8,954 by private septic systems.[28] The emissions associated with the WWTPs are included in the Government Inventory since they are owned and operated by the Town. Both WWTPs utilized aerobic treatment processes, which do not produce methane emissions. **Figure 6** shows Bethlehem's nitrous oxide emissions from wastewater treatment processes and effluent discharge as well as methane emissions from private septic systems. Even though fewer residents were served by septic systems than by WWTPs, septic systems accounted for 75 percent of GHG emissions in the Wastewater sector.

Figure 6:
Bethlehem 2010 Wastewater GHG Emissions by Source



Conclusion and Next Steps

The Town of Bethlehem has developed an invaluable tool through the process of completing its GHG inventory for both government operations and the Bethlehem community. Bethlehem now has a baseline measurement of its energy consumption, costs, and emissions data from which it can determine the priority sectors to target for reduction as well as providing a benchmark for future performance. It will be essential for the Town to keep this data up to date over time and to revisit its annual consumption and emissions numbers in order to evaluate progress in its climate action and energy reduction goals.

27 According to the U.S. EPA, municipal solid waste (MSW) is defined as everyday waste produced by a variety of sectors, such as residents, businesses, schools, governments, and homes. Municipal solid waste does not include hazardous or toxic materials, construction and demolition (C&D) waste, or electronic waste. U.S. Environmental Protection Agency. Wastes - Non-Hazardous Waste - Municipal Solid Waste. 27 January 2012. 7 February 2012. **http://www.epa.gov/epawaste/nonhaz/municipal/index.htm**

28 The Dinmore Rd. WWTP also served 487 commercial users. This was represented in the emissions calculations by using a default "industrial" factor. See the Methodology for more information.

Sustainable Bethlehem

BETHLEHEM, NEW YORK

2010 Greenhouse Gas Emissions Inventory

Methodology

Sustainable Bethlehem

Table of Contents

Sustainable Bethlehem

BETHLEHEM, NEW YORK

2010 Greenhouse Gas Emissions Inventory

Introduction

This Methodology report is intended to serve as a supplement to the Bethlehem Government and Community Greenhouse Gas Inventory Reports. It details the processes, data sources, and assumptions utilized in each sector of the government operations and community-wide GHG inventories and provides the guidance necessary for the Town to update the inventory. The Government Operations Greenhouse Gas Inventory is consistent with the *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories* (Version 1.1, Released in May 2010). The Local Government Operations Protocol (LGOP) was developed in partnership with and adopted by the California Air Resources Board, California Climate Action Registry, ICLEI – Local Governments for Sustainability USA, and the Climate Registry. While no such protocol exists at this time for a Community Scale Greenhouse Gas Inventory, there are a number of industry best practices that were utilized in the development of the Community Inventory and many methods from the LGOP were applied to the community-scale data.

GHG emissions from Bethlehem's government operations and the community as a whole were determined using the same general process:

1. **Data collection.** Activity data necessary to calculate GHG emissions were collected from the appropriate individuals or departments in the Town of Bethlehem and relevant community energy vendors and partners.
2. **Data processing.** Data were often provided in a format that required reformatting or supplemental calculations prior to use in calculating GHG emissions.
3. **Account mapping (stationary energy use from government operations only).** In the account mapping phase, utility and other fuel provider account numbers were matched to the actual government buildings, facilities, departments, or lighting fixtures that used the energy.
4. **GHG Calculations.** Once activity data were in a useable format, GHG emissions were calculated based on the appropriate emissions factors and formulas from the LGOP.

All greenhouse gas (GHG) emissions were reported in units of metric tons of carbon dioxide equivalent (metric tons CO_2e).

Government Inventory

Defining GHG Emissions, Sources, and Sectors

The Government Inventory accounts for greenhouse gas (GHG) emissions from Town government facilities and operations according to the organizational and operational boundaries outlined in the LGOP.[1] Per the LGOP, this inventory assessed emissions of the following GHGs[2]:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)

GHG emissions are reported by source, sector, and scope. GHG emissions "sources" are those activities that directly or indirectly result in the emission of GHGs. Examples include: energy consumption in buildings, fuel consumption in vehicles, methane emissions from landfills, and fugitive emissions from leaking refrigerants. A "sector" refers to various property or activity types within a local government's operations that are likely to produce GHG emissions. GHG emissions can also be categorized by "scope," or the level of control a local government has over the emissions source. **Table 1** provides definitions for Scope 1, 2, and 3 emissions. Definitions of sectors specific to local government operations are provided in **Table 2**. The LGOP stipulates that local governments should calculate GHG emissions from all Scope 1 and Scope

1 See Chapters 3 and 4 of the LGOP (Version 1.1 released May 2010) for information on defining operational and organizational boundaries.

2 PFCs and SF_6 were not found to be emitted from Bethlehem's government operations. PFCs are sometimes used in refrigeration, air-conditioning, and fire-suppression equipment. SF_6 emissions are relevant for municipalities that own transmission and distribution lines for electricity, which Bethlehem did not operate in 2010.

2 emissions sources that fall within their operational control[3], and encourages municipalities to report as many Scope 3 emissions sources as possible.

Table 1. Definitions of GHG Emissions Scopes

Scope 1	All direct GHG emissions (with the exception of direct CO_2 emissions from biogenic sources*)
Scope 2	Indirect emissions associated with the consumption of purchased or acquired electricity, steam, or heat
Scope 3	All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the Town, outsourced activities, waste disposal in facilities not operated by the Town, etc.

Source: California Air Resources Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry. "Local Government Operations Protocol For the quantification and reporting of greenhouse gas emissions inventories." Chapter 4.1. Version 1.1. May 2010.

* Biogenic CO_2 emissions come from sources that recently contained living organic matter. These emissions are reported as information items only, and do not count towards the Town's overall GHG emissions total. In theory, the CO_2 emitted by these sources would have occurred naturally if the material were to decay under natural conditions. However, any CH_4 and N_2O emissions from non-biogenic sources are assumed not to have occurred under natural conditions, and do count towards the Town's overall GHG emissions total.

Table 2. LGOP Sector Definitions

LGOP SECTOR(S)	DEFINITION
Airport and Port Facilities	GHG emissions from stationary energy use and emissions from leaking refrigerants and fire suppressants in government operated port and airport facilities.
Buildings and Other Facilities	GHG emissions from stationary energy use and emissions from leaking refrigerants and fire suppressants in all government operated buildings and facilities that do not fit into any other sector below.
Other Process and Fugitive Emissions	Natural gas system leaks if the government operates a transmission and distribution system or other fugitive emissions from processes discussed in Chapter 11 of LGOP.
Power Generation Facilities	GHG emissions from stationary energy use and emissions from leaking refrigerants and fire suppressants in government operated power generation facilities. Also includes electricity losses and leaking SF_6 from transmission and distribution lines operated by a local government.
Solid Waste Facilities	GHG emissions from stationary energy use and emissions from leaking refrigerants and fire suppressants in government operated waste disposal facilities. Also includes methane escaping from government owned landfills and GHGs from combusting solid waste at government owned incinerators or waste-to-energy facilities.
Streetlights and Traffic Signals	GHG emissions from electricity used by streetlights and traffic signals, including pedestrian signals, flashers, etc.

3 Operational control is defined as having the authority to introduce and implement operating policies and procedures at an operation. For more information on determining operational control, see Chapter 3 of the LGOP (version 1.1 released May 2010).

LGOP SECTOR(S)	DEFINITION
Vehicle Fleet/ Transit Fleet	GHG emissions from energy use and from leaking refrigerants in mobile equipment and vehicles used in the Town's vehicle fleet and transit fleet.
Wastewater Facilities	GHG emissions from stationary energy use and from leaking refrigerants and fire suppressants from facilities used to treat or transport wastewater or sewage. This also includes non-energy related emissions from the processes used to treat wastewater in treatment plants and septic systems.
Water Delivery Facilities	GHG emissions from stationary energy use and emissions from leaking refrigerants and fire suppressants in government operated water delivery facilities or distribution equipment. Also includes natural gas system leaks if the government operates the transmission system.
Optional Scope 3 GHG Emissions	Optional reporting under LGOP. Common scope 3 emissions sources include energy use from employee vehicles commuting to work and from government-generated solid waste disposed of in non Town-owned facilities.

Source: California Air Resources Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry. "Local Government Operations Protocol For the quantification and reporting of greenhouse gas emissions inventories." Chapter 13.1.2. Version 1.1. May 2010.

A complete list of 2010 GHG emissions sources from Bethlehem's government operations by sector and scope is provided in **Table 3.**

Table 3. Town of Bethlehem 2010 Government GHG Emissions Sources by Sector, Source, and Scope

SECTOR	EMISSION SOURCE	SCOPE	GHG SOURCE IN 2010*
Airport and Port Facilities	Electricity – purchased	2	
	Natural Gas	1	
	Fuel Oil	1	
	Propane	1	
	Other Fuel Types	1	
Buildings & Other Facilities	Electricity – purchased	2	X
	Natural Gas	1	X
	Fuel Oil	1	X
	Propane	1	X
	Gasoline	1	
	Other Fuel Types	1	
	Leaking Refrigerants and Fire Suppressants	1	
Employee Commute (Scope 3)	Gasoline	3	X
	Diesel	3	X
	Other Fuels	3	
Power Generation Facilities	Fuels combusted to generate electricity, steam, or heat	1	
	Leaking Refrigerants and Fire Suppressants, SF_6 emissions from Transmission & Distribution lines	1	
Solid Waste Facilities	Energy use from County Owned Disposal Facilities	1	X
	Leaking Refrigerants and Fire Suppressants	1	
	Emissions from disposal of solid waste at non-County owned facilities (Scope 3)	3	X
Streetlights & Traffic Signals	Electricity – purchased	2	X
Water Delivery Facilities (includes buildings, pumps, etc.)	Electricity – purchased	2	X
	Natural Gas	1	X
	Fuel Oil	1	X
	Propane	1	X
	Other Fuel Types	1	
Wastewater Facilities (includes buildings, pumps, etc)	Electricity – purchased	2	X
	Natural Gas	1	X
	Fuel Oil	1	X
	Propane	1	X
	Other Fuel Types	1	
	Process and Fugitive Emissions from Treatment	1	X
Vehicle and Transit Fleets	Gasoline	1	X
	Diesel	1	X
	Other Fuel Types	1	
	Leaking Refrigerants from air-conditioning	1	X

* An "X" indicates a GHG emissions source that was relevant to the Town of Bethlehem in 2010. Bethlehem's government operations did not produce GHG emissions from all LGOP sectors in 2010. For example, the Town did not operate a power generation facility, so emissions from the Power Generation sector were not present in 2010. However, future GHG inventories conducted by the Town should add or remove emissions sources and sectors as the services and facilities operated by the Town may change over time.

GHG Emissions Calculations

The following sections describe the data collection, data processing, and GHG emissions calculation processes for all GHG emissions sources in the Town of Bethlehem's 2010 government operations.

Stationary Fuel Combustion and Purchased Electricity

The Town's facilities, including buildings, outdoor lighting, streetlights and traffic signals, and other energy-consuming property, use electricity, natural gas, heating oil, and propane. Electricity is a Scope 2 source of emissions[4], while natural gas, heating oil, and propane are Scope 1 sources. See **Table 3** for the sectors which used these fuels in 2010.

Data Collection, Data Processing, and Account Mapping

Electricity and natural gas consumption data were downloaded from the Town's online National Grid account. The website login information was provided by the Department of Public Works. National Grid accounts were matched to facility and building names, addresses, and departments using the Facilities Portfolio list included in Part 4 of the "2010 Town of Bethlehem 10-Year Capital Plan Interim Status Report[5]."

Propane, fuel oil, and gasoline data were provided by the Department of Public Works in the form of paper copies of checks and invoices for fuel purchases made by the Town. Fuel purchases in which checks were sent to vendors during calendar year 2010 were included in this inventory. Because the Town does not send checks to vendors on the exact same day fuel is delivered, a check paid to a vendor at the beginning of 2010 may be for fuel that was actually delivered to the Town at the end 2009. Likewise, fuel that was delivered to the Town at the end of 2010 may not be paid for until early 2011. Even though this method may include and exclude certain deliveries of fuel outside of the baseline year of 2010, it includes fuel consumed for one full year and is the most accurate summary of fuel consumption for calendar year 2010 available.

In addition to the cost of purchasing the fuel, the Town also paid small service charges and other fees related to fuel purchases and delivery. These non-fuel charges were included in the cost totals to show the overall cost of fuel delivery. However, the costs and fees related to fixing broken equipment, installing new equipment, or any visit unrelated to fuel delivery were not included in this inventory.

GHG Calculations

GHG emissions were calculated by individual facility, sector, and source. The carbon dioxide, methane, and nitrous oxide emissions factors for electricity were taken from the U.S. Environmental Protection Agency's (EPA) most recent eGRID data (inventory year 2007 data)[6]. The eGRID2010 data files for inventory year 2007 were used in this inventory since 2007 was the most recent year available. An emissions factor is a constant used to convert activity data (such as electricity consumption) into units of GHG emissions. The Town of Bethlehem is in the NPCC Upstate NY eGRID sub-region and the emissions factors are shown in **Table 4.**

4 Emissions occur at an electric power plant outside of the Town, but the Town is the consumer of the generated electricity and its actions determine the level of demand.

5 Capital Planning Committee, Town of Bethlehem. "2010 Town of Bethlehem 10-Year Capital Plan Interim Status Report." 2009

6 U.S. Environmental Protection Agency. eGRID2010 Version 1.1. 24 October 2011. 21 December 2011 **http://epa.gov/cleanenergy/energy-resources/egrid/index.html#download**.

Table 4. eGRID Electricity Emissions Factors for Inventory Year 2007

GREENHOUSE GAS	EMISSIONS FACTOR
Carbon Dioxide (CO_2)	683.27 lbs CO_2 per MWh
Methane (CH_4)	0.01741 lbs CH_4 per MWh
Nitrous Oxide (N_2O)	0.0099 lbs N_2O per MWh

Source: U.S. Environmental Protection Agency. eGRID2010 Version 1.1. 24 October 2011. 21 December 2011 <http://epa.gov/cleanenergy/energy-resources/egrid/index.html#download>.

Emissions factors for natural gas, heating oil #2, and propane were taken from the LGOP, Tables G.1 and G.4:

Table 5. GHG Emissions Factors by Stationary Fuel Type

	EMISSIONS FACTORS BY FUEL TYPE		
GHG	HEATING OIL #2	NATURAL GAS	PROPANE
Carbon Dioxide (CO_2)	10.21 Kg CO_2/gallon	53.02 kg CO_2/ MMBtu	5.59 Kg CO_2/gallon
Methane (CH_4)	0.0015 Kg CH_4/gallon	0.005 kg CH_4/ MMBtu	0.001 Kg CH_4/gallon
Nitrous Oxide (N_2O)	0.0001 Kg N_2O/gallon	0.0001 kg N_2O/ MMBtu	0.0001 Kg N_2O/gallon

Source: California Air Resources Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry. "Local Government Operations Protocol For the quantification and reporting of greenhouse gas emissions inventories." Version 1.1. May 2010.

Emissions of carbon dioxide, methane, and nitrous oxide were multiplied by their respective global warming potentials[7] and summed to calculate the total carbon dioxide equivalent:

Table 6. Global Warming Potential

GHG	GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310

Source: California Air Resources Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry. "Local Government Operations Protocol For the quantification and reporting of greenhouse gas emissions inventories." Version 1.1. May 2010.

7 The global warming potential (GWP) of a gas is the degree of warming one mass-based unit of the gas produces in the atmosphere over a particular period of time in relation to carbon dioxide. Because GWPs of gases are in relation to carbon dioxide, carbon dioxide has a GWP of 1. Nitrous Oxide, which has a GWP of 310, traps 310 times more heat over a 100 year timeframe. All GWPs used in this study are from Appendix E of the LGOP and are for a 100 year timeframe.

Vehicle Fuel Use and Fuel-Powered Equipment

The vehicles and other fuel-powered equipment owned and operated by the Town are a source of Scope 1 emissions. In 2010, Town vehicles and motorized equipment used gasoline and diesel fuel.

Data Collection and Data Processing

Fuel consumption, cost, and vehicle miles traveled (VMT) data were provided electronically from the Town's fuel tracking system. Fuel consumption and cost data were provided by department and fuel type. VMT data were provided by equipment number, manufacturer, model year, vehicle description, and fuel type.

GHG Calculations

Equations 7.2, 7.6, 7.7, and 7.8 from Chapter 7 of the LGOP were then used to calculate carbon dioxide, methane, and nitrous oxide emissions from the Town's vehicle and motorized equipment fleet. As instructed in Chapter 7 of LGOP, the standard emissions factors for unleaded gasoline (8.78 kg CO_2/gal) and diesel (10.21 kg CO_2/gal) in Table G.11 of LGOP were used to calculate the carbon dioxide emissions.

To calculate the methane and nitrous oxide emissions, the vehicles were categorized by vehicle type (passenger car, light truck, heavy duty vehicle, or non-highway vehicle), fuel type, and model year. The appropriate emissions factor for each vehicle type from Tables G.12 and G.14 of the LGOP were used to calculate methane and nitrous oxide emissions. Vehicle model years post-2008 used the same methane and nitrous oxide emissions factors as 2008 model year vehicles due to the fact that methane and nitrous oxide emissions factors were not available beyond 2008.

Methane and nitrous oxide emissions from off-road vehicles and equipment were not calculated in this inventory. Unlike on-road vehicles, where GHG emissions from methane and nitrous oxide are calculated based on VMT, off-road methane and nitrous oxide emissions are calculated based on the gallons of fuel consumed throughout the inventory year. Fuel consumption data were only available at the Department level and could not be separated into on and off-road vehicle and equipment usage. Methane and nitrous emissions from vehicles and equipment labeled as MISC were also not calculated since it was unknown to what type of vehicle or equipment the data were representing. The majority of GHG emissions from vehicles are from carbon dioxide emissions, the calculation of which was not affected by the issues mentioned above. As such, the Vehicle Fleet sector calculations are still an accurate representation of the sector's impact on the Town's overall GHG emissions. The carbon dioxide, methane, and nitrous oxide emissions were then converted to units of metric tons CO_2e using equation 7.8 of the LGOP and the global warming potentials (GWPs) from Table E.1 of the LGOP.

Wastewater Treatment

Data Collection and Data Processing

Emissions from the treatment of wastewater were calculated using data provided by the Town's Stormwater Management Program and from a 2006 energy efficiency study of the Bethlehem Wastewater Treatment Plant[8]. The Town of Bethlehem operates two wastewater facilities: the Bethlehem Wastewater Treatment Plant and the South Albany Wastewater Treatment Plant. The Bethlehem Wastewater Treatment Plant (WWTP) is the larger of the two, servicing 9,854 residential households and 487 commercial users. The plant uses aerobic treatment processes and did not use nitrification or denitrification as a form of tertiary treatment.

The South Albany Wastewater Treatment Plant serves a small 23 home cluster development served by an aerobic system and did not use nitrification or denitrification treatment processes.[9]

GHG Calculations

Nitrous oxide emissions from wastewater treatment and effluent discharge for the two plants were calculated using equations 10.8 and 10.10 from the LGOP as shown below. The population served by each facility was calculated by multiplying number of households served at each plant by the average number of people per household in Bethlehem according to the 2010 U.S. Census. As shown below, equations 10.8 and 10.10 have a factor (Find-com) to account for commercial and industrial contributions of wastewater to the sewer system. The Find-com factor was included in calculations for the Bethlehem Wastewater Treatment Plant but was excluded from the South Albany Wastewater Treatment Plant calculations since the South Albany facility did not receive wastewater from commercial or industrial entities.

Equation 10.8	Process N_2O Emissions from WWTP without Nitrification/Denitrification
Annual N_2O emissions (metric tons CO_2e) = $((P_{total} \times F_{ind\text{-}com}) \times EF\ w/o\ nit/denit \times 10^{-6}) \times GWP$	

Where:

Term		Description	Value
P_{total}	=	population that is served by the centralized WWTP adjusted for industrial discharge, if applicable [person]	user input
$F_{ind\text{-}com}$	=	factor for industrial and commercial co-discharge waste into the sewer system	1.25
EF w/o nit/denit	=	emission factor for a WWTP without nitrification/denitrification [g N_2O/person/year]	3.2
10^{-6}	=	conversion from g to metric ton [metric ton/g]	10^{-6}
GWP	=	Global Warming Potential	310

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-13 (2009).

8 New York State Energy Research and Development Authority (NYSERDA). "Energy Efficiency Study Bethlehem Wastewater Treatment Plant." 2006.

9 The use of nitrification or denitrification at a WWTP is an important factor in determining which equation to use for calculating process emissions in accordance with the LGOP.

Equation 10.10	Process N_2O Emissions from Effluent Discharge (default N load data)
Annual N_2O emissions (metric tons CO_2e) =	
$((P_{total} \times F_{ind\text{-}com}) \times (\text{Total N Load} - \text{N uptake} \times BOD_5 \text{ load}) \times \text{EF effluent} \times 44/28 \times (1 - \text{F plant nit/denit}) \times 365.25 \times 10^{-3}) \times \text{GWP}$	

Where:

Term		Description	Value
P_{total}	=	population served [person]	user input
$F_{ind\text{-}com}$	=	factor for industrial and commercial co-discharge waste into the sewer system	1.25
Total N Load[27]	=	total nitrogen load [kg N/person/day]	0.026
N uptake[28]	=	nitrogen uptake for cell growth in aerobic system (kg N/kg BOD_5)	0.05[1]
	=	nitrogen uptake for cell growth in anaerobic system (e.g., lagoon) (kg N/kg BOD_5)	0.005[1]
BOD_5 load	=	amount of BOD_5 produced per person per day [kg BOD_5/person/day]	0.090
EF effluent	=	emission factor [kg N_2O-N/kg sewage-N produced]	0.005
44/28	=	molecular weight ratio of N_2O to N_2	1.57
F plant nit/denit	=	fraction of nitrogen removed for the centralized WWTP with nitrification/denitrification	0.7[1]
	=	fraction of nitrogen removed for the centralized WWTP w/o nitrification/denitrification	0.0[1]
365.25	=	conversion factor [day/year]	365.25
10^{-3}	=	conversion from kg to metric ton [metric ton/kg]	10^{-3}
GWP	=	Global Warming Potential	310

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-13 (2009), except:
[1] Grady, C. P. L., Jr., G. T. Daigger, and H. C. Lim, *Biological Wastewater Treatment*, p. 108-109, 644 2nd Edition (1999).

Fugitive Emissions from Refrigerants and Fire Suppressants

Fugitive emissions are unintentional releases of GHGs often associated with the transportation of fuels or leaking of gases in storage or equipment. This GHG Inventory included an assessment of fugitive emissions from both buildings and vehicles, though vehicles were the only source of refrigerant leakage for the Town in 2010.

Data Collection and Data Processing

Buildings

In 2010, Eastern Heating and Cooling, Inc. was the service provider for the Town's building air conditioning systems. According to staff at Eastern Heating and Cooling, 1.5 lbs. of R-22 (or Freon) were used to service air conditioning equipment at the Town's dispatch center in the Police Department. Even though Freon does have a GWP, it is an ozone depleting substance (ODS) being phased out under the Montreal Protocol and is not classified as a GHG under the Kyoto Protocol. As such, LGOP says that ODS substances should not be included in municipal GHG inventories.

The Police Department also had a 2-ton air conditioning system installed at the Detective Office that was charged with about 5 lbs. of R-410a and had a full charge capacity of 5.3 lbs. The Town did not dispose of or retire any air conditioning systems in 2010.

Contact information for the Town's fire suppression equipment and systems were unavailable at the time of this report. As such, GHG emissions from leaked and deployed fire suppressants were not included in this inventory. However, GHG from fire suppressants typically comprise a very small fraction of overall GHG emissions and, depending on the suppressant used, may not classify as a GHG.

Vehicles

All data used to calculate GHG emissions from refrigerants leaked from vehicle air conditioning systems were provided by the Town's Fleet Manager. According to the Fleet Manager, vehicle air conditioning systems were serviced by an external provider. No new vehicles were purchased in 2010 with air conditioning systems that required charging of refrigerant. the Fleet Manager also supplied a list showing 10 vehicles or mobile equipment pieces that were disposed of in 2010, six of which were presumed to have air conditioning systems. the Fleet Manager also confirmed that the refrigerant used by the Town's vehicle air conditioning systems was HFC-134a.

To determine the total number of vehicles with air conditioning systems in 2010, it was assumed that all on-road vehicles had air conditioning systems and that all off-road vehicles and motorized equipment did not have air conditioning systems. This criterion was applied to a vehicle inventory list supplied by the Town.

GHG Calculations

Buildings

GHG emissions from air conditioning systems in buildings were calculated using Equation 6.34 of the LGOP and converted to metric tons CO_2e using GWPs in Table E.1 of LGOP:

Total GHG Emissions (metric tons CO2e) = (PN –CN +PS + CD – RD) x 0.001 x GWP

Where:

PN = purchases of refrigerant used to charge new equipment (kg)

CN = total full charge of new equipment (kg)

PS = quantity of refrigerant used to service equipment (kg)

CD = total full charge capacity of retiring equipment (kg)

RD = refrigerant recovered from retiring equipment (kg)

0.001 = factor to convert kg to metric tons

GWP = global warming potential of the refrigerant

Source: Local Government Operations Protocol, Version 1.1, May 2010, Equation 6.34 and Table E.1

RD, and CD were excluded from Equation 6.34 above because the Town did not retire any air conditioning equipment in 2010. The PS factor was also excluded since the refrigerant used to service equipment in 2010, R-22 or Freon, was not a GHG quantified under the LGOP. Because quantity of R-410a used to charge the new 2-ton air conditioning system installed at the Detective Office was "about" 5 lbs, and the full charge capacity of the system was 5.3 lbs, it was assumed that the exact amount of R-410a used to charge the new system 5.3 lbs. As such, PN and CN of Equation 6.34 above cancel each other out, resulting in zero GHG emissions from leaking refrigerants in buildings in 2010.

Vehicles

GHG emissions from vehicle air conditioning systems were calculated using Equation 7.13 of the LGOP and converted to metric tons CO_2 using the GWP for HFC – 134a provided in Table E.1 of LGOP:

Total GHG Emissions (metric tons CO2e= [(CN x k) + (C x V x X x T) + (CD x VD x y x (1-z))] x 0.001 x GWP

Where:

CN = quantity of refrigerant used to charge new equipment (kg)

k = installation emissions factor (% of capacity of new equipment)

C = total full charge (capacity) of the equipment (kg)= 1.5 kg per vehicle or motorized equipment

V = number of Town of Bethlehem vehicles with air conditioning in 2010 = 185

X = operating emissions factor (% of capacity) = 20 percent

T = time in years equipment was in use (e.g. 0.5 if the equipment was used during half the year and then disposed) = 1 year

CD = total full charge (capacity) of equipment being disposed of (kg) = 1.5 kg per vehicle or motorized equipment

VD = number of vehicles disposed in 2010 with air conditioning systems = 6

Y = refrigerant remaining at disposal (% of capacity) = 50 percent

z = recover efficiency (% of remaining refrigerant) = 50 percent

0.001 = factor to convert kg to metric tons

GWP = global warming potential of HFC-134a = 1300

Source: Local Government Operations Protocol, Version 1.1, May 2010, Equation 7.13 and Table E.1

The CN and k factors were omitted from the equation above since the Town of Bethlehem did not purchase any new vehicles that required charging in 2010. Default values for the factors C, X, CD, Y, and Z were taken from Table 7.2 of the LGOP. The number of vehicles with air condition systems (V) was taken from the Town's vehicle inventory list as explained in the Vehicle Data Collection and Data Processing section above. T was set equal to one, as it was assumed all vehicles were in service for all of 2010. VD represented the number of vehicles disposed by the Town in 2010 as explained in the Vehicle Data Collection and Data Processing section of this Methodology.

Employee Commute (Scope 3)

GHG emissions from Town employees commuting to work in 2010 were a Scope 3 source of emissions. GHG emissions were estimated based on state and federal transportation datasets, along with results of an employee commute survey conducted by nearby Schenectady County for the calendar year 2010. Results from the Schenectady County government employee commute survey were used as proxy where state and federal data were unavailable.

Data Collection and Data Processing

Emissions were calculated based on the following assumptions and information:

1. According to the Town of Bethlehem, 300 municipal employees were employed in 2010. It was assumed all 300 employees were full time and excluded seasonal summer employees.
2. All employees drove alone to work five days a week.
3. It was assumed that each Town employee commuted to work 46.95 weeks out of the year. It was assumed that each employee used one quarter of the available number of his or her sick days sick days (13), each employee took 10 vacation days per year, and each employee took all 12 Town paid holidays. When added together, paid time off amounted to 5.05 non-commuting weeks per year or 46.95 annual commuting weeks per employee.[10]
4. All employees had a one-way commute distance of 6.51 miles, the average distance that employees of Schenectady County reported driving alone or carpooling to work as part of the 2010 Schenectady County Employee Commute Survey distributed in 2011.
5. It was assumed that all employees drove either passenger cars or light trucks. Based on 2009 Bureau of Transportation Statistics vehicle registration data for New York State, it was assumed that 79.86 percent of employees drove passenger cars and 20.14 percent drove light trucks.[11]
6. Based on the 2010 Schenectady County Employee Commute Survey, it was assumed that the percent of total vehicle miles traveled (VMT) by each vehicle and fuel type are as shown below:

Table 7: 2010 Schenectady County Employee Vehicle Miles Traveled (VMT) by Fuel and Vehicle Type

VEHICLE TYPE	PERCENT GASOLINE VMT	PERCENT DIESEL VMT
Passenger car	99.63%	0.37%
Light truck	98%	2%

Source: 2010 Schenectady County Employee Commute Survey, conducted by Schenectady County in September and October 2011.

7. Using national fuel economy statistics from the Bureau of Transportation Statistics for 2009, it was assumed that all passenger cars driven by Bethlehem employees had a fuel economy of 23.8 miles per gallon (mpg) and all light trucks and a fuel economy of 17.4 mpg.[12]

10 Assumptions on the amount of paid time off taken by employees in 2010 is based on the Town's vacation, sick leave, and holidays policies in the Town's 2008 Employee Manual: **http://www.townofbethlehem.org/images/pageImages/Comptroller/EmployeeManual2008.pdf#search='vacation days'**.

11 Research and Innovative Technology Administration, Bureau of Transportation Statistics. State Transportation Statistics 2010 Table 5-1: Motor Vehicle Registrations: 2009. December 2011 **http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2010/html/table_05_01.html**.

12 Research and Innovative Technology Administration, Bureau of Transportation Statistics. State Transportation Statistics 2010 Table 5-1: Motor Vehicle Registrations: 2009. December 2011 **http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2010/html/table_05_01.html**.

GHG Calculations

For each vehicle and fuel type (gasoline passenger cars, gasoline light trucks, diesel passenger cars, and diesel light trucks), GHG emissions were calculated using the following steps:

1. Calculate Total 2010 VMT by Town employees commuting to work:

2010 Total VMT = (300 x 46.95 x 5 x 6.51 x 2)

Where:

300 = number of 2010 Town employees

46.95 = number of commuting weeks/year

5 = number of days per week employees commuted to work

6.51 = one-way commute distance (miles)

2 = factor to convert one-way commute distance to the distance of a two-way commute

2. Separate VMT into miles traveled by passenger cars and light trucks:

2010 passenger car VMT = 2010 Total VMT x 0.7986

2010 light truck VMT = 2010 Total VMT x 0.2014

Where:

2010 Total VMT = Total VMT by Town of Bethlehem employees as calculated in Step 1

0.7986 = fraction of VMT by passenger cars registered in New York State

0.2014 = fraction of VMT by light trucks registered in New York State

3. Further separate VMT by fuel type:

2010 gasoline passenger car VMT = 2010 passenger car VMT x 0.9963

2010 gasoline light truck VMT = 2010 light truck VMT x 0.9834

2010 diesel passenger car VMT = 2010 passenger car VMT x 0.0037

2010 diesel light truck VMT =2010 light truck VMT x 0.0166

Where:

2010 passenger car VMT = VMT by Town of Bethlehem employee passenger cars as calculated in Step 2

2010 light truck VMT = VMT by Town of Bethlehem employee light trucks as calculated in Step 2

0.9963 = fraction of 2010 passenger car VMT fueled by gasoline

0.9834 = fraction of 2010 light truck VMT fueled by gasoline

0.0037 = fraction of 2010 passenger car VMT fueled by diesel

0.0166 = fraction of 2010 light truck VMT fueled by diesel

4. Calculate gasoline and diesel fuel consumption by vehicle type:

2010 gasoline passenger car fuel consumption = 2010 gasoline passenger car VMT x 23.75

2010 gasoline light truck fuel consumption =2010 gasoline light truck VMT x 17.36

2010 diesel passenger car fuel consumption = 2010 diesel passenger car VMT x 23.75

2010 diesel light truck fuel consumption = 2010 diesel light truck VMT x 17.36

Where:

2010 gasoline/diesel passenger car/light truck VMT = VMT by Town of Bethlehem employee vehicles as calculated in Step 3

23.75 = passenger car fuel economy

17.36 = light truck fuel economy

5. Use fuel consumption and VMT data broken out by vehicle type and fuel type in steps 1-4 above to calculate GHG emissions from Town employees commuting to work in 2010:

   Equations 7.2, 7.6, 7.7, and 7.8 from Chapter 7 of the LGOP were used to calculate carbon dioxide, methane, and nitrous oxide emissions from employee vehicles commuting to work. As instructed in Chapter 7 of LGOP, the standard emissions factors for unleaded gasoline (8.78 kg CO_2/gal) and diesel (10.21 kg CO_2/gal) in Table G.11 of LGOP were used to calculate the carbon dioxide emissions. The methane and nitrous oxide emissions factors for each vehicle type and fuel type were taken from Table G.15 of LGOP.[13]

Government Generated Solid Waste (Scope 3)

The Government Generated Solid Waste sector calculates GHG emissions resulting from solid waste generated by the Town's operations, but disposed of at facilities that were not operated by the Town. The Town of Bethlehem did operate the Rupert Road Transfer Station. However, waste received by the Transfer Station does not produce GHG emissions until after it leaves the Transfer Station and is disposed of at a landfill or waste-to-energy facility. The Rupert Road Transfer Station did produce GHG emissions from electricity use which were reported in the Solid Waste Facilities sector. Methods for calculating GHG emissions from electricity consumption at the Transfer Station are the same as those explained in the Stationary Fuel Consumption and Purchased Electricity section of this report.

Data Collection and Processing

There were two primary steps to collect and process data for the Government Generated Solid Waste sector:

1. Estimate the tons of waste, by waste type, generated by government operations
2. Determine the type of disposal facility where waste was sent (landfill or waste-to-energy facility)

According to the Recycling Coordinator for the Town of Bethlehem, Town municipal operations generated approximately 62.7 tons of municipal solid waste (MSW)[14] and 106.9 tons of sludge from wastewater treatment facilities. All MSW and sludge were disposed of at the City of Albany's Rapp Rd. landfill, which has a landfill gas collection system.

13 Emissions factors in Table G.15 of LGOP were only available through inventory year 2006. As such, inventory year 2006 emissions factors were used to calculate methane and nitrous oxide emissions from employees commuting to work in 2010.

14 According to the U.S. EPA, municipal solid waste (MSW) is defined as everyday waste produced by a variety of sectors, such as residents, businesses, schools, governments, and homes. Municipal solid waste does not include hazardous or toxic materials, construction and demolition (C&D) waste, or electronic waste. U.S. Environmental Protection Agency. "Wastes - Non-Hazardous Waste - Municipal Solid Waste". 27 January 2012. 7 February 2012. **http://www.epa.gov/epawaste/nonhaz/municipal/index.htm**

GHG Calculations[15]

GHG emissions from government generated landfilled waste were calculated using the California Air Resources Board's (CARB)'s Implementation of IPCC's Mathematically Exact First Order Decay Model[16] (referred to as the CARB FOD tool in this document), a tool designed to estimate GHG emissions from landfills without landfill gas (LFG) collection systems in support of the LGOP. Because the City of Albany's landfill had a LFG collection system, the methane emissions output from the CARB FOD tool were modified using the following equation:

Total methane emissions =

$$\frac{\textbf{CARB FOD tool output x CE x (1-DE) + (CARB FOD tool output x (1-CE))}}{\textbf{(1-OX)}}$$

Where:

DE = CH_4 destruction efficiency =0.99

CE = Collection Efficiency=0.75

OX = oxidation factor=0.10

Source: Local Government Operations Protocol, Version 1.1, May 2010, Equation 9.1 and Table 9.2

The CARB FOD tool is designed to estimate the total amount of methane escaping from an entire landfill in single year based on historical waste deposition data. However, because the Town does not own the Albany landfill, only the emissions associated with waste generated by Bethlehem's 2010 government operations were included in the inventory. To calculate more policy relevant emissions data, the CARB FOD tool's methods were modified to calculate the total methane emissions that waste deposited by the Town in 2010 would produce over the waste's entire decomposition cycle. **Table 8** describes the data inputs and assumptions used into the CARB FOD model.

15 This inventory did not estimate GHG emissions from recycling or composting. Recycling and composting generally result in a net reduction in GHG emissions. Any solid waste diverted from landfills or incineration/waste-to-energy facilities to recycling or composting programs would be reflected in the inventory as a reduced amount of GHG emissions from solid waste disposal.

16 California Air Resources Board. **http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm**

Table 8: California Air Resources Board's Implementation of IPCC's Mathematically Exact First-Order Decay Model

MODEL INPUTS/ASSUMPTIONS				
DATA TYPE	**FIELD OR COLUMN NAME**	**DESCRIPTION**	**DATUM/ INPUT**	**SOURCE(S)**
Landfill Specific Data	k Value	Decay Factor, based on average annual rainfall	k=0.038	k Value for region with 20-40 inches of rainfall per year. K Values are contained in the CARB FOD Model calculator. Average annual rainfall data is for Albany, NY and is provided by the state climatologist's website. New York State Climate Office, Cornell, NOAA. 21 December 2011 **http://nysc.eas.cornell.edu/.**
Landfill Specific Data	State/County	State or Country where the landfill is located. Will be used to determine the waste characterization data used by the model.	US - Other	The CARB FOD tool asks whether the landfill is located in California or not. This is because CARB has waste characterization factors that are specific to California. The tool uses US-wide characterization data for non-California communities. None of Schenectady's waste is sent to California for disposal.
Landfill Specific Data	Open Year of Landfill	Emissions generated by solid waste deposited in 2010 were estimated by front loading all the emissions that waste will produce over its decomposition cycle. The IPCC says that the FOD model requires 3-5 half-lives worth of waste data for an acceptably accurate result. Since the half-life for waste deposited in the Albany area of NY is about 18.24 years (k = ln(2)/half life in years), it was assumed that was deposited in 2010 would continue to release methane for 73 years into the future (or four half-lives). Because the CARB FOD tool only allows for data entry prior to 2010, waste deposition data from 2010 was entered into the CARB FOD tool for the year 1937 (73 years prior to 2010). The emissions produced each year from 1937 through 2010 (representing 2010 through 2083) were then totaled and attributed to inventory year 2010.	73 years in the future	CARB FOD tool, Intergovernmental Panel on Climate Change. "2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste, Chapter 3.2.1." 2006.
Waste Deposit Data	Waste Deposited (tons)	Waste deposited in inventory year	see CARB FOD Tool	Recycling Coordinator, Town of Bethlehem
Waste Deposit Data	Sludge and Greenwaste Cover material	Sludge from the Town's wastewater treatment facilities is landfilled	see CARB FOD Tool	Recycling Coordinator, Town of Bethlehem
Waste Deposit Data	Waste Composition	MSW composition of waste specific to NY state. This NY-specific composition data was used to create a user defined % ANDOC value in the CARB FOD tool. Construction and Demolition (C&D) waste was calculated separately from MSW and the % ANDOC value was used based on 100 % C&D waste. Landfilled sludge was also calculated separately and the % ANDOC value used was based on 100 % sludge waste.	Beyond Waste: A Sustainable Materials Management Strategy for New York State, Table H-4	New York State Department of Environmental Conservation. "Beyond Waste: A Sustainable Materials Management Strategy for New York State." 27 December 2010. 21 December 2011 **http://www.dec.ny.gov/docs/materials_minerals_pdf/frptbeyondwaste.pdf.**

Community Inventory

The Community Inventory is an analysis of GHG emissions occurring within the geographic boundaries of Bethlehem, including: energy consumption from residents, businesses, and Town government facilities; wastewater treatment processes; vehicles traveling on roadways within the town; and disposal of solid waste generated within the town.

Buildings

Electricity and Natural Gas

Electricity and natural gas GHG emissions from residential, commercial, and industrial buildings (including Town government buildings and facilities) were calculated using data provided by National Grid. National Grid provided monthly 2010 and 2011 electricity consumption (kWh) and natural gas consumption (therms) for customers located within the town of Bethlehem by service rate class.

SECTOR	NATIONAL GRID RATE CLASS
Residential	SC1, SC1MO, SC1MC
Commercial/Industrial/Institutional	SC2, SC2D, SC2MO, SC3, SC3MO, SC7, SC3A, SC3T&D

Rate classes were grouped into sectors based on definitions provided by National Grid. Industrial, commercial, and institutional customers were combined into one sector, the Commercial and Industrial sector, for the purposes of this inventory. Large commercial users are often in the same rate class as industrial customers, so it was not possible to separate them into two sectors. GHG emissions from energy use in Town government buildings, facilities, and lighting are included in the Commercial and Industrial sector.

GHG emissions were calculated using the same emissions factors and equations described in the GHG Calculations subsection of the Stationary Fuel Combustion and Purchased Electricity section of the "Government Inventory" portion of the Methodology.

Fuel Oil, Kerosene, Propane, and Wood

GHG emissions from fuel oil (distillate fuel oil), kerosene, propane, and wood were calculated by downscaling energy consumption estimates for the Residential, Commercial and Industrial sectors of New York State to the local level using the U.S. Energy Information Administration's State Energy Data System (EIA SEDS) and the U.S. Census Bureau's House Heating Fuel dataset from the 2008-2010 American Community Survey. EIA SEDS data were not available for 2010, so data for the closest year available – 2009 – were used instead.

The amount of fuel consumption in the Residential sector of Bethlehem was obtained by dividing the total fuel consumed by the Residential sector in New York State[17] by the number of households that heat with fuel oil in New York, multiplied by the number of households heating with fuel oil in Bethlehem:

- Bethlehem Residential Fuel Oil and Kerosene (thousand barrels) = (residential fuel oil and kerosene use in NY / households heating with fuel oil and kerosene in NY) x households heating with fuel oil in Bethlehem

17 U.S. Energy Information Administration. SEDS State Energy Data System, Table CT4. Residential Sector Energy Consumption Estimates, 1960 - 2009, New York. **http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/res/use_res_NY.html&mstate=New%20York**

- Bethlehem Residential Propane (thousand barrels) = (residential propane use in NY / households heating with propane in NY) x households heating with propane in Bethlehem
- Bethlehem Residential Wood (trillion btu)= (trillion btu of residential wood consumption in NY/households heating with wood in NY) x households heating with wood in Bethlehem

Even though the EIA SEDS tracks fuel oil and kerosene consumption separately, the American Community Survey reports the number of households heating with fuel and kerosene as a combined number. To determine the amount of fuel oil and kerosene usage separately, combined fuel oil and kerosene consumption in Bethlehem (see formula above) was multiplied by the fraction of combined fuel oil and kerosene consumption in New York State that was from fuel oil and the fraction that was from kerosene:

- Bethlehem Residential Fuel Oil Use (thousand barrels) = Bethlehem residential fuel oil and kerosene x (NY residential fuel oil / (NY residential fuel oil + NY residential kerosene))
- Bethlehem Residential Kerosene Use (thousand barrels) = Bethlehem residential fuel oil and kerosene x (NY residential kerosene / (NY residential fuel oil + NY residential kerosene))

Fuel consumption in the commercial and industrial sectors were estimated by multiplying the amount of residential fuel consumed in Bethlehem by the ratio of commercial fuel consumed in the commercial or industrial sector of New York State[18] to the amount of fuel consumed in the residential sector of New York State:

- Commercial Fuel Oil in Bethlehem (thousand barrels) = residential fuel oil in Bethlehem x (commercial fuel oil in NY / residential fuel oil in NY)
- Commercial Kerosene in Bethlehem (thousand barrels) = residential kerosene in Bethlehem x (commercial kerosene in NY / residential kerosene in NY)
- Commercial Propane in Bethlehem (thousand barrels) = residential propane in Bethlehem x (commercial propane in NY /residential propane in NY)
- Commercial wood in Bethlehem (trillion btu) = residential wood in Bethlehem x (commercial wood in NY / residential wood in NY)
- Industrial Fuel Oil in Bethlehem (thousand barrels) = residential fuel oil in Bethlehem x (industrial fuel oil in NY/ residential fuel oil in NY)
- Industrial Propane in Bethlehem (thousand barrels) = residential propane in Bethlehem x (industrial propane in NY / residential propane in NY)
- Industrial Wood in Bethlehem (trillion btu) = residential wood in Bethlehem x (industrial wood in NY / residential wood in NY)

Industrial kerosene use was omitted from this inventory because the EIA SEDS reports industrial kerosene in an "Other" category of fuels, which was not listed as a fuel type in the residential sector.

Residual fuel oil use in the town's Commercial and Industrial sectors was also omitted from this inventory. This was because residential households do not heat with residual oil, so the state level commercial and industrial residual oil consumption could not be disaggregated to the town level using the equations above.

18 U.S. Energy Information Administration. SEDS State Energy Data System, Tables CT6 and CT5. Residential and Commercial Sector Energy Consumption Estimates, 1960 - 2009, New York. **http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/ind/use_ind_NY.html&mstate=New%20York** and **http://www.eia.gov/state/seds/hf.jsp?incfile=sep_use/com/use_com_NY.html&mstate=New%20York**

Fuel consumption was converted into GHG emissions (carbon dioxide, methane, and nitrous oxide) using the equation, emissions factors, and unit conversion factors below:

- Bethlehem Residential, Commercial, or Industrial GHG Emissions (metric tons CO_2) =fuel consumption x unit conversion factor(s) x emissions factor x 0.001 x GWP

Fuel Oil # 2 Residential and Commercial

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	10.21	kg CO_2/gallon
CH_4	0.0015	kg CH_4/gallon
N_2O	0.0001	kg N_2O/gallon

Source: Tables G.1 and G.4, Local Government Operations Protocol, Version 1.1

Fuel Oil # 2 Industrial

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	10.21	kg CO_2/gallon
CH_4	0.0004	kg CH_4/gallon
N_2O	0.0001	kg N_2O/gallon

Source: Tables G.1 and G.4, Local Government Operations Protocol, Version 1.1

Kerosene Residential Emissions Factors

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	10.15	kg CO_2/gallon
CH_4	0.0015	kg CH_4/gallon
N_2O	0.0001	kg N_2O/gallon

Source: Tables G.1 and G.4, Local Government Operations Protocol, Version 1.1

Propane Residential and Commercial Emissions Factors

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	5.59	kg CO_2/gallon
CH_4	0.0010	kg CH_4/gallon
N_2O	0.0001	kg N_2O/gallon

Source: Tables G.1 and G.4, Local Government Operations Protocol, Version 1.1

Propane Industrial Emissions Factors

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	5.59	kg CO_2/gallon
CH_4	0.0003	kg CH_4/gallon
N_2O	0.0001	kg N_2O/gallon

Source: Tables G.1 and G.4, Local Government Operations Protocol, Version 1.1

Wood Residential and Commercial

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	1,442.64	kg CO_2/short ton
CH_4	0.0320	kg CH_4/MMBtu
N_2O	0.0042	kg N_2O/MMBtu

Source: Tables G.2 and G.3, Local Government Operations Protocol, Version 1.1

Wood Industrial

GHG TYPE	EMISSIONS FACTOR	UNIT
CO_2	1,442.64	kg CO_2/short ton
CH_4	0.0320	kg CH_4/MMBtu
N_2O	0.0042	kg N_2O/MMBtu

Source: Tables G.2 and G.3, Local Government Operations Protocol, Version 1.1

Conversion Factors

Kg to Metric Tons	0.001
barrels to gallons	42
cords of pine to tons	2.15
cords of hemlock to tons	2.4
average pine and hemlock cords to tons	2.275
trillion btu to MMBtu	1,000,000

Cords to tons source: New Hampshire Department of Revenue Administration. "Property Appraisal Division." 21 December 2011 <http://www.nh.gov/revenue/munc_prop/propertyappraisal.htm>.

Wood Energy Density

MMBtu/short ton	15.38

Source: Local Government Operations Protocol, Version 1.1, May 2010, Table G.2

Global Warming Potential (GWP)

GHG	GWP
CO_2	1
CH_4	21
N_2O	310

Source: Table E.1, Local Government Operations Protocol, Version 1.1

When reporting GHG emissions in this inventory, carbon dioxide emissions from wood were excluded from the inventory totals. Per section 4.5 of the LGOP, it is assumed that carbon dioxide emissions would have occurred if the plant decomposed in its native environment. As such, carbon dioxide emissions are assumed not to be the result of combustion and should be reported as informational items only. However, methane and nitrous oxide emissions from wood combustion were included in the GHG inventory. Those gases are the direct result of combustion and would not have occurred through the plant's natural decomposition process.

Transportation

GHG emissions from vehicles traveling within the boundaries of Bethlehem were calculated using vehicle miles traveled (VMT) data provided by the Capital District Transportation Committee (CDTC). CDTC estimates VMT by road type using a Systematic Traffic Evaluation and Planning Model. VMT on Bethlehem's different road types were categorized by vehicle and fuel type using default vehicle distribution percentages contained in the table on page A-1 of the New York State Department of Transportation's (NYSDOT) MOBLE6.2 CO Emissions Factors for Project Level Microscale Analysis.[19]

VMT were converted into gallons of fuel using the fuel economies shown in the Table below:

Table 10: Default Fuel Economies by Vehicle Type

VEHICLE TYPE	FUEL ECONOMY (MPG)	SOURCE
Heavy Duty /Transit Bus/School Bus	6.29	Long Island Carbon Footprint Project, 2005 Regional Greenhouse Gas Emissions Inventory Methodology, Table 2
Light Truck	23.5	CAFÉ standard for model year 2010
Passenger Car	27.5	CAFE standard for model years 1990 - 2010
Motorcycle	40	-

Equations 7.2, 7.6, 7.7, and 7.8 from Chapter 7 of the LGOP were used to calculate carbon dioxide, methane, and nitrous oxide emissions. As instructed in Chapter 7 of LGOP, the standard emissions factors for unleaded gasoline (8.78 kg CO_2/gal) and diesel (10.21 kg CO_2/gal) in Table G.11 of LGOP were used to calculate the carbon dioxide emissions. The methane and nitrous oxide emissions factors for each vehicle type and fuel type were taken from Table G.15 of LGOP[20] and converted into units of carbon dioxide equivalent using the GWPs in Table E.1 of LGOP.

Wastewater Treatment

Wastewater in Bethlehem is treated using Town-operated wastewater treatment plants (WWTPs) – the Dinmore Rd. (Bethlehem) WWTP and the South Albany WWTP – or by private septic systems. Both WWTPs utilized aerobic treatment processes, so it was assumed that neither facility produced methane emissions. Nitrous oxide emissions from treatment processes and effluent discharge were calculated using the data sources and methods described in the "Wastewater Treatment" sub-section of the "Government Inventory" section of the Methodology. It was assumed that the difference between the population served by the WWTPs and the total town population in 2010 was the population served by septic systems.

19 New York State Department of Transportation. "Mobile6.2 CO Emissions Factors For Project Level Micro-Scale Analysis." Table1. 2009. **https://www.dot.ny.gov/divisions/engineering/environmental-analysis/manuals-and-guidance/epm/repository/coeftab0.pdf?nd=nysdot**

20 Emissions factors in Table G.15 of LGOP were only available through inventory year 2006. As such, inventory year 2006 emissions factors were used to calculate methane and nitrous oxide emissions from vehicles traveling within Bethlehem in 2010.

Methane emissions leaking from septic systems were calculated using Equation 10.6 of the LGOP as shown below:

Equation 10.6	Fugitive CH_4 from Septic Systems (default BOD_5 load)
Annual CH_4 emissions (metric tons CO_2e) =	
$(P \times BOD_5 \text{ load} \times Bo \times MCF_{septic} \times 365.25 \times 10^{-3}) \times GWP$	

Where:

Term		Description	Value
P	=	population served by septic systems [person]	user input
BOD_5 load	=	amount of BOD_5 produced per person per day [kg BOD_5/person/day]	0.090
Bo	=	maximum CH_4-producing capacity for domestic wastewater [kg CH_4/kg BOD_5 removed]	0.6
MCF_{septic}	=	CH_4 correction factor for septic systems	0.5
365.25	=	conversion factor [day/year]	365.25
10^{-3}	=	conversion from kg to metric ton [metric ton/kg]	10^{-3}
GWP	=	Global Warming Potential	21

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006*, Chapter 8, 8-9 (2008).

Solid Waste Disposal

To calculate GHG emissions from solid waste disposal, it is necessary to know the quantity, type, and disposal method of the waste. According to the Recycling Coordinator for the Town of Bethlehem, residents and businesses generated 11,845.67 tons of municipal solid waste (MSW). This was sent to the following facilities:

3. The Rupert Road Transfer Station (owned by the Town of Bethlehem).

   All solid waste collected at the Rupert Road transfer station is sent to the City of Albany Rapp Road Landfill. According to the Town's records, 1,224.84 tons of municipal solid waste (MSW) and 952.54 tons of construction and demolition (C&D) waste were collected at the transfer station in 2010.

   Of the waste that was not send to the Town's Rupert Road Transfer Station, the facilities below are listed in descending order of quantity of waste received from the town according to the Town's estimates. However, the quantity sent to each facility from the town was unknown.

4. **County Waste Transfer Station in Troy, NY** – According to the New York Department of Environmental Conservation's (DEC) Transfer Station Annual Report, 5 percent of waste received by the Transfer Station from all origins (not just Bethlehem) went to the Hudson Falls ARRA plant. The rest of the waste was sent to landfills with landfill gas (LFG) collection systems.

5. **Town of Colonie Landfill** – According to the New York DEC's Landfill Annual Report for 2010, this landfill has a LFG collection system covering 93 of 105 acres.

6. **Albany Rapp Rd. Landfill** - According to the New York DEC's Landfill Annual Report for 2010, this landfill has a LFG collection system covering the entire landfill area.

7. **Port of Albany Transfer Station run by Waste Management** – This facility collects only dry commercial and construction and demolition waste. According to New York DEC's Transfer Station Annual Report, dry commercial waste (about 17 percent of waste received at the facility) was sent to the Wheelabrator facility (waste-to energy or WTE), while the C&D waste was sent to the High Acres landfill. The High Acres landfill has a landfill gas collection system which collects gas from 146 acres of 174 acres.

Even though a small amount of waste received by the Port of Albany Transfer station was sent to a WTE facility, the majority of Bethlehem's waste was disposed in landfills with LFG collection systems. Because it was not possible to determine the exact amount of Bethlehem's solid waste that was sent to a WTE facility, it was assumed that 100 percent of Bethlehem's waste was disposed of in a landfill with a comprehensive LFG collection system.

GHG emissions were calculated using the methods described in the "Government Generated Solid Waste (Scope 3)" sub-section in the "Government Inventory" section of the Methodology. The GHG emissions calculated in the Government Generated Solid Waste sector from the Government Inventory were added to the GHG emissions calculated in the Community Inventory Solid Waste sector. This is because government generated solid waste was not included in the community tonnage data provided.

It is important to note that organic solid waste decomposing in a landfill emits methane and carbon dioxide over a lengthy decomposition period. This GHG inventory reports all methane emissions that waste disposed of in 2010 will produce over its entire decomposition cycle, even though many of the emissions occur after 2010. Carbon dioxide from organic waste decomposing in the landfill was excluded from the inventory since it is assumed the organic material would have produced carbon dioxide through its natural decomposition cycle. Methane is produced when the organic material decays in landfill and would not normally occur through the natural decomposition process.

Industrial Process Emissions

Certain industrial and manufacturing processes produce GHG emissions. These emissions are the result of chemical processes or leaking gases, and are not included in the Commercial and Industrial sectors described in previous parts of this inventory. According to Chapter 11 of the LGOP, the following processes can result in non-energy related GHG emissions:

- Adipic acid production (process N_2O emissions)
- Aluminum production (process CO_2 emissions)
- Ammonia production (process CO_2 emissions)
- Cement production (process CO_2 emissions)
- HCFC – 22 production (process HFC-23 emissions)
- Iron and steel production (process CO_2 emissions)
- Lime production (process CO_2 emissions)
- Nitric acid production (process N_2O emissions)
- Pulp and paper production (process CO_2 emissions)
- Refrigeration and air conditioning equipment manufacturing (process HFC and PFC emissions)
- Semiconductor manufacturing (process PFC and SF_6 emissions)

Using a list of commercial and industrial entities provided by the Town, it was determined that there were three industrial gas suppliers that could potentially produce nitric acid, HCFC – 22, ammonia, or adipic acid. According to the Industrial Process module of the U.S. Environmental Protection Agency's State Inventory and Projection Tool, there were no industries in New York state producing nitric acid.[21] Of the three industrial gas suppliers located in Bethlehem, two confirmed that their Bethlehem facilities do not produce nitric acid, HCFC – 22,

21 U.S. Environmental Protection Agency. State Inventory and Projection Tool. 19 January 2012. http://www.epa.gov/statelocalclimate/resources/tool.html

or ammonia. The third industrial gas supplier was unable to be reached for this project. As such, GHG emissions from industrial processes were not reported in this inventory.

Data Sources List

The following table provides a list of data sources and contacts used in the collection of data for this inventory.

NAME	DATA PROVIDED	INVENTORY TYPE	SECTOR
Town of Bethlehem *Stormwater Management Program* **contact:** (518) 439-4955	Households served by wastewater treatment facilities	Government/ Community	Wastewater Facilities
	Login information for the Town's online National Grid account (electricity and natural gas)	Government	Wastewater Facilities, Buildings and Other Facilities, Streetlights and Traffic Signals, Solid Waste Facilities, Water Treatment and Delivery
	Vehicle inventory list from fuel tracking system: vehicle miles traveled, gasoline and diesel consumption, vehicle/equipment types, model years, fuel costs, etc.	Government	Vehicle Fleet
Town of Bethlehem *Department of Public Works* **contact:** (518) 439-4955	Paper copies of fuel oil propane checks and invoices for the Town's facilities.	Government	Wastewater Facilities, Buildings and Other Facilities, Solid Waste Facilities, Water Treatment and Delivery
Town of Bethlehem *Fleet Management* **contact:** (518) 439-4955	Number of vehicles purchased that required refrigerant charging (0), number of vehicles disposed (6), and the type of refrigerant (R-134a) used in vehicle air conditioning systems.	Government	Vehicle Fleet - Refrigerants
Eastern Heating and Cooling **contact:** (518) 465-8878	Types and quantities of refrigerants used to charge new air conditioning systems and the full charge capacity of those new air conditioning systems. Also, the type and quantity of refrigerant used to service existing equipment.	Government	Buildings and Other Facilities - Refrigerants
Town of Bethlehem *Recycling Department* **contact:** (518) 439-4955	Tons of waste, by waste type, generated by the Town's government operations. Also provided information on the destination of waste generated by the Town.	Government	Government Generated Solid Waste
	Tons of waste generated within the geographic boundaries of the town of Bethlehem.	Community	Waste
	Estimate of the quantity of waste sent to the Town's Rupert Road Transfer Station, and the disposal destination of waste received by the Transfer Station.	Community	Waste
	List of facilities where waste not hauled to the Rupert Road Transfer Station was sent.	Community	Waste
	Landfill and Transfer Station Annual Reports from the New York Department of Environmental Conservation.	Community	Waste
National Grid	Electricity and natural gas usage by rate class	Community	Buildings
Capital District Transportation Committee	Vehicle miles traveled within the town of Bethlehem by road type	Community	Transportation

Energy Project Prioritization

List of Key Facilities

Final Report

Sustainable Bethlehem

Sustainable Bethlehem

BETHLEHEM, NEW YORK

Sustainable Bethlehem Program

List of Key Facilities

Greenhouse Gas Project Walk-Through Energy Audit Recommendations
Town of Bethlehem, New York
Novus Engineering - February 10, 2012

ECM	Location	System	Issue	Recommendation	Project Type	Electricity Savings (kWh)	Gas or Oil Savings (therms)	Other Benefits	Total Estimated Annual Cost Savings	Estimated Project Implementation Cost	Potential Incentives	Net Project Cost	Project Payback (Years)	Project Priority (1-4)
Town Hall (Police, Court)														
TH-1	Building-wide	Windows	The building has operable windows that are a combination of awning and casement. The windows have insulated glazing and are of fairly recent vintage. When installed the windows were caulked on the outside but not the inside making it difficult to keep track of the deteriorating caulking on the exterior of the building, particularly at the upper levels.	We recommend that the perimeters of the windows be caulked on the interior side to be sure that they are tightly sealed.	O&M	N/A	265	Improved Occupant Comfort	$ 247	$ 200	N/A	$ 200.00	0.8	2
TH-2	Roof	Roof Gravity Vents	The building attic has four, 36" diameter roof ventilators that are open to the atmosphere at all times. There are also several smaller diameter ventilators. These were once part of a building-wide ventilation system that is now mostly dismantled and not functioning. The ventilators create a route for uncontrolled exfiltration of conditioned air from the building. Heat loss during the winter is likely to be very significant. The second floor spaces have plaster ceilings with dropped ceilings below. However, there are numerous penetrations in the plaster ceilings, which permits an easy pathway for conditioned air to leave the building through the roof ventilators. The ventilators provide necessary relief for ventilation air brought in at the roof top units. However, the free area is excessive. The ventilators also may provide some attic ventilation (depending on whether the roof deck is insulated)	Most of the relief vents should be permanently sealed. Control dampers can be installed in one or two to provide controlled relief when the building is in occupied mode. Further study is required to determine if attic ventilation is necessary in this building and to develop an optimum solution.	Further Study; $2000	N/A	2260	Improved Occupant Comfort	$ 2,111	$ 6,000	N/A	$ 6,000.00	2.8	1
TH-3	Multipurpose Room	Skylights	There are two large skylights over the multipurpose room. These have been covered with standing seam sheet metal and are not visible from below due to the dropped ceiling. There are four large gravity vents (2 each) in the skylights. It is unknown whether they are open. Skylights covered with sheet metal with no insulation would be a location for significant heat loss	These areas should be insulated if they are not currently. Further investigation is required to determine the current status and to develop suitable recommendations.	Further Study; $1000	Unknown	Unknown	Unknown	Unknown	Unknown	N/A	Unknown	Unknown	Unknown
TH-4	Roof	Rooftop Units	Rooftop units are cooling only. Some are equipped with electric heat. They are shut off during the heating season. Therefore, during the heating season, there is no mechanical ventilation in the building.	Carry out detailed savings analysis of feasibility of installing natural gas heat in the existing RTUs so they could be run year round to provide ventilation.	Further Study; $2000	Unknown	Unknown	Adequate Building Ventilation	Unknown	Unknown	$200 - $500/furnace	Unknown	Unknown	Unknown
TH-5	Mechanical Room	Heating System	Heating in the building is provided by two large steam boilers. Steam heating is fairly efficient during mid-winter, but inefficient during swing seasons. Heating energy consumption for the building is about 1.0 Therms per square foot. This is about double what it should be in a building of this vintage. The existing boilers are being well maintained and well run. There are efficiency limits on steam systems that are difficult to overcome. The steam radiators also provide heating along the outside walls which improves comfort since the walls are solid masonry with no insulation	Heating costs could be substantially reduced with installation of hot water coils in supply duct work, fed by a new condensing boiler. This would be a costly project and would require new piping to be run in the building to all the RTU locations. This project should be seriously considered when the steam boilers reach the end of their useful life.	Further Study; $3000	N/A	10,000	Improved Occupant Comfort	$ 9,079	>$100,000	NGrid - Condensing Boilers	>$100,000	>10 years	4
TH-6	Building-wide	Utility Bill Information	Currently utility bill information is not shared with custodians or with Eastern Heating and Cooling (the maintenance contractor). These parties have the greatest ability to control utility costs. Furthermore, building occupants do not receive any information on building energy costs. Without access to utility costs on a monthly basis, building operators have no idea what impact their decisions regarding building operation have on utility bills. Building occupants have no incentive to save energy since there is no feedback mechanism or reward system	Make copes of actual bills and distribute them to building operators each month, or create on-line access on the National Grid website and give building operators access to the bills. Post monthly energy consumption data on a bulletin board that all occupants can see. Institute a program to reward building occupants for achieving certain energy conservation goals.	O&M	Dependent on Occupant Response	Dependent on Occupant Response	Increased occupant and maintenance staff awareness; changes in behavior to reduce energy consumption.	Dependent on Occupant Response	Minimal	N/A	Minimal	0.1	1
TH-7	Building-wide	Lighting	Many of the lighting fixtures throughout utilize outdated u-tube lamps, older T12 lamps, energy-intensive incandescent lamps, and inefficient mercury vapor high bay fixtures. Many areas suffer from a lack of automatic controls, while other areas such as some restrooms utilize automatic controls improperly. The lighting system has gone through continuous improvements through the life of the building. Some areas have been modified inadequately during renovations. These and other areas are due for upgrades based on the availability of new, more efficient technology.	Implement lighting fixture and sensor changes where appropriate. 2' x 2' u-tube fixtures should be relamped with T8 linear fluorescent lamps and ballasts. Hallways and other areas requiring less light should have two lamps removed from the four lamp 2' x 4' troffer fixtures. T12 lamps in certain fixtures should be replaced with modern T8 lamps and ballasts. Occupancy sensors should be added in many areas including ceiling sensors in shared spaces (cubicle offices, meeting rooms, and hallways) while wall switch sensors should be used in small restrooms and closets. The Auditorium should have the (16) mercury vapor fixtures replaced with high-bay fluorescent fixtures. Many occupants utilize table or desk lamps with incandescent bulbs. Initiatives should be made to swap these out with equivalent CFLs. Likewise, many downlights and recessed cans have incandescent floodlights which should be replaced with equivalent CFLs or LEDs.	Capital	68,000	N/A	Improved occupant comfort, Decreased load on A/C system in summer.	$ 9,180	$ 38,700	$ 1,725.00	$36,975.00	4.0	1

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Clapper Road Water Treatment Plant														
C-1	Plant	Envelope	There are two louvers high on the north wall that admit air when the chlorine exhaust fans are enabled. They are single thickness metal dampers with no jamb seals. The actuator is not properly adjusted and the dampers do not close, permitting a lot of air infiltration and heat loss.	O&M Option - Adjust the actuator linkage so that the dampers close-off tightly. Capital Option - Replace the dampers with new fully insulated, low leakage dampers such as Tamco Model 5000.	O&M	N/A	500	N/A	$ 875	$ 250	N/A	$ 250.00	0.3	1
C-2	Chlorine Room	Envelope	The chlorine room doors are weather-stripped but light is visible in a number of places. The room is maintained at a temperature of 60 ºF with two electric unit heaters.	Repair weather-stripping to make door air tight to prevent heat loss	O&M	1000	N/A	N/A	$ 134	$ 250	N/A	$ 250.00	1.9	1
C-3	Plant	Envelope	The rollup door is made of insulated panels but the top seal appears to be broken loose. Top seals on roll up doors are difficult to see and should be inspected with a ladder annually	Replace the weatherization flap at the top of the door	O&M	N/A	500	N/A	$ 875	$ 1,500	N/A	$ 1,500.00	1.7	1
C-4	Plant	Heating System	The main plant is maintained at 62 ºF constant temperature. It is heated with an oil fired furnace. Sometimes the door is left open when the outdoor temperature is below 62 degrees.	Interlock the furnace with the door opener so that the furnace is disabled whenever the door is open.	O&M	N/A	250	N/A	$ 438	$ 2,000	N/A	$ 2,000.00	4.6	2
C-5	Plant	Heating System	The oil-fired furnace flue was disconnected from the stack. This is a potential hazard since flue gas can leak into the furnace room.	Repair immediately	Life Safety	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
C-6	Plant	Heating System	The furnace appears to be in fairly poor condition though an internal inspection was not carried out.	Make sure that the maintenance contractor checks the integrity of the heat exchanger annually to be sure that combustion products are not leaking into the air side and into the plant.	Life Safety	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
C-7	Plant	Heating System	If the furnace is in need of repair it should be replaced with water to air heat pumps using the plant water as a heat source.	A water to air heat pump would use no oil, would minimize annual maintenance, and would be cheaper to operate. Source water for the heat pump cold be piped from any convenient location on the main water piping.	Capital	-60,000	8,018	N/A	$ 3,105	$ 25,000	$ 800.00	$24,200.00	7.8	4
C-8	Plant	Heating System	During the winter the water being treated at the plant is around 48 ºF. The space temperature in the plant is being maintained at 62 ºF. The huge metal filter tanks absorb a tremendous amount of heat from the plant air, greatly increasing the fuel consumed to heat the plant.	There are no easy solutions to this problem. Insulating the tanks would be a tremendous undertaking and probably not cost effective. However, the lower the air temperature maintained in the plant in winter, the less fuel will be used. Also a setback thermostat could be installed to set back the air temperature to match the water temperature during unoccupied periods.	Further Study; $3000	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
C-9	Offices	Heating System	The offices are heated with an indoor heat pump air handling unit with electric backup heat, though the electric coils were not found. The system is controlled with a good quality Honeywell thermostat, but the schedule on the thermostat was not properly set up.	The thermostat should be programmed to set back the temperature to 55 or 60 when the offices are not occupied.	O&M	N/A	N/A	N/A	$ 100	$ 25	N/A	$ 25.00	0.25	1
C-10	Building-wide	Lighting	The plant is lit with 150W high pressure sodium high bay fixtures. These have a warm up time and are consequently left on continuously and are rarely fully shut off. Lighting in the office areas and maintenance areas utilize outdated T12 u-tube or straight lamps. All areas besides the restrooms suffer from a lack of automatic controls.	Replace high pressure sodium fixtures with high bay fluorescent fixtures. Install high bay occupancy sensors in plant to shut off half or more of the high bay fluorescents when not in use. Implement lighting fixture and sensor changes where appropriate. 2' x 2' u-tube fixtures and T12 strip fixtures should be relamped with T8 linear fluorescent lamps and ballasts. Occupancy sensors should be added in the office	Capital	29,000	N/A	Improved occupant comfort. Improved visibility in plant area.	$ 3,915	$ 13,400	$ 3,525.00	$ 9,875.00	2.5	1

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New Salem Water Treatment Plant														
NS-1	Various	Envelope	The doors are extremely inefficient. Many have single layer metal panels and single layer glazing. Many are rusting out at the bottoms providing excessive air leakage.	Doors throughout the plant should be selectively replaced with insulated metal doors with insulated lights.	Capital	N/A	750	N/A	$ 1,823	TBD	N/A	TBD	10	3
NS-2	Facility-wide	Heating	The steam boilers are set to generate 6 psi pressure. Steam heating is more efficient the lower the pressure.	The steam pressure setpoint should be progressively lowered by 0.5 psi increments to determine the lowest pressure that can effectively heat the plant. JD Warren confirmed that the setpoint was specified by the town and they have not tried to lower the pressure..	O&M	None	500	N/A	$ 1,000	Minimal	N/A	Minimal	0.1	1
NS-3	Facility-wide	Compressed Air Systems	The compressed air system distributes are at 90 psig, which is required by the valve operators. This is a relatively high distribution pressure so that any leak will waste a lot of air. Air leaks are impossible to hear due to the high level of background noise in the plant.	Have an ultrasonic leak detection performed on the compressed air piping.	O&M	N/A	Unknown	N/A	Unknown	$ 1,500	N/A	$ 1,500.00	Unknown	2
NS-4	Facility-wide	Windows	Most of the windows in the plant are very old steel frame, single glazed industrial windows. They leak considerable about of air. Some have interior triple track storms installed. These provide a little additional protection, but are not resistant to air infiltration.	Due to the high cost of window replacement, we recommend installation of Windo-Therm double layer plastic interior storms in place of the triple track units.. These will reduce air infiltration to close to zero. Estimate based on 500 SF of window area.	Capital	N/A	490	N/A	$ 1,191	$ 5,000	N/A	$ 5,000.00	4.2	2
NS-5	Facility-wide	Heating	The plant is generally heated with steam unit heaters controlled by single setpoint thermostats. The thermostats. Are generally set around 60 ºF at all times. The thermostats are corroding from the chlorine in the room atmosphere.	Install clock thermostats in areas where the temperature that can be setback. Much of the heat loss in the building is from warming the water piping which can be as cold as 38 ºF in winter. Lowering the temperature setpoint even a few degrees will reduce heat loss to the water piping.	O&M	N/A	750	N/A	$ 1,500	$ 1,500	Unknown	$ 1,500.00	1.0	1
NS-6	Compressor Room	Heating	There is uncontrolled steam radiation in the compressor room directly below the air intake louver. The air compressor generates enough heat to keep this room warm.	Either cap the steam lines in this area or install a self-contained, non-electric control valve on the radiation. As a temporary fix, put a blanket over the radiation to stop the heat loss.	O&M	N/A	80	N/A	$ 194	$ 350	N/A	$ 350.00	1.8	1
NS-7	Valve Room adjacent to Tank #5	Heating	This room is used to store paint and is kept warm by a through the wall propane heater. One wall of the room is comprised of the metal wall of the water tank. And there is large water piping in the room. The cold water in the tank and pipes greatly increases the heat load in the room and makes it more difficult to keep warm.	Insulate the wall of the tank with semi-rigid fiberglass or spray foam insulation. Insulate the pipes with Armaflex insulation.	O&M	N/A	150	N/A	$ 415	$ 1,000	N/A	$ 1,000.00	6.7	3
NS-8	Carbon Room	Heating	This room has an exhaust fan with the damper stuck partially open.	Repair stuck damper.	O&M	N/A	100	N/A	$ 243	Minimal	N/A	Minimal	0.1	1
NS-9	Garage	Heating	This building is maintained at 55 ºF by a propane infrared heater and a single setpoint thermostat. The overhead doors are good quality but the bottom and top seals leak air. The man door is rotting out at the bottom.	Consider installing a setback thermostat and reduce temperature to 45 ºF when unoccupied or bring up to temperature with an occupancy sensor. Repair seals on overhead door and replace man door..	O&M	N/A	75	N/A	$ 200	$ 1,000	Unknown	$ 1,000.00	5.0	3
NS-10	Facility-wide	Lighting	The facility suffers from lack of automatic controls, especially in pump, filter, tank, and break rooms that are variable in occupancy and are only occupied for a small amount of time. Hanging 75W incandescent PAR lamps are required to be on continuously for water quality verification using a significant amount of energy. The vending machine near the front entrance has its lights on all the time, using a significant amount of energy throughout the year.	Install PIR/ultrasonic occupancy sensors in pump rooms, filter rooms, break rooms, and offices so lights will switch off automatically when not in use. Replace the (10) hanging incandescent 75W PAR38 lamps with 18W water-resistant LED equivalent lamps. Install a vending miser on the front vending machine to reduce its lighting and compressor usage.	Capital	21,500	N/A	N/A	$ 2,903	$ 3,200	$ 600.00	$ 2,600.00	0.9	1

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Elm Avenue Park														
E-1	Pool Filter Room	Heating	The filter room is heated with an electric unit heater. The heater is controlled by an uncalibrated thermostatic dial. It is impossible to tell what the setting is.	Install a wall thermometer below the unit heater so staff can set the thermostat properly. Suggest 55ºF setpoint. Mark the dial thermostat control to show the preferred setting.	Maintenance; Minor Energy	375	N/A	N/A	$ 50	$ 10	Unknown	$ 20.00	0.4	1
E-2	Parks and Recreation Dept. Office Building	Thermostats	The main office thermostat setback temperature is 65ºF.	This office thermostat should be reduced to 55ºF or 60ºF. If necessary start up earlier on Monday morning to bring building back to temperature. Conference room thermostat is on HOLD at 67ºF. The program should be re-enabled. A new password protected thermostat should be considered that cannot be put on permanent hold by occupants or visitors	O&M	N/A	65	N/A	$ 81	$ 500	N/A	$ 500.00	6.2	3
E-3	Parks and Recreation Dept. Office Building	Envelope	The building was built with a shed style clerestory over much of the office area, with large east facing Kalwall panels for daylighting. A dropped ceiling has been installed below the clerestory and fiberglass batts have been installed in the trusses. Therefore, the daylighting is not used. Insulated ductwork is located in the upper shed area which is not an attic. This area is currently not conditioned except for air leakage through the batt insulation below. There are two permanently open air vents at the top of each shed end wall. These were probably installed when the dropped ceiling was installed to provide ventilation and moisture control. It is not clear if these are necessary since the roof and walls are insulated. The vents also provide a permanently opening for unheated air to escape.	Calculate heating fuel use of the Park Office Building. If usage is over 0.4 Therms per square foot, air leakage may be significant. Measure temperature in upper shed attic area in winter and use IR camera to determine extent of heat loss though open vents. Ideally, dampers should be installed on vents to close them off. If motorized dampers were installed, their operation could be incorporated into an economizer (free cooling) cycle for the roof top units to provide air relief when needed. Most of the electric space heaters were reported not to operate. These should be shut off at the circuit breaker to prevent unauthorized or accidental use. One heater in the office area is reported to be needed. This one should be left on.	Further Study, $2000	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
E-4	Large Maintenance Garage	Heating	Daylight is visible at the bottom of the overhead door when it is closed. Man-door weatherstripping is in poor condition.	Install a new clock thermostat. Program the thermostat with a night setback temperature of 50 or 55ºF. There should be no need to keep the building any warmer during unoccupied periods. Check to see that the overhead door is closing all the way to compress the bottom seal. Repair the seal or level the sill if necessary. Install new weatherstripping on the man door.	O&M	N/A	100	N/A	$ 276	$ 500	Unknown	$ 500.00	1.8 years	1
E-5	Main Pool Building	Heating	This building was not meant to be heated or occupied in the winter. It is not insulated and has very poorly fitting single pane windows and door with large air gaps. The windows rattle when touched. Several areas are currently heated including the skating warming area, two bathrooms, and the kitchen. The skater warming area is heated with 3, 10 kW electric unit heaters which are switched off nightly by staff. Bathrooms are heated with recessed cabinet heaters. The concession kitchen is heated with two, 5 kW unit heaters which are left on continuously. All the unit heaters have integral dial thermostats which cannot be set to a specific temperature. During the site visit the temperature at the ceiling of the kitchen was measured at 102ºF. The bathrooms were also very warm. There is a separate electric meter for the concession kitchen, but apparently it is not read or used. Hot water for locker room showers is heated with a conventional, Boch, oil-fired hot water heater.	If the skater warming area is to continue to be used, energy improvements should be made to decrease energy and cost for space heating. Ideally a propane fired unit heater should be installed to replace the electric heaters. This could be controlled on an occupancy sensor so it only comes on when the space is occupied. Windows should be caulked so they do not rattle when pushed and weatherstripping should be installed on the two sets of double doors. The need to heat the kitchen area should be re-evaluated. It was reported that the water is turned off in that area, so heat may not be necessary. If heat continues to be used, determine the appropriate setting for the unit heaters and lock the setting by removing the control know and covering the potentiometer stem. A setting of 55 or 60ºF should be appropriate. Meter readings of the existing submeter should be recorded monthly and the concessionaire should be back charged for electric use. This will recover the cost and also decrease electric use	Further Study; $500	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
E-6	Line Drive Park Concession Building	Heating	The Bethlehem Tom Boys operate this concession. The concession includes quite a bit equipment including: reach-in freezer, 2 refrigerators, 2 solid coolers, hot dog machine, cookie baker, microwave oven, 30 gallon, 6 kW domestic hot water heater, and a 5 kW unit heater. Much of the equipment apparently belongs to the Tom Boys. They are not billed for their electric use. The concession is operated until mid-November. The bathrooms are also heated with electric unit heaters. The unit heaters have dial knobs with no temperature scale. The temperature at the ceiling of the woman's room was 100 ºF during the walkthrough.	Consider back-charging the Tom Boys for some or all of their electric use. This will encourage conservation of energy. If necessary, install a submeter to record concession usage. Determine the appropriate setting for the restroom unit heaters and lock the setting by removing the control know and covering the potentiometer stem. A setting of 55 or 60ºF should be appropriate.	O&M	2,000	N/A	N/A	$ 268	$ 25	N/A	$25	0.1	1
E-7	Facility-wide	Lighting	The T12 strips in the large maintenance garage have a poor light quality and utilize outdated inefficient technology. Flood lights throughout the lobby of the recreation dept. offices and the pool area facilities utilize inefficient PAR halogen lamps. Areas in the rec. dept offices suffer from a lack of automatic controls. Roadway and site lighting utilize inefficient 1000W mercury vapor technology.	Replace T12 strips in the large maintenance garage with new T5-High Output reflector strips. Add occupancy sensors in the garage as well as many spaces in the rec. dept offices. Replace PAR halogen flood lamps with CFL or LED equivalent in the admin building and throughout the pool area facilities where appropriate. Retrofit the roadway and site lighting with lower wattage metal halide or LED where appropriate.	Capital	49,000	N/A	Improved Visibility	$ 6,615	$ 13,500	$ 460.00	$13,040.00	2.0	1

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Rockefeller Road Sewage Pump Station														
R-1	Pump Building	Heating	The pump building has two large 2' x 5 ' dampers that provide air for the generator cooling when it runs. These dampers leak badly.	Since the room is electrically heated, the dampers should be adjusted so that they seal tightly to prevent heat loss.	O&M	1,500	N/A	N/A	$ 195	$ 500	N/A	$ 500.00	2.5	1
R-2	Pump Building	Heating	There are two electric unit heaters in the room - one on each level. There are numerous controls on the wall, but it is unclear how they work or what they control.	Clearly label heating controls and remove unused controls, if any.	O&M	N/A	N/A	N/A	Unknown	$ 50	N/A	$ 50.00	Unknown	3
R-3	Grit Removal Building	Heating	This building is heated by a 92 MBH oil fired boiler located in a small storage room. The boiler is maintained by Main Care. There is no record of combustion efficiency tests being done annually.	Contractor should perform an annual combustion efficiency test and leave a record of the test in the boiler repair log in the boiler room.	O&M	N/A	N/A	N/A	Unknown	$ 50	N/A	$ 50.00	Unknown	1
R-4	Grit Removal Building	Heating	Hopper Room overhead door does not close fully.	Adjust door so that it closes fully.	O&M	N/A	50	N/A	$ 121	Minimal	N/A	Minimal	0.1	1
R-5	Grit Removal Building	Envelope	There are several man doors with degraded or missing weather stripping.	Replace weather-stripping and consider installing drop down door bottom.	O&M	N/A	7	N/A	$ 19	$ 200	N/A	$ 200.00	10.0	4
R-6	Grit Removal Building	Envelope	The building has a well constructed envelope with a 2" EIFS exterior. The EIFS exterior is being damaged by birds who have pecked numerous holes.	Repair holes and install a plastic owl to deter further damage.	O&M	N/A	Unknown	N/A	Unknown	Unknown	N/A	Unknown	Unknown	4
R-7	Grit Removal Building	Ventilation	The upper room has two 24"x24" exhaust fans with motorized dampers.	Check damper actuator linkage periodically and make sure that the dampers seal tightly to prevent infiltration.	O&M	N/A	33	N/A	$ 89	Minimal	N/A	Minimal	0.1	1
Delaware Avenue Sewage Pump Station														
D-1	Pump Building	Ventilation	The building has an exhaust fan with a motorized damper and a gravity makeup air damper. The makeup air damper is spring return and does not close.	Adjust spring return dampers to close fully the reduce heat loss.	O&M	322	Unknown	N/A	$ 42	Minimal	N/A	Minimal	0.1	1
D-2	Pump Building	Heating	The pump building has a small electric unit heater with a control knob that is not calibrated so there is no way to know what the temperature setpoint is.	Install a wall thermometer below the unit heater so staff can set the thermostat properly. Suggest 45 ºF setpoint. Mark the dial thermostat control to show the preferred setting.	O&M	Unknown	Unknown	Unknown	Unknown	$ 10	N/A	$ 10.00	Unknown	2

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Adams St. Garage														
A-1	Facility-wide	Envelope	The building has large single pane, metal frame windows that do not close tightly and leak excessive amounts of air.	Install Windo-Therm type interios storms to improve R-value and eliminate infiltration. Based on 350 SF of window area.	Capital	N/A	525	N/A	$ 515	$ 3,500	N/A	$ 3,500.00	6.8	3
A-2		Envelope	Overhead door was replaced by not caulked around the perimeter	Caulk perimeter of door from.	O&M	N/A	30	Reduced draft	$ 42	$ 50	N/A	$ 50.00	1.2	1
A-3		Envelope	The quanset hut style roof is in very poor condition and has numerous water leaks.	If the building is to be kept in service, we recommend coating the roof on the exterior with urethane foam. This would improve the R-value and stop the water leaks.	Capital	N/A	1250	N/A	$ 1,225	$ 12,800	$ 1,000.00	$11,800.00	9.6	3
A-4		Cooling	There are window air conditioners in second floor rooms that are not used.	The window A/C's should be removed and the window openings permanently sealed.	O&M	N/A	15	Reduced draft	$ 20	$ 500	N/A	$ 500.00	25.0	4
A-5		Heating	The building is heated with gas-fired unit heaters with single setpoint thermostats. The thermostats are not accurate. Bathrooms have electric heat with uncalibrated dial thermostats	Either replace thermostats with digital stats or install large thermometers adjacent to the stats, so that the occupants can set them to the desired temperature. A setpoint of 55 ºF should be adequate in most areas.	O&M	N/A	750	N/A	$ 930	$ 500	Unknown	$ 500.00	1.8	1
A-6	Facility-wide	Lighting	The lighting in the Adams St. DPW garage and the Highway consists of T12 Industrial strip lighting and medium base fixtures with 150W incandescent lamps. The office section is lit with T12 industrial strips. Second floor offices as well as restrooms under variable occupancy contain outdated T12 wrap fixtures and have no automatic controls.	Retrofit T12 fixtures with T8 lamps and ballasts. Replace incandescent lamps with equivalent CFL or LED. Install PIR wall switch sensors in restrooms and offices where appropriate.	Capital	3,200	N/A	Improved lighting levels	$ 432	$ 3,000	$ 500.00	$ 2,500.00	5.8	3
Highway Garage Elm Avenue														
H-1		Heating	Many of the hot water lines in the boiler room are uninsulated	Insulate all hot water lines in boiler room withat least 1" fiberglass insulation with a white all service jacket. This needs to be purchased from an insulation supplier, not a home store.	O&M	N/A	45	N/A	$ 121	$ 500	N/A	$ 500.00	4.1	2
H-2		Heating	The circulator pumps are enabled when the outside air temperature is below 65 degF. It is unclear if the boilers are also disabled automatically on outside temerpature	Install outside air cutout for boilers if none existing. Set cutout temperatures as low as possible.	O&M	2,800	N/A	N/A	$ 370	$ 500	N/A	$ 500.00	1.4	1
H-3		Heating	Staff were unaware if the boiler burner is adjusted annually for combustion effieincy. There was not boiler log book in the boiler room.	Make sure that boiler service company adjusts boiler ecombustion effiency at the beginning of each heating season. Have him enter the data in a log in the boiler room of the results.	O&M	N/A	300	N/A	$ 729	$ 100	N/A	$ 100.00	0.1	1
H-4		Heating	The boiler is oil fired. There is currently no natural gas available, but there is a gas main about 800 feet away.	Obtain a costs estimate for extending the gas lne. For the past year, the cost of oil has been nearly double the cost of gas on a BTU basis. WE recommend that if the project can be implemented for a 7 year or less payback, that it be carried out.	Capital	N/A	0	N/A	$ 12,000	$ 40,000	N/A	$40,000.00	3.3	2
H-5		Heating	The existing boiler is a standard cast iron biler that operates at an annual efficiency of 80%. Gas-fired modulating/condensign boilers operate at much higher effieincy.	Once natural gas is extended to the building and when the boilier reached the end of its useful life, replace it with a mod/con boiler that will operate at an annual efficiency of around 92% versus 80% for the existing boiler.	Capital	N/A	Unknown	N/A	$ 2,000	$ 30,000	$ 6,000.00	$24,000.00	12.0	4
H-6		Envelope	The weatherstripping on the large overhead doors is in variable condition. ON some doors it is missing entirely.	Install, repair, or replace weatherstripping on overhead doors. The along brush type appears to work best with this syle door since it follows the contour of the door surface. Repair top sealkng flap where damaged or missing.	O&M	N/A	1200	N/A	$ 3,205	$ 20,000	N/A	$20,000.00	6.25	3
H-7		Envelope	The concrete floor is corroded at the entrances under the doors so that there are large air gaps under many of the doors. Lighitng is visible at the tops of some of the doors, indicating that the top seal is degraded or missing.	The building originally had a steel angle embedded in the concrete floor at the doors to create a tight air seal. Investigage means to relevel the floors at these locations so that the doors close tightly.	Capital	N/A	2000	N/A	$ 5,500	$ 30,000	N/A	$30,000.00	5.5	3
H-8		Envelope	Many of the man doors have no weather-stripping and in some the weather-stripping is out of adjustment and does not mate with the door surface	Install weather-stripping where missing. Readjust existing where necessary the weather-stripping. Replace if degraded. Use commercial quality weather-stripping.	O&M	N/A	62	N/A	$ 167	$ 500	N/A	Unknown	3.0	1
H-9	Facility-wide	Lighting	The lighting found throughout the facility consists of T-12, standard and high output lamps with 120-Volt magnetic ballasts. This technology is currently being phased out under the U.S. Department of Energy's Fluorescent Lighting Mandate. The facility also has no automatic controls and lighting is often left on regardless of occupancy.	Utility incentives are available to upgrade to energy efficient T-8 and T5 fluorescent systems. Incentives are also available for automatic lighting controls.	Capital	48,541	N/A	Improved lighting levels	$ 6,553	$ 27,500	$ 8,559.80	$18,940.20	2.6	1

Greenhouse Gas Project Walk-Through Energy Audit Recommendations
Town of Bethlehem, New York
Novus Engineering - February 10, 2012

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DPW Garage Kenwood Avenue														
DPW-1	Windows	Envelope	Except for the restroom windows, the buildings windows are about 30 years old. They are inefficient by today's standards	Replace windows with new vinyl replacement units with insulated glass.	Capital	N/A	Unknown	N/A	$ 600	$ 10,400	$ 1,000.00	$ 9,400.00	15.7	4
DPW-2	Man door weather-stripping	Envelope	Man doors are weather-stripped but the side and bottom weather-stripping is not adjusted properly and does not seal the air gap.	Readjust weather-stripping so that it closes air gap but does not impede operation of the door.	O&M	N/A	50	N/A	$ 55	$ 25	N/A	$ 25.00	0.5	1
DPW-3	OH Doors Vehicle bays and repair shop.	Envelope	Weatherseals on overhead doors are pulling away from the door. The wooden door stop is rotting out in several areas. The weatherseal at the bottom of the door on bay #4 is degraded.	Replace wooden door stops and reset weatherseals. Replace as needed.	O&M	N/A	150	N/A	$ 165	$ 1,000	N/A	$ 1,000.00	6.1	3
DPW-4	Vehicle Bays	Thermostats	Gas fired unit heaters controlled with Honeywell round T-stats which are left at fixed temperatures	Install password protected programmable thermostats. Program substantial night setback.	O&M	N/A	150	N/A	$ 165	$ 500	Unknown	$ 500.00	3.0	2
DPW-5	Offices	Thermostats	Thermostat is not programmed.	Novus programmed thermostat with approval of staff and left settings with staff.	O&M	N/A	50	N/A	$ 63	$ -	N/A	$ 25.00	0.4	1
DPW-6	Facility-wide	Lighting	The lighting found throughout the facility consists of T-12, standard and high output lamps with 120-Volt magnetic ballasts. This technology is currently being phased out under the U.S. Department of Energy's Fluorescent Lighting Mandate. The facility also has no automatic controls and lighting is often left on regardless of occupancy.	Utility incentives are available to upgrade to energy efficient T-8 and T5 fluorescent systems. Incentives are also available for automatic lighting controls.	Capital	48,541	N/A	Improved lighting levels	$ 6,553	$ 27,500	$ 8,559.80	$18,940.20	2.9	1
Park Tank														
PT-1	Generator Room	HVAC	The generator has an internal electric heater that runs during cold weather to keep the generator warm. There is a 32"x48" damper on the opening that provides ventilation for the generator when it is running. This is a leaky single layer control. There is an air gap around the perimeter of the damper frame.	Replace damper with new low leakage insulated damper to reduce heat required to keep the generator warm.. Caulk the perimeter of the damper frame.	O&M	N/A	120	N/A	$ 128	$ 500	N/A	$ 500.00	3.9	2
PT-2	Generator Room	HVAC	There is a smaller damper in the adjoining room that is permanently open. The damper linkage is disconnected.	Permanently close off this opening if this damper is not needed. If it is needed, fix the actuator so that the damper closes properly.	O&M	N/A	Unknown	N/A	$ 25	$ 25	N/A	$ 25.00	1.0	1
PT-3	Generator Room	Envelope	There is an old penetration for the old generator flue that is a source of air leakage.	Fill the old flue hole with fiberglass insulation and spray foam surface to stop infiltration.	O&M	N/A	50	N/A	$ 25	$ 1	N/A	$ 1.00	0.0	1
PT-4	Main Room	Envelope	The entry doors are double doors what are well weather-stripped except for the mee4ting stiles between the doors.	Weather-strip this area with low density foam tape so it does not impede the closing of the door.	O&M	N/A	50	N/A	$ 25	$ 5	N/A	$ 5.00	0.2	1
PT-5	Facility-wide	Lighting	Lighting consists of 2-lamp T12 strip fixtures.	Retrofit T12 fixtures with T8 lamps and ballasts.	O&M	512	N/A	N/A	$ 69	$ 400	$ 240.00	$ 160.00	2.3	1
Well Pump Control Building														
WPCB-1	Pump Control Building	Pumps	The GE variable speed drives that operate three large pumps that transfer water to the storage pond appear to be quite old. Newer drives would be more efficient and could save a considerable amount of electric energy.	Perform a study of the efficiency improvements resulting from replacing the drives with newer models.	Further Study	Unkown	Unkown	Unkown	Unkown	Unkown	Unkown	Unkown	Unknown	Unkown

Sustainable Bethlehem

BETHLEHEM, NEW YORK

Sustainable Bethlehem Program

Walk-through Energy Audits: Findings and Recommendations

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Town of Bethlehem, NY Energy Management, GHG Inventory & Bicycle/Pedestrian Program Initiatives Project

Walk-Through Energy Audits: Findings and Recommendations

A. Introduction

Novus Engineering performed walk-through energy audits for eleven Town of Bethlehem facilities from October through December, 2011 as part of the Town of Bethlehem, NY Energy Management, GHG Inventory & Bicycle/Pedestrian Program Initiatives Project. The following facilities were visited:

1. Town Hall (TH)
2. Clapper Road Water Treatment Facility (C)
3. New Salem Water Treatment Facility (NS)
4. Elm Avenue Park (E)
5. Rockefeller Road Sewage Pump Station (R)
6. Delaware Avenue Sewage Pump Station (D)
7. Adams St. Garage (A)
8. Highway Garage – Elm Avenue (H)
9. DPW Garage Kenwood Avenue (DPW)
10. Park Tank (PT)
11. Well Pump Control Building (WPCB)

Approximately 1 to 3 hours were spent at each facility, accompanied by a town employee who was generally knowledgeable about the facility. The purpose of the walk-throughs was to identify energy upgrade measures that could be implemented either as low-cost operations and maintenance (O&M) measures; capital projects, which have higher implementation costs; or measures needing further study, meaning more information is required to determine feasibility and payback. Several additional maintenance and life safety measures were also identified, which should be addressed as quickly as possible.

B. Energy Recommendations Spreadsheet

An energy recommendations spreadsheet was prepared to summarize the results of the walk-through audits and follow-up analysis. The spreadsheet is presented in tabular form below, and the Microsoft Excel source file accompanies this report. The Excel file is provided with filters, which will enable to the Town of Bethlehem staff to screen the projects by a variety of variables. Energy issues are identified by location and system type (envelope, HVAC, lighting. etc). Each measure is assigned a ranking for implementation, which was based entirely on payback period as follows:

1 - 0-3 years
2 - 3-5 years
3 - 5-10 years
4 - 10+ years

Payback period was used as the primary criteria for determining priority based on our past experience and discussions with the town. Projects that pay for themselves quickly are generally easy to install and will generate an immediate savings.

In general, we recommend implementing very low cost measures, even if the ranking is 2. Energy and cost savings estimates for the measures were based on quick calculations and should be considered order of magnitude estimates. Further detailed study of larger and/or more complex measures is required to provide more accurate energy and cost savings analyses. For these measures, an estimate of study costs is provided. Additional details and/or a proposed scope of work can be provided for these measures upon request.

Also attached following the results of the walk-through is a summary of projects identified during past energy studies that have not yet been implemented. These have been included for review and incorporation of the Town's future energy project implementation plan.

C. Implementation Strategies

Once energy projects have been selected for implementation, Novus recommends assigning key people for each task to follow through on installation. As a part of this effort, it is recommended to assign one person from each department (or main facility, as appropriate) as an energy manager. This person would not only help to oversee energy improvements in each facility for their department, but would participate in the energy training provided as a part of the Town of Bethlehem, NY Energy Management, GHG Inventory & Bicycle/Pedestrian Program Initiatives Project, and possibly track and report future utility data and energy progress for their facility(ies). It is critical that these individuals receive copies of utility bills in a timely manner for all their facilities.

For larger implementation projects, Novus recommends hiring an outside consultant to guide the process. An outside consultant can help by scoping the project; preparing design documents, if necessary; creating a bidding document; identifying potential contractors to be invited to bid; and identifying incentive and financing opportunities. Novus would be happy to serve as a consultant for the recommended energy projects and can provide a proposal of services, if interested.

Finally, we recommend researching and understanding the available incentive opportunities available for energy implementation projects. This can be done individually, or through the use of an outside consultant. Incentives are available both through NYSERDA or National Grid. A list of potential programs and resources follows:

- **NYSERDA FlexTech Study** – NYSERDA will cover 50% of the costs to provide an energy study and implementation assistance services for a variety of energy projects. This is typically reserved for larger building projects, but multiple facilities/projects can be combined into one FlexTech study. Novus is an approved FlexTech Technical Assistance (TA) provider. Details about the program are available at: http://www.nyserda.ny.gov/en/Page-Sections/Commercial-and-Industrial/Programs/FlexTech-Program.aspx

- **NYSERDA Existing Facilities Program** – this program offers incentives for implementation projects, including motors, drives, lighting, HVAC units, etc. The best way to pursue this program is through the "prequalified" approach. You can find more information on http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Programs/Existing-Facilities-Program.aspx. This program would not necessarily require an outside consultant, but Novus has extensive experience helping clients receive incentives through this program, if you are interested.

- **National Grid Incentives** – Similar to NYSERDA, National Grid offers incentives for implementation projects. The incentives are somewhat similar to those in the NYSERDA Existing Facilities Program, but National Grid has some incentives that NYSERDA does not (and vice versa). You can pursue incentives from both parties, as long as you are not pursuing incentives for the same improvement project. More information can be found on the National Grid website: https://www.powerofaction.com/efficiency/.

Greenhouse Gas Project Walk-Through Energy Audit Recommendations
Town of Bethlehem, New York
Novus Engineering - February 10, 2012

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Town Hall (Police, Court)														
TH-1	Building-wide	Windows	The building has operable windows that are a combination of awning and casement. The windows have insulated glazing and are of fairly recent vintage. When installed the windows were caulked on the outside but not the inside making it difficult to keep track of the deteriorating caulking on the exterior of the building, particularly at the upper levels.	We recommend that the perimeters of the windows be caulked on the interior side to be sure that they are tightly sealed.	O&M	N/A	265	Improved Occupant Comfort	$ 247	$ 200	N/A	$ 200.00	0.8	2
TH-2	Roof	Roof Gravity Vents	The building attic has four, 36" diameter roof ventilators that are open to the atmosphere at all times. There are also several smaller diameter ventilators. These were once part of a building-wide ventilation system that is now mostly dismantled and not functioning. The ventilators create a route for uncontrolled exfiltration of conditioned air from the building. Heat loss during the winter is likely to be very significant. The second floor spaces have plaster ceilings with dropped ceilings below. However, there are numerous penetrations in the plaster ceilings, which permits an easy pathway for conditioned air to leave the building through the roof ventilators. The ventilators provide necessary relief for ventilation air brought in at the roof top units. However, the free area is excessive. The ventilators also may provide some attic ventilation (depending on whether the roof deck is insulated).	Most of the relief vents should be permanently sealed. Control dampers can be installed in one or two to provide controlled relief when the building is in occupied mode. Further study is required to determine if attic ventilation is necessary in this building and to develop an optimum solution.	Further Study; $2000	N/A	2260	Improved Occupant Comfort	$ 2,111	$ 6,000	N/A	$ 6,000.00	2.8	1
TH-3	Multipurpose Room	Skylights	There are two large skylights over the multipurpose room. These have been covered with standing seam sheet metal and are not visible from below due to the dropped ceiling. There are four large gravity vents (2 each) in the skylights. It is unknown whether they are open. Skylights covered with sheet metal with no insulation would be a location for significant heat loss.	These areas should be insulated if they are not currently. Further investigation is required to determine the current status and to develop suitable recommendations.	Further Study; $1000	Unknown	Unknown	Unknown	Unknown	Unknown	N/A	Unknown	Unknown	Unknown
TH-4	Roof	Rooftop Units	Rooftop units are cooling only. Some are equipped with electric heat. They are shut off during the heating season. Therefore, during the heating season, there is no mechanical ventilation in the building.	Carry out detailed savings analysis of feasibility of installing natural gas heat in the existing RTUs so they could be run year round to provide ventilation.	Further Study; $2000	Unknown	Unknown	Adequate Building Ventilation	Unknown	Unknown	$200 - $500/furnace	Unknown	Unknown	Unknown
TH-5	Mechanical Room	Heating System	Heating in the building is provided by two large steam boilers. Steam heating is fairly efficient during mid-winter, but inefficient during swing seasons. Heating energy consumption for the building is about 1.0 Therms per square foot. This is about double what it should be in a building of this vintage. The existing boilers are being well maintained and well run. There are efficiency limits on steam systems that are difficult to overcome. The steam radiators also provide heating along the outside walls which improves comfort since the walls are solid masonry with no insulation..	Heating costs could be substantially reduced with installation of hot water coils in supply duct work, fed by a new condensing boiler. This would be a costly project and would require new piping to be run in the building to all the RTU locations. This project should be seriously considered when the steam boilers reach the end of their useful life.	Further Study; $3000	N/A	10,000	Improved Occupant Comfort	$ 9,079	>$100,000	NGrid - Condensing Boilers	>$100,000	>10 years	4
TH-6	Building-wide	Utility Bill Information	Currently utility bill information is not shared with custodians or with Eastern Heating and Cooling (the maintenance contractor). These parties have the greatest ability to control utility costs. Furthermore, building occupants do not receive any information on building energy costs. Without access to utility costs on a monthly basis, building operators have no idea what impact their decisions regarding building operation have on utility bills. Building occupants have no incentive to save energy since there is no feedback mechanism or reward system.	Make copes of actual bills and distribute them to building operators each month, or create on-line access on the National Grid website and give building operators access to the bills. Post monthly energy consumption data on a bulletin board that all occupants can see. Institute a program to reward building occupants for achieving certain energy conservation goals.	O&M	Dependent on Occupant Response	Dependent on Occupant Response	Increased occupant and maintenance staff awareness; changes in behavior to reduce energy consumption.	Dependent on Occupant Response	Minimal	N/A	Minimal	0.1	1
TH-7	Building-wide	Lighting	Many of the lighting fixtures throughout utilize outdated u-tube lamps, older T12 lamps, energy-intensive incandescent lamps, and inefficient mercury vapor high bay fixtures. Many areas suffer from a lack of automatic controls, while other areas such as some restrooms utilize automatic controls improperly. The lighting system has gone through continuous improvements through the life of the building. Some areas have been modified inadequately during renovations. These and other areas are due for upgrades based on the availability of new, more efficient technology.	Implement lighting fixture and sensor changes where appropriate. 2' x 2' u-tube fixtures should be relamped with T8 linear fluorescent lamps and ballasts. Hallways and other areas requiring less light should have two lamps removed from the four lamp 2' x 4' troffer fixtures. T12 lamps in certain fixtures should be replaced with modern T8 lamps and ballasts. Occupancy sensors should be added in many areas including ceiling sensors in shared spaces (cubicle offices, meeting rooms, and hallways) while wall switch sensors should be used in small restrooms and closets. The Auditorium should have the (16) mercury vapor fixtures replaced with high-bay fluorescent fixtures. Many occupants utilize table or desk lamps with incandescent bulbs. Initiatives should be made to swap these out with equivalent CFLs. Likewise, many downlights and recessed cans have incandescent floodlights which should be replaced with equivalent CFLs or LEDs.	Capital	68,000	N/A	Improved occupant comfort, Decreased load on A/C system in summer.	$ 9,180	$ 38,700	$ 1,725.00	$36,975.00	4.0	1

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Town of Bethlehem, New York
Novus Engineering - February 10, 2012

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Clapper Road Water Treatment Plant														
C-1	Plant	Envelope	There are two louvers high on the north wall that admit air when the chlorine exhaust fans are enabled. They are single thickness metal dampers with no jamb seals. The actuator is not properly adjusted and the dampers do not close, permitting a lot of air infiltration and heat loss.	O&M Option - Adjust the actuator linkage so that the dampers close-off tightly. Capital Option - Replace the dampers with new fully insulated, low leakage dampers such as Tamco Model 5000.	O&M	N/A	500	N/A	$ 875	$ 250	N/A	$ 250.00	0.3	1
C-2	Chlorine Room	Envelope	The chlorine room doors are weather-stripped but light is visible in a number of places. The room is maintained at a temperature of 60 ºF with two electric unit heaters.	Repair weather-stripping to make door air tight to prevent heat loss	O&M	1000	N/A	N/A	$ 134	$ 250	N/A	$ 250.00	1.9	1
C-3	Plant	Envelope	The rollup door is made of insulated panels but the top seal appears to be broken loose. Top seals on roll up doors are difficult to see and should be inspected with a ladder annually	Replace the weatherization flap at the top of the door	O&M	N/A	500	N/A	$ 875	$ 1,500	N/A	$ 1,500.00	1.7	1
C-4	Plant	Heating System	The main plant is maintained at 62 ºF constant temperature. It is heated with an oil fired furnace. Sometimes the door is left open when the outdoor temperature is below 62 degrees.	Interlock the furnace with the door opener so that the furnace is disabled whenever the door is open.	O&M	N/A	250	N/A	$ 438	$ 2,000	N/A	$ 2,000.00	4.6	2
C-5	Plant	Heating System	The oil-fired furnace flue was disconnected from the stack. This is a potential hazard since flue gas can leak into the furnace room.	Repair immediately	Life Safety	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
C-6	Plant	Heating System	The furnace appears to be in fairly poor condition though an internal inspection was not carried out.	Make sure that the maintenance contractor checks the integrity of the heat exchanger annually to be sure that combustion products are not leaking into the air side and into the plant.	Life Safety	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
C-7	Plant	Heating System	If the furnace is in need of repair it should be replaced with water to air heat pumps using the plant water as a heat source.	A water to air heat pump would use no oil, would minimize annual maintenance, and would be cheaper to operate. Source water for the heat pump cold be piped from any convenient location on the main water piping.	Capital	-60,000	8,018	N/A	$ 3,105	$ 25,000	$ 800.00	$24,200.00	7.8	4
C-8	Plant	Heating System	During the winter the water being treated at the plant is around 48 ºF. The space temperature in the plant is being maintained at 62 ºF. The huge metal filter tanks absorb a tremendous amount of heat from the plant air, greatly increasing the fuel consumed to heat the plant.	There are no easy solutions to this problem. Insulating the tanks would be a tremendous undertaking and probably not cost effective. However, the lower the air temperature maintained in the plant in winter, the less fuel will be used. Also a setback thermostat could be installed to set back the air temperature to match the water temperature during unoccupied periods.	Further Study; $3000	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
C-9	Offices	Heating System	The offices are heated with an indoor heat pump air handling unit with electric backup heat, though the electric coils were not found. The system is controlled with a good quality Honeywell thermostat, but the schedule on the thermostat was not properly set up.	The thermostat should be programmed to set back the temperature to 55 or 60 when the offices are not occupied.	O&M	N/A	N/A	N/A	$ 100	$ 25	N/A	$ 25.00	0.25	1
C-10	Building-wide	Lighting	The plant is lit with 150W high pressure sodium high bay fixtures. These have a warm up time and are consequently left on continuously and are rarely fully shut off. Lighting in the office areas and maintenance areas utilize outdated T12 u-tube or straight lamps. All areas besides the restrooms suffer from a lack of automatic controls.	Replace high pressure sodium fixtures with high bay fluorescent fixtures. Install high bay occupancy sensors in plant to shut off half or more of the high bay fluorescents when not in use. Implement lighting fixture and sensor changes where appropriate. 2' x 2' u-tube fixtures and T12 strip fixtures should be relamped with T8 linear fluorescent lamps and ballasts. Occupancy sensors should be added in the office	Capital	29,000	N/A	Improved occupant comfort. Improved visibility in plant area.	$ 3,915	$ 13,400	$ 3,525.00	$ 9,875.00	2.5	1

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Town of Bethlehem, New York
Novus Engineering - February 10, 2012

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New Salem Water Treatment Plant														
NS-1	Various	Envelope	The doors are extremely inefficient. Many have single layer metal panels and single layer glazing. Many are rusting out at the bottoms providing excessive air leakage.	Doors throughout the plant should be selectively replaced with insulated metal doors with insulated lights.	Capital	N/A	750	N/A	$ 1,823	TBD	N/A	TBD	10	3
NS-2	Facility-wide	Heating	The steam boilers are set to generate 6 psi pressure. Steam heating is more efficient the lower the pressure.	The steam pressure setpoint should be progressively lowered by 0.5 psi increments to determine the lowest pressure that can effectively heat the plant. JD Warren confirmed that the setpoint was specified by the town and they have not tried to lower the pressure..	O&M	None	500	N/A	$ 1,000	Minimal	N/A	Minimal	0.1	1
NS-3	Facility-wide	Compressed Air Systems	The compressed air system distributes are at 90 psig, which is required by the valve operators. This is a relatively high distribution pressure so that any leak will waste a lot of air. Air leaks are impossible to hear due to the high level of background noise in the plant.	Have an ultrasonic leak detection performed on the compressed air piping.	O&M	N/A	Unknown	N/A	Unknown	$ 1,500	N/A	$ 1,500.00	Unknown	2
NS-4	Facility-wide	Windows	Most of the windows in the plant are very old steel frame, single glazed industrial windows. They leak considerable about of air. Some have interior triple track storms installed. These provide a little additional protection, but are not resistant to air infiltration.	Due to the high cost of window replacement, we recommend installation of Windo-Therm double layer plastic interior storms in place of the triple track units.. These will reduce air infiltration to close to zero. Estimate based on 500 SF of window area.	Capital	N/A	490	N/A	$ 1,191	$ 5,000	N/A	$ 5,000.00	4.2	2
NS-5	Facility-wide	Heating	The plant is generally heated with steam unit heaters controlled by single setpoint thermostats. The thermostats. Are generally set around 60 ºF at all times. The thermostats are corroding from the chlorine in the room atmosphere.	Install clock thermostats in areas where the temperature that can be setback. Much of the heat loss in the building is from warming the water piping which can be as cold as 38 ºF in winter. Lowering the temperature setpoint even a few degrees will reduce heat loss to the water piping.	O&M	N/A	750	N/A	$ 1,500	$ 1,500	Unknown	$ 1,500.00	1.0	1
NS-6	Compressor Room	Heating	There is uncontrolled steam radiation in the compressor room directly below the air intake louver. The air compressor generates enough heat to keep this room warm.	Either cap the steam lines in this area or install a self-contained, non-electric control valve on the radiation. As a temporary fix, put a blanket over the radiation to stop the heat loss.	O&M	N/A	80	N/A	$ 194	$ 350	N/A	$ 350.00	1.8	1
NS-7	Valve Room adjacent to Tank #5	Heating	This room is used to store paint and is kept warm by a through the wall propane heater. One wall of the room is comprised of the metal wall of the water tank. And there is large water piping in the room. The cold water in the tank and pipes greatly increases the heat load in the room and makes it more difficult to keep warm.	Insulate the wall of the tank with semi-rigid fiberglass or spray foam insulation. Insulate the pipes with Armaflex insulation.	O&M	N/A	150	N/A	$ 415	$ 1,000	N/A	$ 1,000.00	6.7	3
NS-8	Carbon Room	Heating	This room has an exhaust fan with the damper stuck partially open.	Repair stuck damper.	O&M	N/A	100	N/A	$ 243	Minimal	N/A	Minimal	0.1	1
NS-9	Garage	Heating	This building is maintained at 55 ºF by a propane infrared heater and a single setpoint thermostat. The overhead doors are good quality but the bottom and top seals leak air. The man door is rotting out at the bottom.	Consider installing a setback thermostat and reduce temperature to 45 ºF when unoccupied or bring up to temperature with an occupancy sensor. Repair seals on overhead door and replace man door..	O&M	N/A	75	N/A	$ 200	$ 1,000	Unknown	$ 1,000.00	5.0	3
NS-10	Facility-wide	Lighting	The facility suffers from lack of automatic controls, especially in pump, filter, tank, and break rooms that are variable in occupancy and are only occupied for a small amount of time. Hanging 75W incandescent PAR lamps are required to be on continuously for water quality verification using a significant amount of energy. The vending machine near the front entrance has its lights on all the time, using a significant amount of energy throughout the year.	Install PIR/ultrasonic occupancy sensors in pump rooms, filter rooms, break rooms, and offices so lights will switch off automatically when not in use. Replace the (10) hanging incandescent 75W PAR38 lamps with 18W water-resistant LED equivalent lamps. Install a vending miser on the front vending machine to reduce its lighting and compressor usage.	Capital	21,500	N/A	N/A	$ 2,903	$ 3,200	$ 600.00	$ 2,600.00	0.9	1

Greenhouse Gas Project Walk-Through Energy Audit Recommendations
Town of Bethlehem, New York
Novus Engineering - February 10, 2012

ECM	Location	System	Issue	Recommendation	Project Type	Electricity Savings (kWh)	Gas or Oil Savings (therms)	Other Benefits	Total Estimated Annual Cost Savings	Estimated Project Implementation Cost	Potential Incentives	Net Project Cost	Project Payback (Years)	Project Priority (1-4)
Elm Avenue Park														
E-1	Pool Filter Room	Heating	The filter room is heated with an electric unit heater. The heater is controlled by an uncalibrated thermostatic dial. It is impossible to tell what the setting is.	Install a wall thermometer below the unit heater so staff can set the thermostat properly. Suggest 55ºF setpoint. Mark the dial thermostat control to show the preferred setting.	Maintenance; Minor Energy	375	N/A	N/A	$ 50	$ 10	Unknown	$ 20.00	0.4	1
E-2	Parks and Recreation Dept. Office Building	Thermostats	The main office thermostat setback temperature is 65ºF.	This office thermostat should be reduced to 55ºF or 60ºF. If necessary start up earlier on Monday morning to bring building back to temperature. Conference room thermostat is on HOLD at 67ºF. The program should be re-enabled. A new password protected thermostat should be considered that cannot be put on permanent hold by occupants or visitors	O&M	N/A	65	N/A	$ 81	$ 500	N/A	$ 500.00	6.2	3
E-3	Parks and Recreation Dept. Office Building	Envelope	The building was built with a shed style clerestory over much of the office area, with large east facing Kalwall panels for daylighting. A dropped ceiling has been installed below the clerestory and fiberglass batts have been installed in the trusses. Therefore, the daylighting is not used. Insulated ductwork is located in the upper shed area which is not an attic. This area is currently not conditioned except for air leakage through the batt insulation below. There are two permanently open air vents at the top of each shed end wall. These were probably installed when the dropped ceiling was installed to provide ventilation and moisture control. It is not clear if these are necessary since the roof and walls are insulated. The vents also provide a permanently opening for unheated air to escape.	Calculate heating fuel use of the Park Office Building. If usage is over 0.4 Therms per square foot, air leakage may be significant. Measure temperature in upper shed attic area in winter and use IR camera to determine extent of heat loss though open vents. Ideally, dampers should be installed on vents to close them off. If motorized dampers were installed, their operation could be incorporated into an economizer (free cooling) cycle for the roof top units to provide air relief when needed. Most of the electric space heaters were reported not to operate. These should be shut off at the circuit breaker to prevent unauthorized or accidental use. One heater in the office area is reported to be needed. This one should be left on.	Further Study, $2000	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
E-4	Large Maintenance Garage	Heating	Daylight is visible at the bottom of the overhead door when it is closed. Man-door weatherstripping is in poor condition.	Install a new clock thermostat. Program the thermostat with a night setback temperature of 50 or 55ºF. There should be no need to keep the building any warmer during unoccupied periods. Check to see that the overhead door is closing all the way to compress the bottom seal. Repair the seal or level the sill if necessary. Install new weatherstripping on the man door.	O&M	N/A	100	N/A	$ 276	$ 500	Unknown	$ 500.00	1.8 years	1
E-5	Main Pool Building	Heating	This building was not meant to be heated or occupied in the winter. It is not insulated and has very poorly fitting single pane windows and door with large air gaps. The windows rattle when touched. Several areas are currently heated including the skating warming area, two bathrooms, and the kitchen. The skater warming area is heated with 3, 10 kW electric unit heaters which are switched off nightly by staff. Bathrooms are heated with recessed cabinet heaters. The concession kitchen is heated with two, 5 kW unit heaters which are left on continuously. All the unit heaters have integral dial thermostats which cannot be set to a specific temperature. During the site visit the temperature at the ceiling of the kitchen was measured at 102ºF. The bathrooms were also very warm. There is a separate electric meter for the concession kitchen, but apparently it is not read or used. Hot water for locker room showers is heated with a conventional, Boch, oil-fired hot water heater.	If the skater warming area is to continue to be used, energy improvements should be made to decrease energy and cost for space heating. Ideally a propane fired unit heater should be installed to replace the electric heaters. This could be controlled on an occupancy sensor so it only comes on when the space is occupied. Windows should be caulked so they do not rattle when pushed and weatherstripping should be installed on the two sets of double doors. The need to heat the kitchen area should be re-evaluated. It was reported that the water is turned off in that area, so heat may not be necessary. If heat continues to be used, determine the appropriate setting for the unit heaters and lock the setting by removing the control know and covering the potentiometer stem. A setting of 55 or 60ºF should be appropriate. Meter readings of the existing submeter should be recorded monthly and the concessionaire should be back charged for electric use. This will recover the cost and also decrease electric use.	Further Study; $500	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
E-6	Line Drive Park Concession Building	Heating	The Bethlehem Tom Boys operate this concession. The concession includes quite a bit equipment including: reach-in freezer, 2 refrigerators, 2 solid coolers, hot dog machine, cookie baker, microwave oven, 30 gallon, 6 kW domestic hot water heater, and a 5 kW unit heater. Much of the equipment apparently belongs to the Tom Boys. They are not billed for their electric use. The concession is operated until mid-November. The bathrooms are also heated with electric unit heaters. The unit heaters have dial knobs with no temperature scale. The temperature at the ceiling of the woman's room was 100 ºF during the walkthrough.	Consider back-charging the Tom Boys for some or all of their electric use. This will encourage conservation of energy. If necessary, install a submeter to record concession usage. Determine the appropriate setting for the restroom unit heaters and lock the setting by removing the control know and covering the potentiometer stem. A setting of 55 or 60ºF should be appropriate.	O&M	2,000	N/A	N/A	$ 268	$ 25	N/A	$25	0.1	1
E-7	Facility-wide	Lighting	The T12 strips in the large maintenance garage have a poor light quality and utilize outdated inefficient technology. Flood lights throughout the lobby of the recreation dept. offices and the pool area facilities utilize inefficient PAR halogen lamps. Areas in the rec. dept offices suffer from a lack of automatic controls. Roadway and site lighting utilize inefficient 1000W mercury vapor technology.	Replace T12 strips in the large maintenance garage with new T5-High Output reflector strips. Add occupancy sensors in the garage as well as many spaces in the rec. dept offices. Replace PAR halogen flood lamps with CFL or LED equivalent in the admin building and throughout the pool area facilities where appropriate. Retrofit the roadway and site lighting with lower wattage metal halide or LED where appropriate.	Capital	49,000	N/A	Improved Visibility	$ 6,615	$ 13,500	$ 460.00	$13,040.00	2.0	1

Greenhouse Gas Project Walk-Through Energy Audit Recommendations
Town of Bethlehem, New York
Novus Engineering - February 10, 2012

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Rockefeller Road Sewage Pump Station														
R-1	Pump Building	Heating	The pump building has two large 2' x 5 ' dampers that provide air for the generator cooling when it runs. These dampers leak badly.	Since the room is electrically heated, the dampers should be adjusted so that they seal tightly to prevent heat loss.	O&M	1,500	N/A	N/A	$ 195	$ 500	N/A	$ 500.00	2.5	1
R-2	Pump Building	Heating	There are two electric unit heaters in the room - one on each level. There are numerous controls on the wall, but it is unclear how they work or what they control.	Clearly label heating controls and remove unused controls, if any.	O&M	N/A	N/A	N/A	Unknown	$ 50	N/A	$ 50.00	Unknown	3
R-3	Grit Removal Building	Heating	This building is heated by a 92 MBH oil fired boiler located in a small storage room. The boiler is maintained by Main Care. There is no record of combustion efficiency tests being done annually.	Contractor should perform an annual combustion efficiency test and leave a record of the test in the boiler repair log in the boiler room.	O&M	N/A	N/A	N/A	Unknown	$ 50	N/A	$ 50.00	Unknown	1
R-4	Grit Removal Building	Heating	Hopper Room overhead door does not close fully.	Adjust door so that it closes fully.	O&M	N/A	50	N/A	$ 121	Minimal	N/A	Minimal	0.1	1
R-5	Grit Removal Building	Envelope	There are several man doors with degraded or missing weather stripping.	Replace weather-stripping and consider installing drop down door bottom.	O&M	N/A	7	N/A	$ 19	$ 200	N/A	$ 200.00	10.0	4
R-6	Grit Removal Building	Envelope	The building has a well constructed envelope with a 2" EIFS exterior. The EIFS exterior is being damaged by birds who have pecked numerous holes.	Repair holes and install a plastic owl to deter further damage.	O&M	N/A	Unknown	N/A	Unknown	Unknown	N/A	Unknown	Unknown	4
R-7	Grit Removal Building	Ventilation	The upper room has two 24"x24" exhaust fans with motorized dampers.	Check damper actuator linkage periodically and make sure that the dampers seal tightly to prevent infiltration.	O&M	N/A	33	N/A	$ 89	Minimal	N/A	Minimal	0.1	1
Delaware Avenue Sewage Pump Station														
D-1	Pump Building	Ventilation	The building has an exhaust fan with a motorized damper and a gravity makeup air damper. The makeup air damper is spring return and does not close.	Adjust spring return dampers to close fully the reduce heat loss.	O&M	322	Unknown	N/A	$ 42	Minimal	N/A	Minimal	0.1	1
D-2	Pump Building	Heating	The pump building has a small electric unit heater with a control knob that is not calibrated so there is no way to know what the temperature setpoint is.	Install a wall thermometer below the unit heater so staff can set the thermostat properly. Suggest 45 ºF setpoint. Mark the dial thermostat control to show the preferred setting.	O&M	Unknown	Unknown	Unknown	Unknown	$ 10	N/A	$ 10.00	Unknown	2

Greenhouse Gas Project Walk-Through Energy Audit Recommendations
Town of Bethlehem, New York
Novus Engineering - February 10, 2012

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Adams St. Garage														
A-1	Facility-wide	Envelope	The building has large single pane, metal frame windows that do not close tightly and leak excessive amounts of air.	Install Windo-Therm type interios storms to improve R-value and eliminate infiltration. Based on 350 SF of window area.	Capital	N/A	525	N/A	$ 515	$ 3,500	N/A	$ 3,500.00	6.8	3
A-2		Envelope	Overhead door was replaced by not caulked around the perimeter	Caulk perimeter of door from.	O&M	N/A	30	Reduced draft	$ 42	$ 50	N/A	$ 50.00	1.2	1
A-3		Envelope	The quanset hut style roof is in very poor condition and has numerous water leaks.	If the building is to be kept in service, we recommend coating the roof on the exterior with urethane foam. This would improve the R-value and stop the water leaks.	Capital	N/A	1250	N/A	$ 1,225	$ 12,800	$ 1,000.00	$11,800.00	9.6	3
A-4		Cooling	There are window air conditioners in second floor rooms that are not used.	The window A/C's should be removed and the window openings permanently sealed.	O&M	N/A	15	Reduced draft	$ 20	$ 500	N/A	$ 500.00	25.0	4
A-5		Heating	The building is heated with gas-fired unit heaters with single setpoint thermostats. The thermostats are not accurate. Bathrooms have electric heat with uncalibrated dial thermostats	Either replace thermostats with digital stats or install large thermometers adjacent to the stats, so that the occupants can set them to the desired temperature. A setpoint of 55 ºF should be adequate in most areas.	O&M	N/A	750	N/A	$ 930	$ 500	Unknown	$ 500.00	1.8	1
A-6	Facility-wide	Lighting	The lighting in the Adams St. DPW garage and the Highway consists of T12 Industrial strip lighting and medium base fixtures with 150W incandescent lamps. The office section is lit with T12 industrial strips. Second floor offices as well as restrooms under variable occupancy contain outdated T12 wrap fixtures and have no automatic controls.	Retrofit T12 fixtures with T8 lamps and ballasts. Replace incandescent lamps with equivalent CFL or LED. Install PIR wall switch sensors in restrooms and offices where appropriate.	Capital	3,200	N/A	Improved lighting levels	$ 432	$ 3,000	$ 500.00	$ 2,500.00	5.8	3
Highway Garage Elm Avenue														
H-1		Heating	Many of the hot water lines in the boiler room are uninsulated	Insulate all hot water lines in boiler room withat least 1" fiberglass insulation with a white all service jacket. This needs to be purchased from an insulation supplier, not a home store.	O&M	N/A	45	N/A	$ 121	$ 500	N/A	$ 500.00	4.1	2
H-2		Heating	The circulator pumps are enabled when the outside air temperature is below 65 degF. It is unclear if the boilers are also disabled automatically on outside temerpature	Install outside air cutout for boilers if none existing. Set cutout temperatures as low as possible.	O&M	2,800	N/A	N/A	$ 370	$ 500	N/A	$ 500.00	1.4	1
H-3		Heating	Staff were unaware if the boiler burner is adjusted annually for combustion effieincy. There was not boiler log book in the boiler room.	Make sure that boiler service company adjusts boiler ecombustion effiency at the beginning of each heating season. Have him enter the data in a log in the boiler room of the results.	O&M	N/A	300	N/A	$ 729	$ 100	N/A	$ 100.00	0.1	1
H-4		Heating	The boiler is oil fired. There is currently no natural gas available, but there is a gas main about 800 feet away.	Obtain a costs estimate for extending the gas lne. For the past year, the cost of oil has been nearly double the cost of gas on a BTU basis. WE recommend that if the project can be implemented for a 7 year or less payback, that it be carried out.	Capital	N/A	0	N/A	$ 12,000	$ 40,000	N/A	$40,000.00	3.3	2
H-5		Heating	The existing boiler is a standard cast iron biler that operates at an annual efficiency of 80%. Gas-fired modulating/condensign boilers operate at much higher effieincy.	Once natural gas is extended to the building and when the boilier reached the end of its useful life, replace it with a mod/con boiler that will operate at an annual efficiency of around 92% versus 80% for the existing boiler.	Capital	N/A	Unknown	N/A	$ 2,000	$ 30,000	$ 6,000.00	$24,000.00	12.0	4
H-6		Envelope	The weatherstripping on the large overhead doors is in variable condition. ON some doors it is missing entirely.	Install, repair, or replace weatherstripping on overhead doors. The along brush type appears to work best with this syle door since it follows the contour of the door surface. Repair top sealkng flap where damaged or missing.	O&M	N/A	1200	N/A	$ 3,205	$ 20,000	N/A	$20,000.00	6.25	3
H-7		Envelope	The concrete floor is corroded at the entrances under the doors so that there are large air gaps under many of the doors. Lighitng is visible at the tops of some of the doors, indicating that the top seal is degraded or missing.	The building originally had a steel angle embedded in the concrete floor at the doors to create a tight air seal. Investigage means to relevel the floors at these locations so that the doors close tightly.	Capital	N/A	2000	N/A	$ 5,500	$ 30,000	N/A	$30,000.00	5.5	3
H-8		Envelope	Many of the man doors have no weather-stripping and in some the weather-stripping is out of adjustment and does not mate with the door surface	Install weather-stripping where missing. Readjust existing where necessary the weather-stripping. Replace if degraded. Use commercial quality weather-stripping.	O&M	N/A	62	N/A	$ 167	$ 500	N/A	Unknown	3.0	1
H-9	Facility-wide	Lighting	The lighting found throughout the facility consists of T-12, standard and high output lamps with 120-Volt magnetic ballasts. This technology is currently being phased out under the U.S. Department of Energy's Fluorescent Lighting Mandate. The facility also has no automatic controls and lighting is often left on regardless of occupancy.	Utility incentives are available to upgrade to energy efficient T-8 and T5 fluorescent systems. Incentives are also available for automatic lighting controls.	Capital	48,541	N/A	Improved lighting levels	$ 6,553	$ 27,500	$ 8,559.80	$18,940.20	2.6	1

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DPW Garage Kenwood Avenue														
DPW-1	Windows	Envelope	Except for the restroom windows, the buildings windows are about 30 years old. They are inefficient by today's standards	Replace windows with new vinyl replacement units with insulated glass.	Capital	N/A	Unknown	N/A	$ 600	$ 10,400	$ 1,000.00	$ 9,400.00	15.7	4
DPW-2	Man door weather-stripping	Envelope	Man doors are weather-stripped but the side and bottom weather-stripping is not adjusted properly and does not seal the air gap.	Readjust weather-stripping so that it closes air gap but does not impede operation of the door.	O&M	N/A	50	N/A	$ 55	$ 25	N/A	$ 25.00	0.5	1
DPW-3	OH Doors Vehicle bays and repair shop.	Envelope	Weatherseals on overhead doors are pulling away from the door. The wooden door stop is rotting out in several areas. The weatherseal at the bottom of the door on bay #4 is degraded.	Replace wooden door stops and reset weatherseals. Replace as needed.	O&M	N/A	150	N/A	$ 165	$ 1,000	N/A	$ 1,000.00	6.1	3
DPW-4	Vehicle Bays	Thermostats	Gas fired unit heaters controlled with Honeywell round T-stats which are left at fixed temperatures	Install password protected programmable thermostats. Program substantial night setback.	O&M	N/A	150	N/A	$ 165	$ 500	Unknown	$ 500.00	3.0	2
DPW-5	Offices	Thermostats	Thermostat is not programmed.	Novus programmed thermostat with approval of staff and left settings with staff.	O&M	N/A	50	N/A	$ 63	$ -	N/A	$ 25.00	0.4	1
DPW-6	Facility-wide	Lighting	The lighting found throughout the facility consists of T-12, standard and high output lamps with 120-Volt magnetic ballasts. This technology is currently being phased out under the U.S. Department of Energy's Fluorescent Lighting Mandate. The facility also has no automatic controls and lighting is often left on regardless of occupancy.	Utility incentives are available to upgrade to energy efficient T-8 and T5 fluorescent systems. Incentives are also available for automatic lighting controls.	Capital	48,541	N/A	Improved lighting levels	$ 6,553	$ 27,500	$ 8,559.80	$18,940.20	2.9	1
Park Tank														
PT-1	Generator Room	HVAC	The generator has an internal electric heater that runs during cold weather to keep the generator warm. There is a 32"x48" damper on the opening that provides ventilation for the generator when it is running. This is a leaky single layer control. There is an air gap around the perimeter of the damper frame.	Replace damper with new low leakage insulated damper to reduce heat required to keep the generator warm.. Caulk the perimeter of the damper frame.	O&M	N/A	120	N/A	$ 128	$ 500	N/A	$ 500.00	3.9	2
PT-2	Generator Room	HVAC	There is a smaller damper in the adjoining room that is permanently open. The damper linkage is disconnected.	Permanently close off this opening if this damper is not needed. If it is needed, fix the actuator so that the damper closes properly.	O&M	N/A	Unknown	N/A	$ 25	$ 25	N/A	$ 25.00	1.0	1
PT-3	Generator Room	Envelope	There is an old penetration for the old generator flue that is a source of air leakage.	Fill the old flue hole with fiberglass insulation and spray foam surface to stop infiltration.	O&M	N/A	50	N/A	$ 25	$ 1	N/A	$ 1.00	0.0	1
PT-4	Main Room	Envelope	The entry doors are double doors what are well weather-stripped except for the mee4ting stiles between the doors.	Weather-strip this area with low density foam tape so it does not impede the closing of the door.	O&M	N/A	50	N/A	$ 25	$ 5	N/A	$ 5.00	0.2	1
PT-5	Facility-wide	Lighting	Lighting consists of 2-lamp T12 strip fixtures.	Retrofit T12 fixtures with T8 lamps and ballasts.	O&M	512	N/A	N/A	$ 69	$ 400	$ 240.00	$ 160.00	2.3	1
Well Pump Control Building														
WPCB-1	Pump Control Building	Pumps	The GE variable speed drives that operate three large pumps that transfer water to the storage pond appear to be quite old. Newer drives would be more efficient and could save a considerable amount of electric energy.	Perform a study of the efficiency improvements resulting from replacing the drives with newer models.	Further Study	Unkown	Unkown	Unkown	Unkown	Unkown	Unkown	Unkown	Unknown	Unkown

Previously Identified Energy Projects
Town of Bethlehem, New York

Building	Building Address	Study Completed By	Date of Study	Proposed Project	Annual Electricity Savings (kWh)	Annual Demand Savings (kW)	Annual Gas Savings (MMBtu)	Total Annual Cost Savings	Project Implementation Cost	Project Payback (Years)
Highway Garage	74 Elm Avenue East	Town, State Energy Program ARRA	8/24/09	Replace hot water boiler and hot water unit heaters with infrared garage heaters and condensing boilers			807.8	$8,892	$66,200	7.4
		National Grid	3/30/10	T8 Lighting Retrofit; Occupancy Sensor Installation	47,501			$5,282	$18,197	3.4
Elm Avenue Park	261 Elm Avenue	Town, State Energy Program ARRA	8/24/09	Replace electric unit heaters with infrared heaters. Install batt insulation.			44.1	$2,162	$17,100	7.9
Town Hall and Justice	445/447 Delaware Avenue	Town, State Energy Program ARRA	8/24/09	Replace steam boilers, DHW system, and hot water boiler with high efficiency equipment			595.7	$6,724	$46,500	6.9
		National Grid	3/30/10	Exterior Lighting Retrofits; Occupancy Sensor Installation	41,395			$4,603	$14,090	3.1
DPW Garage	308 Kenwood Avenue	National Grid	3/30/10	T8 Lighting Retrofit; Occupancy Sensor Installation	13,421			$1,492	$6,325	4.2

Building	Building Address	Study Completed By	Date of Study	Proposed Project	Annual Electricity Savings (kWh)	Annual Demand Savings (kW)	Annual Gas Savings (MMBtu)	Total Annual Cost Savings	Project Implementation Cost	Project Payback (Years)
Waste Water Treatment Plant	98 Dinmore Road	Stearns & Wheler, LLC; NYSERDA Submetering Program	9/1/04	Grit Removal Reduction Summer Interval	490	0		$50	$0	0.0
				Grit Removal Interval Adjustment	711	0		$65	$0	0.0
				Aeration Blower Reduction with Existing Equipment	103,200	150		$9,200	$0	0.0
				Aeration Blower Replacement with VFD	236,700	325		$22,400	$7,500	0.3
				Aeration Blower Replacement with VFD controlled by Dissolved Oxygen Monitoring	236,700	325		$22,400	$8,300	0.4
				Sludge Aeration Mixing Replacement by Submersible Mechanical Mixers	61,300	85		$6,000	$60,000	10.0
				Sludge Aeration Mixing Enhanced by Piping Modifications	0	0		$0	$12,000	N/A
				Oil-Fired Heating	102,650	250		$9,500	$31,100	3.3
				Illumination Evaluations and Alternative	17,550	4		$2,000	$4,250	2.1
				Aeration Tank Blower Motor Replacements	58,000	72		$3,830	$8,000	2.1
				Return Activated Sludge Pump Motor Replacement	5,800	8		$440	$2,460	5.6
				Sludge Tank Blower Motor Replacement	14,100	20		$1,075	$770	0.7
Clapper Road Water Treatment Plant	217 Clapper Road	Arthur Picard, Gexpro	3/3/10	T5 Lighting Retrofit	20,250	4.5		$2,033	$4,222	2.1
Fisher Boulevard PRV Building	4 Fisher Boulevard	Malcolm Pirnie; Green Innovation Grant	5/29/09	Install 12 kW hydroelectric generator	90,000	12		$5,400	$428,000	79.3
					2,071,868	1,256	1,448	$256,648	$1,475,364	5.7

Energy and Land Use Review

Recommendations Report with Summary Matrix of Best Practices

Sustainable Bethlehem

Sustainable Bethlehem

BETHLEHEM, NEW YORK

Energy and Land Use Review

Sustainability Policy and Regulatory Review Analysis & Recommendations Report

Sustainable Bethlehem

Table of Contents

Sustainable Bethlehem

BETHLEHEM, NEW YORK

Energy and Land Use Review

Introduction

The Town of Bethlehem, New York, in an effort to become a more sustainable and livable community, is looking for new ways to encourage and incentivize sustainable and energy efficient development. By revising their existing zoning and building codes, Bethlehem can further enhance its standing as a leader in sustainable growth both in the Capital Region and throughout New York.

Municipalities throughout the country are successfully using building and zoning ordinances to promote and incentivize green development. The use of creative and innovative building codes and zoning ordinances can reduce energy use in both the initial construction of a project, as well as its daily operations. They can also be used to increase energy efficiency and promote the health and productivity of residents, workers and visitors to Bethlehem.

Some example incentives that the Town could provide include density bonuses, reduced parking requirements and/or expedited or waived permitting fees in exchange for securing projects compliant with a municipally or third party designed green building standard for commercial and residential development. New York State allows local jurisdictions to adopt Energy Star as their minimum residential energy code.

Using policy areas identified by Town of Bethlehem staff, this document references both existing regulations and existing policies and then provides recommendations to further enhance the Town's overall sustainability. Existing regulations are those regulations that have been formally adopted by Bethlehem in local ordinances. Existing policies refer to existing recommendations made in planning documents adopted by the Town, such as the comprehensive plan or neighborhood planning studies. The specific policy areas discussed are;

- Conservation Subdivision Incentives and Energy Conservation
- Parking
- Stormwater Management and Green Infrastructure
- Bicycles and Pedestrians

The review and proposed revisions to existing local zoning and building codes made in this document give Bethlehem an opportunity to further guide its development in a sustainable manner. If implemented properly, these and other tools can be effective in decreasing energy use and associated greenhouse gas (GHG) emissions, providing a high quality of life for residents of Bethlehem and creating a desirable and competitive place to live, work, and play.

Recommendations for the Town to consider in order to becoming a more sustainable and livable community include:

- Expand conservation subdivision incentives to include green building design components.
- Incorporate green building components into the Zoning Law's various design guidelines.
- Revise Zoning Law §128-10 Exemptions to include language exempting solar energy equipment from height restrictions.
- Establish LEED certification standards for any project receiving municipal funding.
- Improve standards for outdoor lighting to promote energy conservation.
- Revise Zoning Law §128-56 Off Street Parking and Loading to encourage the reduction of parking spaces, promote the use of alternative means of transportation and to address stormwater impacts of impervious surfaces.
- Expand stormwater management practices by reducing the minimum disturbance threshold.
- Consider the creation of a Commercial Property Assessed Clean Energy (PACE) Program.
- Encourage Albany County to exempt residents from sales tax associated with solar energy systems.

These recommendations are discussed further in the review that follows.

Finally, included in **Appendix A** is a matrix of example policies from communities around the country relevant to potential policies in Bethlehem. These examples provide models for future implementation of the recommended policies in this document.

Conservation Subdivision Incentives and Energy Conservation

Existing Regulations

The Town subdivision regulations include provisions for conservation subdivision (also known as clustering), which allows for reducing lot sizes while maintaining overall yield in order to preserve open space and minimize disturbance. Density incentives are also available in exchange for provision of significant open space or other public facilities and amenities. The existing conservation subdivision regulations are described in more detail below. It is recommended that the incentives for conservation subdivision be expanded beyond open space and affordable housing to include green building design components. This would involve the addition of a new subsection (3) to Section 128-51. E.

The remainder of the subdivision regulations relates primarily to procedural and submission requirements that do not directly bear upon standards that may relate to sustainability objectives (e.g., limitations on pervious pavement).

Conservation Subdivision and Incentive Zoning

Per §103.18 of the Town Code, conservation subdivisions are encouraged to preserve open space, agricultural land, water supplies, and other environmental resources. Applicable provisions of the zoning code for major subdivisions can be modified at the discretion of the Planning Board if certain conditions are met. The use of a conservation subdivision is specifically encouraged on properties with environmentally sensitive lands, which may have the following features:

- Total amount of land is > than 50 acres;
- Total number of lots is > 10;
- NYSDEC or ACOE wetlands >/= 25 percent of the site;
- Slopes of greater than 20 percent occupying >/= 25 percent of the site;
- FEMA floodplains, or flood hazard; and
- Site contains a CEA (s) or scenic views/vistas, is included within an agricultural district, or under a forestry management plan

Per §128.51, an applicant proposing a conservation subdivision may apply for additional density under the Incentive Zoning provision in exchange for the preservation of significant open space (or other public facilities/amenities). The density incentive is granted only if there is a permanent benefit to the town. The open space should generally consist of large contiguous land tracks, and therefore no less than 50 percent of the lands preserved shall be continuous and at its narrowest point, not be less than 30 feet in width. The open space shall be protected by perpetual conservation easements restricting development (may be used for forestry, active agriculture, passive recreation or protection of natural resources). The open space can be a separate parcel owned by a home owners association (HOA), a qualified not-for-profit or in private ownership by one or more of the residents of the conservation subdivision.

For any conservation subdivision, density is calculated by determining the Buildable Yield (BY)[1] and applying the formula to determine the minimum open space set aside as defined by the two tiers of incentives as follows:

1 Buildable Yield (BY) is calculated by subtracting constrained lands (unless a permit has been secured from an applicable agency to build on that constrained land) from the Total acreage: BY=Total acreage minus (wetlands, floodplains, steep slopes).

- Tier 1 Incentive: For the permanent preservation of not less than 40 percent of the GROSS land area, a 15 percent increase incentive applies to the maximum unit density and if 50 percent is preserved, a 20 percent density increase is offered.
  - With public water and sewer: minimum open space required is calculated as follows: BY x 0.40 = open space set aside
  - With private wells and/or septic: BY x 0.50 = open space set aside
- Tier 2 Incentive: The Tier 2 incentive shall be in addition to the Tier 1 incentive adjustment, however, when combined, the Tier 1 and Tier 2 incentives cannot exceed 50 percent of the base maximum density. The Tier 2 Incentive, which grants an additional 15 percent increase in density, applies when an applicant dedicates not less than ten contiguous acres of land for public use (trails, active/passive recreation, waterfront access). The dedication may be by permanent easement or conveyance of land in fee to the Town.

A review of the projects utilizing the Conservation Subdivision tool since the adoption of the Town Zoning Law in 2006, reveals only one (1) project has been approved and two (2) are currently under review by the Planning Board. Staff from the Town Department of Economic Development and Planning has indicated that the conservation subdivision is a tool originally designed to conserve land in semi-rural and rural areas at the urban fringe. The concept can and does work where underlying densities permitted in a zoning code are low enough, and minimum lot size requirements are large enough, to provide economic incentive for clustering and production of a product that developers are familiar with and that they feel is marketable. Successful programs and examples usually begin with minimum underlying lot size requirements in the two (2) to five (5) acre range or larger. The tool is not easily applied to a suburban environment, as in the case of Bethlehem, where underlying minimum lot size requirements range from 0.166 acres in the Core Residential Zoning District to 0.32 acres in the Residential A Zoning District.

The Town also allows Average Density Subdivisions (§103-30 of the Code) to further open space preservation objectives. The parent parcel of an average density subdivision must be located in a residential district (R, RLL, RA, RB, CR or RR). It is calculated so that the mean, or average, lot area throughout the subdivision meets or exceeds the minimum lot area requirement for the zoning district (provided than any reduced area lot meets all of the other minimum area, yard and bulk requirements of the zoning district). The Planning Board must determine that the adverse environmental impacts of the average density subdivision would be less than those for a conventional subdivision.

To date, no subdivision projects have been submitted to the Planning Board using the Average Density Subdivision tool.

Existing Policy

Bethlehem's primary land use policy document, the Comprehensive Plan, recommends the use of conservation subdivision techniques as a way to support its goals of protecting significant environmental systems and natural resources, and to provide for a variety of housing options. As indicated above, a conservation subdivision regulation is in place to implement this regulation.

It is noted that the Comprehensive Plan also includes a goal to "promote energy efficiency and conservation, and the use of renewable energy in the town." The supporting policy recommendation is to encourage the use of Leadership in Energy Efficiency and Environmental Design (LEED) standard for development and redevelopment projects. The Comprehensive Plan recommendation is excerpted below.

Recommendations for Energy Conservation

- Promote the use of alternative, renewable energy sources for public and private buildings (i.e. replace less efficient heating and cooling systems and utilize alternatives such as geothermal energy).
- Encourage the use of Leadership in Energy and Environmental Design (LEED) standards for new development and redevelopment of buildings and sites in the town. LEED information could be provided through the Building Department and distributed as potential developers seek information regarding building in Bethlehem. LEED standards consider:
  - Erosion and sedimentation control
  - Site selection
  - Urban redevelopment
  - Brownfield redevelopment
  - Alternative transportation, public transportation access
  - Alternative transportation, bicycle friendly
  - Alternative transportation, parking reductions
  - Reduced site disturbance, protect and restore open space
  - Reduced site disturbance, maximize open space
  - Stormwater management, flow treatment and reduction
  - Landscape and exterior design to reduce heat islands, non-roof and roof surfaces
  - Light pollution reduction
- Assist developers in understanding and identifying available funding opportunities supportive of sustainable design and construction, including grant funding assistance and technical assistance.

Recommendations

Land Preservation Recommendations

Bethlehem's existing conservation subdivision regulations are generally appropriate and consistent with the types of conservation or clustering subdivision ordinances used in other communities to encourage the protection of open space. One suggestion for consideration is an adjustment of the code language to ensure that the required open space component includes a degree of "usable" open space, not just areas that would be required as set-asides to comply with other regulations (e.g., state wetland requirements, floodplains). It is also suggested that the provisions encourage the introduction of walking/hiking trails along the protected natural features. The intent would be to facilitate additional recreation opportunities and support expansion of a town-wide trail network.

Green Building Technology Recommendations

Green Building Criteria

It is recommended that, in order to advance the energy conservation objectives identified in the Comprehensive Plan and through Sustainable Bethlehem, green building criteria either be established and integrated into the incentives for conservation subdivision or established as a stand-alone mandatory requirement. An incentive program as part of conservation subdivision would involve addition of a new subsection (3) to Section 128-51. E., while a mandate would require its own section in the code.

Incentive based systems typically include fast-tracking of permitting, refunding of fees, and/or providing density bonuses for projects that reach a certain numbers of points or specific degree of certification within a rating system. The incentives may also be tiered to provide greater density or floor area ratios (FAR) bonuses depending on the level of efficiency/green building design achieved.

While conservation subdivision regulations provide one opportunity for incorporating these types of concepts, the Town should also consider whether potential green building criteria would only apply to projects undergoing subdivision, or whether to establish size or other thresholds (e.g., buildings over a certain floor area, or publicly-funded projects, etc.) that would trigger compliance for other development activity, such as site plan applications. For example, it is noted that each zoning district in the code currently includes design guidelines that are intended to shape development proposals. In some instances, the recommendations/guidelines already support sustainability concepts, such as stating that the amount of parking spaces should be the minimum required to adequately serve the intended uses and that cross easements should be used to provide shared parking access where possible. This could provide an appropriate location to insert additional recommendations/mandates relating to green building components that would have applicability beyond conservation subdivision applications.

This document's **Appendix B** includes samples of local ordinances from around the country that mandate new development to meet specific thresholds of either third-party rating systems or independent municipal criteria, as well as others that rely on incentives to encourage high efficiency construction. For both mandates and incentives, it is important to identify the substantive green building design criteria to be utilized. Potential options include incorporating an existing third-party system, such as the US Green Building Council's LEED rating system (as referenced in the Comprehensive Plan), Green Globes, or EPA's Energy Star standard, or establishing independent or supplementary municipal criteria.

If a third-party rating system is used, the Town should also consider whether it will require certification (which incurs additional fees for builders), or whether submission of checklist documentation to the municipality (or evidence of "certifiability"), but not formal certification, would be more appropriate. The towns of Babylon and Huntington, New York require that all new non-residential and multifamily buildings of 4,000 square feet or larger submit a LEED checklist and pay a green building fee, which is refunded if LEED-certified status is achieved.

Excerpts from the Boulder and West Hollywood Codes have been provided in this document's **Appendix B** as examples of municipalities that have developed their own mandatory green building criteria. Examples from Greenburgh, Pasadena, Babylon and Livermore have been provided as examples that have integrated third-party rating systems.

Additionally, the Town could collaborate with the Bethlehem Industrial Development Agency (IDA) to implement energy efficiency requirements for all projects seeking municipal funding. The Town could require a LEED standard for building construction and IDA incentives could vary based upon the level of LEED certification achieved. These requirements could be added to Section II Question D, Description of the Proposed Construction, of the Town of Bethlehem Industrial Development Application.

Other Renewable Energy Technology

To encourage and support the installation of solar panels and other renewable energy technology to new and existing buildings, the Town should revise its zoning code to include a height exemption for such equipment within Chapter 128 Section 10, Exemptions, including language allowing solar energy equipment would make the installation process easier.

In conjunction with the energy efficiency design standards outlined, the Town could improve standards for outdoor lighting. The current lighting code is generally focused on reducing light trespass on adjoining properties. The code also includes requirements for cut-off luminaires to minimize uplighting/dark-sky impacts. There are also general guidelines/recommendations that seek to encourage use of timers, dimmers, sensors or photocell controllers to reduce energy consumption. It is recommended that these guidelines be strengthened beyond mere recommendations to requirements.

Parking

Existing Regulations

The Town Code requirements for off-street parking and loading are located within Chapter 128-56. Off-street parking and loading the code currently relies on traditional parking minimums for individual uses. It is noted, however, that Section 128-56.H does authorize the Planning Board to reduce the number of spaces, provided that space is landbanked if additional parking is needed in the future. The code also allows for use of joint parking lots for multiple uses in hamlet or commercial districts, but there is no specific provision regarding shared parking. The site plan requirements stipulate that at least ten percent of the land area of parking facilities consist of landscaped areas.

Existing Policy

Delaware Avenue Hamlet Enhancement Study

The purpose of the Delaware Avenue Hamlet Enhancement Study was to identify transportation and land use design treatments that would help strengthen Delaware Avenue's main street character, consistent with Bethlehem's Comprehensive Plan and the Capital District Transportation Committee's (CDTC's) New Visions 2035 Plan Update. This document specifically addresses Delaware Avenue, in the Delmar Hamlet and provides responsibility and discretion for implementation of these measures to the Planning Board.

- Streetscape & Hamlet Design Standards and Guidelines (October 26, 2010)

On-Street Parking

- Require landscaping within parking lots, as well as to buffer to adjacent uses.

Off-Street Parking

- Allow the Planning Board to reduce the amount of parking required to be constructed.
- Allow joint parking lots for one or more uses located on separate lots or on common lots.
- Allow the Planning Board to approve the shared use of a parking facility.

Recommendations Addressing Stormwater Impacts

- All projects within the study area shall be designed to the latest NYSDEC stormwater design standards.
- Parking areas should drain into vegetative or grassy swales that are incorporated into large common landscaped areas.
- Driveways, where possible, should drain into adjacent on-site landscaped areas.

- Transportation Improvement Plan (February 7, 2011)
  - Reduce the amount of land area within the hamlet devoted to parking vehicles.
  - Minimize the number of off-street parking spaces to adequately serve the intended use.
  - Evaluate the feasibility of implementing a system of parking maximums, which place a limit on the maximum amount of parking capacity allowed at particular sites or within a particular area.
  - Develop bicycle parking minimum/maximum standards that determine bicycle parking requirements based upon land use.
  - Allow the shared use of a parking facility where it is clearly demonstrated that the reduction in spaces and shared use of the parking facility would meet general parking guidelines.

Recommendations

To further support the sustainability concepts related to parking advanced in the Delaware Hamlet Enhance Study discussed above, the following recommendations with regards to Section 128-56 of the Town Code are suggested. **Appendix C** contains of this report provides detailed proposed amendments to that section.

- Grandfather non-existing spaces where there is a change of use, but no change in size.
- In order to not overbuild parking and in order to reduce the amount of impervious surfaces, reduce the size of parking spaces in some instances.
- Based upon a review of current national parking standards, as presented by the Institute of Transportation Engineers (ITE), revise the number of off-street parking spaces required.
- In order to not overbuild parking and in order to reduce the amount of impervious surfaces, change the number of off-street parking spaces required to a minimum and maximum, with the difference land-banked.
- In order to have a more positive impact on the environment by minimizing sprawl, add a section on providing reductions in the amount of required off-street parking for new development in already built-up areas. For example, medical offices are required to provide a minimum of one parking space for every 285 square feet constructed. If a medical office building is located in a built-up or Hamlet District, the minimum amount of parking required may be reduced by 15 percent. Thus, a 4,700 square foot medical office building would be required to provide 20 parking spaces, but only 17 in a Hamlet District.
- In order to promote the use of alternative forms of transportation, which, in turn, will have positive impacts on the environment, add a section on providing reductions in the amount of required off-street parking for new development along bus routes. For example, if a medical office building is located within a quarter mile of a bus route, the minimum amount of parking required may be reduced by 10 percent. Thus, a 4,700 square foot medical office building would be required to provide 20 parking spaces, but only 18 if located within a quarter mile of a bus route. If the same medical office building is located within a Hamlet District and within a quarter mile of a bus route, the minimum amount of parking required may be reduced by 15 percent for the hamlet location and five percent for its proximity to a bus route. Thus, instead of being required to provide 20 parking spaces, the medical office building would only be required to provide 16 parking spaces. All parking reductions would require the site be served by existing or proposed sidewalks.
- Add a section specifically permitting shared parking, in addition to joint use. Shared parking is a tool through which adjacent property owners share their parking lots and reduce the number of parking spaces that each would provide on their individual properties. If adjacent land uses have different peak hours of parking demand, then they can share the some of the same parking spaces.

Stormwater Management and Green Infrastructure

Existing Regulations

The Town of Bethlehem Stormwater Code is divided into two sections. The first section referred to as Part One outlines the methods for controlling pollutants into the municipal separated stormwater systems (MS4s) in order to remain in compliance with the requirements of the State Pollutant Discharge Elimination System (SPDES) permit. The second section, Part Two of the code, establishes minimum stormwater management requirements. These minimum requirements include requiring that all land development activities conform to the substantive requirements of the New York State Department of Environmental Conservation SPDES General Permit for Construction Activities.

Existing Policy

In 2003, as a consequence of amendments to the Federal Clean Water Act, stormwater discharges from construction sites disturbing greater than one acre of land and discharges from publicly owned stormwater conveyance systems in urbanized areas became unlawful unless authorized through the SPDES permit program, a program administered by the New York State Department of Environmental Conservation (NYSDEC).

Bethlehem as an MS4 filed for coverage under the MS4 Permit. To comply with the law in 2008 Bethlehem with all other regulated "MS4" municipalities in Albany County entered into an intermunicipal agreement to form the Stormwater Coalition of Albany County. The purpose of the coalition is to pool resources so that Coalition members adequately implement MS4 Permit requirements. These requirements include implementing a Stormwater Management Program which addresses the following six minimum control measures:

- Public Education and Outreach;
- Public Involvement and Participation;
- Detection and Elimination of Illicit Stormwater Discharges;
- Construction Site Stormwater Runoff Control;
- Post-Construction Stormwater Management;
- Pollution Prevention/Good Housekeeping for Municipal Operations

As part of its membership in the Coalition, Bethlehem is a participant in a study pertaining to the Clean Water Act Stormwater Regulations pertaining to Green Infrastructure. The purpose of this project is to assist members of the Stormwater Coalition of Albany County in developing model local land use laws and/or procedures related to green infrastructure practices for potential adoption by the Coalition members.

These local laws and/or procedures will provide Coalition members with the necessary legal underpinnings to fully embrace green infrastructure practices identified specifically in the New York State Stormwater Management Design Manual and elsewhere in more general guidance documents developed by the US Environmental Protection Agency (EPA). Upon completion of this study the Town should formally adopt the recommendations and take the necessary steps to adopt the local laws.

In addition, the Town has developed a "Green Infrastructure Stormwater Management Selection Matrices Form". The form is to be used in concert with the Town's SMP Selection Matrices to select of a proposed project's stormwater management systems.

Recommendations

The Town of Bethlehem should continue their voluntary participation in the Stormwater Coalition of Albany County and should explore the possibility of reducing the disturbance standard from greater than one acre to greater than half an acre. This threshold reduction would require greater stormwater management practices throughout the town and would decrease the burden on the existing water systems. Similar threshold reductions have been successfully implemented in the Town of Rotterdam in Schenectady County.

In addition to reducing the threshold, the Town should also promote the use of permeable pavement where applicable in parking lots and other low-volume, low-speed areas including driveways and bicycle and pedestrian only areas. Using similar density incentives outlined in the energy efficiency building section, the Town should, where applicable, require or incentivize the reduction of impermeable surfaces.

In addition, Bethlehem must remove the existing barriers for development. These include making revisions to the current zoning code to add definitions and exemptions that allow for green infrastructure installations. For example in Section 128-10 of the current zoning code the height exemption could be revised to include an exemption for green roofs and other rainwater harvesting system components. This exemption will allow for the easier installation of these systems.

To further assist with the reduction of stormwater runoff, Bethlehem should seek to partner with organizations such as the Cornell Cooperative Extension of Albany County to create a program that provides discounted rain barrels as well as educate the residents on their uses and benefits. The Town should also develop a program that rewards residents for the disconnection of current downspouts into the municipal sewer system. This reward could be a financial incentive and/or assistance in the redirection of rainwater into a rain garden or barrels.

Bicycles and Pedestrians

Existing Regulations

The Town of Bethlehem has a number of existing regulations and policies related to bicycle and pedestrians. The review of these regulations and policies indicate a consistent commitment to providing sidewalks and other pedestrian-oriented design recommendations and requirements throughout the Town's zoning districts. What follows is a brief synopsis of these regulations and policies.

Complete Streets Policy

On August 12, 2009, the Town passed Resolution No. 30, Complete Streets, which is a representative commitment by the Town to incorporate pedestrian- and bicycle-friendly policies into the Town's roadway and neighborhood design. The adopted policy requires that, where practically feasible, bicycle and pedestrian facilities are to be incorporated into all new roadway design throughout the town. The policy has two primary intents:

- "…to recognize bicyclists and pedestrians as equally important as motorists in the planning and design of all new street construction and street reconstruction undertaken by the Town."
- "To recognize that local Town streets with low vehicle volumes and slow travel speeds safely and efficiently accommodate bicyclists and pedestrians. However, principal Town roads that are characterized as having high vehicle volumes and high travel speeds, and are important for bicycle and pedestrian travel to access and connect to destinations in and adjacent to the Town, shall be considered for Complete Streets treatment."

The policy itself contains three main elements:

- **Engineering** – The Highway Superintendent will consider the accommodation of bicyclists and pedestrians in all new street construction and street reconstruction undertaken by the Town of Bethlehem.
- **Education and Encouragement** – The Town will promote bicycling and walking for health, fitness, transportation and recreation through events, programs and other educational activities. Furthermore, the Town will encourage NYSDOT and Albany County to consider a Complete Streets approach when constructing or reconstructing their respective streets in the town.
- **Enforcement** – The Town will provide a balanced enforcement of the New York State Vehicle and Traffic Law for motorists, pedestrians, and bicyclists. This will include enforcement of pedestrian's right-of-way in crosswalks, bicyclists riding with traffic, and all modes sharing the road safely. Additionally, the Town may consider the use of traffic calming applications as an alternative to bicycle and pedestrian facilities.

Bicycle and Pedestrian Priority Network

In addition to establishing a complete streets policy, the Town of Bethlehem has developed a Bicycle and Pedestrian Priority Network Map. The map identifies an approximately 103-mile network of travel corridors that are intended to eventually provide a continuous system of bicycle and pedestrian travel accommodations. The network includes major travel routes that connect major destinations (such as schools, shopping areas, recreation facilities, and communities) with each other and residential neighborhoods. In addition to serving as a working plan for bicycle and pedestrian travel and identifying desirable travel corridors, the map is intended to be used as way to target and prioritize local pathway investment (i.e., in order to maximize the benefits from limited resources, only projects located on the network should be considered for funding). The map is also intended to be used during Planning Board review of site plan and subdivision applications, and as a tool to support grant applications.

Town Code

Chapter 46: Bicycle Ordinance

The Town Code includes a section specifically addressing registration and maintenance of bicycles to ensure the safety and oversight of equipment. The bicycle ordinance, however, does not discuss bicycle facilities and/or bicycle projects and the local approval process. Several items in the Chapter are out of date (original adoption was in the 1950's) and are not consistent with the New York State Vehicle and Traffic Law (NYS V&T). The Town should consider revising the Chapter to be consistent with the NYS V&T Law or remove the chapter completely since the Town is required to follow the NYS V&T Law.

Chapter 128: Zoning

Several articles in the Town's Zoning Ordinance specifically reference incorporating pedestrian-oriented and bicycle-friendly initiatives. The following districts contain design guidelines that 1) encourage the installation of sidewalks and walkways, 2) encourage connectivity to open space and recreation, including the Hudson River, and 3) encourage building and entrance orientation geared towards the pedestrian.

- Residential A, B, C;
- Core Residential;
- Multifamily;
- Rural Riverfront;
- Hamlet;
- Commercial Hamlet;
- Rural Hamlet;
- General Commercial; and,
- Mixed Economic Development)

In particular, the Core Residential and Hamlet Districts have a focus on walkability, as indicated by the following "District Purposes" identified in § 128-4:

- **§ 128-4.E** – "Core Residential District. Areas of the Town designated under this district are generally mature residential neighborhoods. The purpose of this district is to ensure that the general character of these neighborhoods, which include tree-lined streets, sidewalks, smaller lot sizes, moderately sized homes, interconnected street patterns, and a location near some small-scale services, is protected from pressures to convert residential structures to inappropriately sized nonresidential uses."
- **§ 128-4.H** – "Hamlet District. Areas of the Town designated under this district are typically the original settlement areas along major corridors and at crossroads and contain small-scale businesses and essential services in close proximity to residences. Very often the first floors of buildings in the hamlet districts are in commercial use with the upper floors in residential use. The hamlets are defined by pedestrian friendly access along street fronts and alleyways, with on-street parking and loading. The purpose of these districts is to encourage compact, mixed-use commercial and residential development or redevelopment in identified neighborhood commercial centers and hamlet centers throughout the Town. Appropriately scaled mixed-use developments with pedestrian connections to adjacent neighborhoods are critical to the success of such centers."

Chapter 103: Subdivision Regulations

The Subdivision Regulations do not make any specific reference to pedestrian or bicycle facilities, other than Article V. §103.26 General Requirements and Design Standards – Layouts of Streets and Roads, which require that "streets shall be graded and improved with…sidewalks, street lighting, curbs…in accordance with Town of Bethlehem Department of Public Works Guidelines for Final Subdivision Plan… and the State Highway Law."

Existing Policies

There are a number of local and regional public policy documents/projects that provide bicycle and/or pedestrian recommendations. Although, not specifically provided for in the Town of Bethlehem Town Code, the Town's and region's public policy documents consistently highlight recommendations for additional bicycle lanes, in some cases along specific roadways and to provide connections to the Helderberg Rail-Trail, and more generally design recommendations to incorporate bicycle lanes when the opportunity arises. What follows is a brief synopsis of the local and regional public policy recommendations.

Town of Bethlehem Comprehensive Plan/Generic Environmental Impact Statement (August 24, 2005)

The Town's 2005 Comprehensive Plan, adopted in August 2005, guides and prioritizes investments and policies over a fifteen year period to 2020.

The Plan has two primary goals with regards to bicycles and pedestrians:

- Encourage compact, mixed-use commercial and residential development/redevelopment in identified neighborhood commercial centers and hamlet centers throughout the town. Appropriate scale, design, and character, attention to the pedestrian environment, and connections to adjacent neighborhoods are critical to the success of such centers.
- Improve mobility – the ability of people, regardless of age and status, to engage in desired activities at moderate cost to themselves and society – throughout the town. This includes strategic investments in needed highway infrastructure, improved access to public transportation and development that is supportive of public transportation, and significant enhancements to the safety and attractiveness of non-motorized modes of travel.

The Town's 2005 Comprehensive Plan contains a number of recommendations related to bicycles and pedestrians.

Town-Wide/General Recommendations

- Provide adequate bicycle facilities and establish a signed system of bicycle routes throughout the town, including: bike lanes, proper pavement markings and signage, and a map of bike routes in the town.
- Establish regional bicycle routes along several key corridors including: Kenwood Avenue and Wemple Road to Elsmere Avenue.
- Provide paved shoulders on all collector and arterial roads, where sidewalks are not provided. These paved shoulders should be wide enough to allow for safe pedestrian and bicycle use.
- Establish a town-wide Bethlehem Greenways Network.
- Consider town-wide referendum to create funding for land acquisition and preservation of open space and parkland.
- Coordinate with the Albany County Land Conservancy, the Hudson River Valley Greenway, and other interested organizations in developing and maintaining a recreational trail system.
- Develop mechanisms for creating and funding recreational trails.

Hamlet Area Recommendations

- Maintain and improve walkability.
- Streetscape improvements (from building front to building front) including: planting strips, street trees, curbs, pedestrian-scaled lighting, benches, bike racks and other pedestrian amenities.
- Encourage developers to utilize existing vacant buildings and vacant or underutilized sites before building on greenfields. Encourage such development by offering tax incentives, an expedited review process, or a reduction in application fees.
- Providing commercial and community services within a 1,500 feet radius of a hamlet center to create a walkable hamlet.

In-Town Residential Area Recommendations

- Maintain and enhance pedestrian connections within neighborhoods and between neighborhoods and hamlet centers.
- Consider recreational trail connections as development proposals are being reviewed.
- Explore specific opportunities for sidewalks and other pedestrian connections that would create a connection to Delaware Avenue. Improved crossings on the Delmar Bypass should also be considered.

Rural Area Recommendations

- Consider reducing street width in new residential developments and encourage a connected street network.

Mixed Economic Development Area Recommendations

- Update the zoning regulations to allow for mixed uses (office, light industry and technology) in the areas specified.
- Revise zoning to require master 'development plans' and design guidelines (cluster buildings, connect with trails and sidewalks, shared parking, generous landscaping, shared curb cuts, minimize impervious surface) ensuring that areas are designed with sensitivity to the natural resources and special features of the landscape.
- Encourage consolidation of smaller parcels under one master developer.
- Connect each phase of development to the next using roadways and trails.
- Connect mixed-use areas to nearby residential areas, commercial areas, or hamlets.
- Allow high-density residential development and neighborhood commercial uses as secondary uses to the primary light industry, office or technology uses.

Commercial Area Recommendations

- Update zoning to include design guidelines and address pedestrian concerns, including: appropriate site design, site organization and architectural standards.

Delaware Avenue Hamlet Enhancement Study

Streetscape & Hamlet Design Standards and Guidelines (October 26, 2010)

Significant guidance for implementing walkability and bicycle-oriented standards is provided in the Delaware Avenue Hamlet Enhancement Study – Hamlet Design Standards and Guidelines report.

Recommendations related to walkability are divided between 'standards' and 'guidelines' under the following categories:

- General Standards
- Sidewalks
- Curbs
- Curb Cuts
- Drive-Through Facilities
- Pedestrian Network
- Service Stations
- Existing Shopping Plazas

As an example, the following standards and guidelines are recommended under the 'Pedestrian Network' category:

Standards

- Provide attractive pedestrian routes between building entrances, pedestrian areas, and public transit stops. Clearly defined and marked sidewalks or pedestrian pathways shall be required and distinguished from driving surfaces through the use of special pavers (bricks, scored concrete or other similar materials) and other distinctive colors.

Guidelines

- Cooperate with adjoining properties in creating a pedestrian network with mid-block connections, public courtyards and small plazas.
- Maintain visibility and clear sightlines from vehicles to pedestrian and bicycle crossings.

Similar to walkability, recommendations related to multi-modal transportation and parking is divided between 'standards' and 'guidelines' under the following categories:

- Bicycle Parking
- Transit Stops
- Parking Lot Pedestrian Linkages

Beyond walkability, the report also discusses Hamlet Character, Architectural Design, Signage, Landscaping, Lighting, Utilities, and other Multi-Modal Transportation and Parking, some of which contain recommendations related to bicycles and pedestrians.

Transportation Improvement Plan (February 7, 2011)

The Delaware Avenue Hamlet Enhancement Study – Transportation Improvement Plan report contains recommended actions to improve the overall walkability and bikeability of the study area, as well as improve the vehicular and transit environment. The report contains area-wide recommendations, traffic calming concepts at specific intersections, and recommendations for roadway segments. For the purposes of this report, the recommendations have been broken down by those applicable to pedestrian and bicycle infrastructure. The Delaware Avenue Hamlet Enhancement Study – Transportation Improvement Plan report also contains a number of technical items, including a Rail Trail Connections Map, Sidewalk Inventory Map, and the Town's Complete Streets resolution.

Bicycle Recommendations

The bicycle recommendations are aimed toward creating a network of bicycle routes, markings, and bicycle parking to connect people to destinations throughout the Hamlet, to Veterans Memorial Park (where bicycle racks have recently been installed) and to the Albany County Rail Trail. Recommendations include:

- Provision of bike detection pavement markings and signage, alerting motorists that bicyclists "Share the Road" and traffic control devices with bicycle traffic controls.
- Installation of sharrows along Delaware Avenue through the Hamlet and on other roadways as appropriate such as Hudson Avenue, Kenwood Avenue, Adams Street, and Adams Place/Herber Avenue.
- Install loop detection sensors at signalized intersections (such as at Delaware Avenue/ Kenwood Avenue and Delaware Avenue/Elsmere Avenue) that are sensitive enough for bicycles to trigger.
- Adopt bicycle parking provisions in the Town's zoning ordinance as a means of promoting bicycle travel to local destinations.

Pedestrian Recommendations

The pedestrian recommendations focus on two functions: mobility and accessibility. Recommendations include:

- Reconstruct existing sidewalks within the Study Area, except for those recently reconstructed within the Four Corners area along Delaware and Kenwood Avenues. The Four Corners sidewalk and curbing project should be replicated elsewhere throughout the study area.
- Install Americans with Disabilities Act (ADA)-compliant curb ramps at all intersections, and signs, pavement markings, crosswalks with street print and traffic control as appropriate.
- Curb cuts, width of driveways and shared entrances should be designed to minimize conflicts with bicyclists and pedestrians. Consolidate driveways and control access whenever possible to create a safe walking environment.
- Marked crosswalks guide pedestrians and alert drivers to a crossing location. The new pedestrian crossings could consist of standard parallel or be the ladder style of crosswalk, where additional perpendicular lines are added to the crosswalk to increase its visibility.
- Cooperate with adjoining properties in creating a pedestrian network with mid-block connections, pedestrian refuge, public courtyards and small plazas.
- Provide attractive pedestrian routes between building entrances, pedestrian areas, and public transportation stops and pedestrian refuges.

Helderberg Rail-Trail (Albany County)

In August 2008, Albany County purchased the old Delaware and Hudson railway that runs for approximately 9.3 miles, from the Port of Albany to the Village of Voorheesville through the Town of Bethlehem (including Delmar). The Rail-Trail will connect residential neighborhoods, businesses, and community/civic properties to adjacent areas of the town and will improve the bicycling environment by offering a dedicated route that serves the corridor and town. Recommendations for integration of the Rail-Trail include:

- Consider bike and pedestrian connections to the Albany County Rail-Trail during the site plan review and approval process for new development or redevelopment.
- Consider other specific connections (including to Four Corners, Delaware Avenue, Veterans Park, Hudson Avenue, American Legion Hall, Oakwood Avenue, and other locations).
- Reserve (or "railbank") future right-of-way in the event that light rail becomes feasible.

CDTC Choosing Our Future: New Visions for a Quality Region

In 2011, CDTC updated its Regional Transportation Plan (RTP) to the year 2035. The updated Plan, entitled "Choosing Our Future: New Visions for a Quality Region" reaffirmed a set of principles to guide transportation planning and investment in the region for coming years. It also articulated a series of short-range and long-range strategies and actions to help achieve broad regional goals, and provided an innovative budget approach to ensure implementation.

Within the Plan, CDTC has made a strong commitment to improving bicycle and pedestrian facilities in the region by incorporating bicycle and pedestrian accommodations into highway construction and into municipal plans.

June 2004 Draft Hudson Valley Greenway Trail Vision Plan

The Hudson River Valley Greenway Conservancy and Hudson River Valley Greenway Council examined trails located within its greenway communities. The Town of Bethlehem is a greenway community and as such, several potential trails are identified in the June 2004 Draft Hudson River Valley Greenway Trail Vision Plan, including a potential southern extension of the Mohawk-Hudson Bike-Hike Trail and a greenway water trail in the Town's Henry Hudson Park. While still in its draft stage, the Vision Plan strives to create links to communities throughout the region and the Hudson River corridor.

The Plan indicates that a number of action items have been implemented with regards to bicycles and pedestrians, including:

Capital Coexist – In April 2010, CDTC launched a localized bicycle education campaign, Capital Coexist . (http://www.capitalcoexist.org)

Regional Bike Rack Program – CDTC staff worked closely with CDTA to develop the first regional Bike Rack Program. The 2010 program was a success with more than 300 new bike racks being distributed. The 2011 program is underway using $50,000 in TDM funds.

NYS Pedestrian Action Plan/Statewide Bicycle and Pedestrian Advisory Committee – CDTC staff has played a major role in representing the NYSMPO Association on a committee looking to develop a statewide Pedestrian Action Plan.

Linkage Planning Studies – The overwhelming majority of Linkage Program planning projects undertaken by CDTC with regional and community partners completed since 2007 consider bicycle and pedestrian issues, needs and potential improvements in development of their conceptual improvement plans. Some notable projects have included the Altamont Pedestrian and Bicycle Plan and the City of Albany Bicycle Master Plan.

Bicycle and Pedestrian Issues Task Force – The Bicycle and Pedestrian Issues Task Force continued to meet on a monthly basis, providing technical and policy suggestions to the Planning Committee and Policy Board.

Transportation Enhancement – Since the original RTP was adopted in 2007, the Capital Region received funding for four Transportation Enhancement projects (2008).

Spot Improvement Program – CDTC continued its support of the Program by increasing funding availability during the 2010-2015 TIP update to $250,000 per year. The Spot Improvement Program funded a large variety of small-scale bicycle and pedestrian projects. In 2008, six projects were funded with continued emphasis on 'filling gaps' while maintaining geographic balance.

The Safe Routes to School Program provided an excellent opportunity for municipal/school district partnerships to be created to improve the bicycle and pedestrian travel environment. In the first round, six projects were awarded funding in NYSDOT Region 1.

Some progress has been made in implementing components of the Greenway Concept Plan for the Capital Region.

American with Disabilities Act (ADA) – NYSDOT recently completed a draft-for-public-review ADA Transition Plan which includes information on ADA compliance status of NYSDOT facilities, including the state-owned pedestrian network.

National Bicycle and Pedestrian Planning

Communities throughout the United States are expressing interest in creating streets that accommodate the needs of a wide-range of users. At the heart of this movement is a push to change the way transportation agencies and local governments plan, design, and regulate transportation improvements. As such, so called "complete streets" policies and ordinances are the best examples of land use regulations and policies that promote bicycle- and pedestrian-friendly changes to our transportation infrastructure. The national driving force behind the Complete Streets movement and the clearinghouse for complete streets information is the Complete Streets Coalition, which tracks adoption of complete streets legislation and ordinances across the country, publishes an annual review and analysis of these policies, and makes them available in a database on their website. Because each street segment has a different context and constraints, complete streets ordinances typically do not mandate specific requirements, but rather direct developers and engineers to accommodate the needs of all users when planning, designing, and constructing transportation improvements, sometimes referencing facility recommendations and design provided by design guidelines or bicycle/pedestrian plans. By adopting a Complete Streets policy, the Town of Bethlehem is ahead of the curve.

New York State adopted Complete Streets legislation in August 2011. The legislation requires state, county and local agencies to consider complete streets design features to facilitate the convenient access and mobility of all users, including pedestrians, bicyclists and public transportation users, in transportation projects that are either undertaken by the state or federally and state-funded and subject to state oversight. The types of complete streets design features identified by the legislation include sidewalks, paved shoulders suitable for use by bicyclists, lane striping, bike lanes, share the road signage, road diets, crosswalks, pedestrian control signals, pull outs, curb cuts, and traffic calming measures.

An additional area in which to promote bicycle and pedestrian friendliness is in site access and circulation ordinances for both residential and commercial developments. This can be

done by requiring on-site bicycle and pedestrian internal circulation plans, facilities, and connections to surrounding areas and circulation networks for new and retrofit development projects. Such ordinances typically call for protecting pedestrians from on-site vehicular traffic through the use of such mechanisms as special paving, grade separations, pavement markings, bollards, landscaping, lighting, and other methods to clearly delineate pedestrian areas. Walkways must connect main building entrances with sidewalks, other building entrances, other pedestrian areas or amenities, nearby bicycle/pedestrian trail networks, and adjacent developments, and pedestrian access through parking lots must be clearly defined and aligned to allow for safe and efficient pedestrian movement. Example bicycle and/or pedestrian ordinances are included in **Appendix D** of this report.

Recommendations

Based upon the review of existing policies in place for bicycles and pedestrians, there is no need to recommend any specific code changes, as the existing policies, notably the Complete Streets policy, are strong enough to create a proper bicycle and pedestrian environment. These policies should be strengthened, through enforcement and through implementation. What follows is a discussion of the funding sources that are available for implementation.

Although a number of municipalities have created dedicated funding streams for pedestrian or bicycle projects (see below), it is very uncommon for these funds to originate through development exactions such as impact fees or other land use based policies. More commonly, these funds either come from state or federal sources or are carved out of the general fund.

Federal Funding Sources

Federal funding for bicycle and pedestrian programs increased significantly with the passage of the Federal Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991. ISTEA created the Transportation Enhancements Program, and also required that state Departments of Transportation (DOTs) adopt a more collaborative, multi-modal paradigm. Many of ISTEA's provisions have been carried forth in subsequent federal transportation laws, including Transportation Equity Act for the 21st Century (TEA-21) and Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2005. SAFETEA-LU expired as of September 30, 2009. Congress has extended the SAFETEA-LU legislation several times keeping funding of existing projects at current levels since its expiration date and is expected to begin working on a replacement bill for the next six-year period during its 2012 session. To that end, the discussion here focuses on SAFETEA-LU programs, which may or may not be included in the new Federal transportation funding legislation.

SAFETEA-LU also includes several categories of federal transportation funding for bicycle, pedestrian, and streetscape projects. The following is a summary of the funding sources currently available.

- **Surface Transportation Program (STP)** – The STP provides flexible funding that may be used by states and localities for projects on any federal-aid highway, including the construction of bicycle facilities and pedestrian walkways on land adjacent to any highway on the National Highway System (NHS). Additionally, NHS funds can be spent on non-motorized projects within Interstate corridors. At least ten percent of each state's STP must be set aside for Hazard Elimination programs. This program's purpose is to identify and improve locations that have a documented history of numerous crashes. Funds may be used for safety improvement projects on any public road, any public surface transportation facility, and any publicly owned bicycle or pedestrian pathway or trail.
- **Congressional Earmark** – Earmarks have specific applicability for bicycle-pedestrian projects for which there is political and/or public support. They are generally more expensive projects that would burden typical funding sources. Projects most likely to be included are bridge projects with bicycle-pedestrian accommodations, bridges for paths, long distance rail trail projects, or high profile path projects.

- **Safe Routes to School (SRTS)** – Federal sponsorship and funding of the Safe Routes to School program began with SAFETEA-LU in 2005. This new program enables and encourages kindergarten through eighth grade school children to walk and bicycle to school. Both infrastructure-related and behavioral projects are geared toward providing a safe, appealing environment for walking and biking that will improve the quality of children's lives and support national health objectives by reducing traffic, fuel consumption, and air pollution in the vicinity of schools. To be eligible for funding under this program, project infrastructure improvements must relate directly to a specific school and comprise a minimum of 70 percent to a maximum of 90 percent of project total. The remainder is available for the non-infrastructure components, including education, encouragement, and enforcement.

- **Transportation, Community, and System Preservation (TCSP)** – This is a comprehensive program designed to address the relationships among transportation, community, and system preservation plans and practices. Bicycle- and pedestrian-related projects funded under this program include transit-oriented/compact development plans and traffic calming.

- **Transportation Enhancements Program (TEP)** – SAFETEA-LU requires that 10 percent of the funding made available to each state under the STP be utilized for activities defined as Transportation Enhancement Activities (TEAs). Of the 12 defined TEAs, the following are specifically bicycle and pedestrian related:
  - Provision of facilities for pedestrians and bicycles;
  - Provision of safety and educational activities for pedestrians and bicyclists; and,
  - Preservation of abandoned railway corridors (including the conversion and use of the corridors for pedestrian or bicycle trails).

- **Congestion Mitigation and Air Quality (CMAQ)** – Under SAFETEA-LU, funds may be used for bicycle and pedestrian activities, including:
  - Constructing bicycle and pedestrian facilities (paths, bike racks, support facilities, etc.) that are not exclusively recreational and reduce vehicle trips;
  - Non-construction outreach related to safe bicycle use; and,
  - Funding State bicycle/pedestrian coordinator positions for promoting and facilitating non-motorized transportation modes through public education, safety programs, etc. This is limited to one full-time position per state.

- **High Priority Projects** – The High Priority Projects program provides designated funding for specific projects identified in SAFETEA-LU. Additionally, High Priority Projects are often congressional designations of funding that occur during the six-year authorization (e.g. ISTEA, SAFETEA-LU).

- **Transit Enhancement Funds** – The FTA requires that at least one percent of transit expenditures for urbanized areas of more than 200,000 people (known as 5307 formula funds) go to projects that improve access to transit service. Many of these projects focus on cycling and walking.

- **Highway Safety Programs** – Pedestrian and bicyclist safety remain priority areas for State and Community Highway Safety Grants funded by the Section 402 formula grant program. A State is eligible for these grants by submitting a Performance plan (establishing goals and performance measures for improving highway safety) and a Highway Safety Plan (describing activities to achieve those goals). Research, development, demonstrations and training to improve highway safety (including bicycle and pedestrian safety) is carried out under the Highway Safety Research and Development (Section 403) program.

- **Federal Lands Highways Program (FLHP)** – Funds authorized for forest highways, forest development roads and trails, public lands development roads and trails, park roads, parkways, Indian reservation roads, and public lands highways may be used for construction of pedestrian walkways and bicycle transportation facilities.

- **High Risk Rural Roads Program (HRRRP)** – HRRRP funds may be used to carry out construction and operational improvements on roadways functionally classified as rural major and minor collectors or a rural local road.
- **Highway Safety Improvement Program (HSIP)** – HSIP funds may be used to carry out highway safety improvement projects on any public road or publicly owned bicycle or pedestrian pathway or trail.
- **Public Lands Highways** - Discretionary and Forest Highways (PLHD and FH) – PLHD and FH funds shall be available for eligible transportation projects that are within or adjacent to, or that provides public access to, the areas served by a forest highway or public lands highway. Under the provisions of 23 U.S.C. 204(h), eligible projects could include: "...Provisions for pedestrians and bicycles."
- **Transportation, Community, and System Preservation Program** – Funds authorized are eligible for planning, developing and implementing strategies to integrate transportation, community, and system preservation plans and practices including corridor preservation activities that are necessary to implement transit-oriented development plans, traffic calming measures, or other coordinated transportation, community, and system preservation practices.

Non-Transportation Federal Funding and Assistance

Outside of the federal transportation programs, there are a wide range of other federal funds that can be used for bicycling and walking facilities.

- **Community Development Block Grant Program (CDBG)** – Providing annual grants on a formula basis to local governments and states for a wide range of community planning initiatives, CDBG monies have been used for bicycle and pedestrian activities. CDBG projects must be used for activities that benefit low- and moderate-income persons, prevent or eliminate slums or blight, and address community development needs having a particular urgency.
- **Public Works and Economic Development Program (PWED)** – One of a few investment programs administered by the Economic Development Administration of the United States Department of Commerce, PWED is meant to provide funding for "construction or rehabilitation of essential public infrastructure and facilities" that, among other things, can help to "redevelop brownfield sites and provide eco-industrial development."
- United States Department of Health and Human Services, Office of Grants Management.
- United States Environmental Protection Agency Rosemary Monahan Sustainability Grant.

New York State Funding Sources

- **NYSERDA**-The New York State Energy and Research Development Agency provides funding to projects that help New York State meet its energy goals of reducing energy consumption, promoting the use of renewable energy sources and protecting the environment.
- **Marchiselli Program (Municipal Streets and Highway Program)** – In 2008, New York State Governor Patterson signed a new law which includes bicycle and pedestrian paths within the types of construction and improvement projects (e.g., bridge, roadway, and highway projects) of the Department of Transportation which are eligible for Marchiselli funds. These funds can be used for the local 20 percent match for federal funding projects and the law specifies that such eligibility does not restrict the use of other funds for design, construction, or land acquisition for bicycle paths or pedestrian paths.
- **New York State Scenic Byway Program** – Scenic byways are transportation corridors that are of particular statewide interest. They are representative of a region's scenic, recreational, cultural, natural, historic or archeological significance. Both technical and

financial assistance may be available through this program administered by NYSDOT for communities desiring to establish a scenic byway. These funds may be used for "construction along scenic byways of a facility for pedestrians and bicyclists." Source of funds: Federal Highway Administration.

- **Consolidated Local Street and Highway Improvement Program (CHIPS)** – A New York State funded program available to provide for bicycle, pedestrian and traffic calming measures.
- **Smart Growth Initiative** – The Smart Growth Public Infrastructure Act went into effect in New York on September 29, 2010 and requires most state agencies and all state authorities, prior to approving of funding any public infrastructure projects, to prepare and file a Smart Growth Impact Statement finding that the project is consistent with 10 Smart Growth Criteria or justifying why it is not practicable to do so. Federal and state grant may be available to assist local communities to implement Smart Growth principles.
- **New York Main Street Program** – The Office of Community Renewal administers this program which provides financial resources and technical assistance to communities to strengthen the economic vitality of the state's traditional main streets and neighborhoods. This program provides funds to local governments, business improvement districts and other not-for-profit organizations that are committed to revitalizing historic downtowns, mixed-use neighborhood commercial districts and village centers.
- **Spot Improvement Program** – The Capital District Transportation Committee (CDTC), the MPO for the Capital region, including Bethlehem, provides Spot Improvement grants for small-scale projects that will improve the region's bicycle and pedestrian travel environments. Actions funded through this program should address problems at specific locations, such as intersections, short lengths of roadway, or single destinations.
- **Recreational Trails Program (RTP)** – This is a Federal-aid reimbursement program for the acquisition, development, rehabilitation, and maintenance of trails and trail-related projects. Funds are available to non-profit organizations; municipal, State, and Federal agencies; Indian tribal governments; and other public agencies and authorities. Funded projects must be identified in, or further a specific goal of, the SCORP and must be available to the general public. This program is administered by the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP). Source of funds: Federal Highway Administration.
- **New York State Congestion Mitigation and Air Quality (CMAQ) Program** – A federal reimbursement program for surface transportation and other related projects that contribute to air-quality improvements and reduced congestion. Program funds may be used to construct bicycle and pedestrian facilities intended to reduce automobile travel and/or emissions in areas that have failed to meet air-quality standards for ozone, carbon monoxide and small particulate. This program is administered by NYSDOT. Source of funds: Federal Highway Administration.

Examples of Other Public Funding Sources

In light of the current national economic situation and its affect on state and local government revenues, there is a greater need than ever to develop innovative strategies to fund bicycle and pedestrian projects. The following are examples of innovative funding strategies currently being used:

- **Dedicated Funding for Bicycle and Pedestrian Projects, New Jersey** – The State of New Jersey has dedicated approximately $57.5 million of state funds towards pedestrian safety in an effort to reduce the growing pedestrian fatality rate within the state.
- **Oregon Mandated 1 percent Law** – Oregon Revised Statute 366.514 requires Oregon Department of Transportation (ODOT), cities, and counties to include "bikeways and

walkways" on all road construction and reconstruction projects. The 1971 law also requires ODOT, cities, and counties to spend reasonable amounts of their share of the state highway fund (state gas tax and vehicle registration fees) on needed pedestrian and bicyclist facilities. A "reasonable amount" is open to interpretation, and the statute specifies that ODOT, cities, and counties must spend no less than one percent of their share of the state highway fund on such facilities. ODOT has to spend the one percent minimum each year, but cities and counties can carry the one percent share over a ten-year period to allow it to accumulate.

- **City of Portland, Maine** – In 2011, the city passed an ordinance which created a Sustainable Transportation Fund, supplied by parking in-lieu fees. Under the new rule, developers may pay a fee of $10,000 for each required parking space not built. Rather than the money being spent on building public parking garages, as parking in-lieu fees generally are, all the money in the fund must be spent on alternative transportation projects (though this is not limited only to pedestrian or bicycle projects, as public transit uses are also allowed). In addition, the Portland Office of Transportation has used Local Improvement Districts (LIDs) to fund numerous pedestrian-related streetscape improvements. Before an LID can be established, the City of Portland polls area property owners to determine improvements needed. Once the consensus is established, the City works with property owners to develop an assessment method, which may include square footage, linear footage, or a combination of methods. The City then designs, engineers, and manages the construction of the project, but does not actually build the project. LIDs can be used to improve streets, build sidewalks, and install stormwater management systems. LIDs are typically business districts, but can also be residential.
- **Town of Kennebunk, Maine** – The town of Kennebunk has created a separate impact fee account dedicated to bicycle facility improvements.
- **Collier County, Florida** – Collier County is in the process of approving its Master Mobility Plan, which would allow for development impact fees to be used for alternative transportation projects.
- **City of Orlando, Florida** – The City of Orlando is considering updating its transportation impact fees to be used for multi-modal projects, including automobiles, public transit, bicycles, and pedestrians.
- **Dedicated Sales Tax Revenue, Mammoth, California** – Because of its recognition as a world-renowned year-round resort, the City of Mammoth, California introduced a half-cent sales tax measure that would raise and secure a stable funding source for development and maintenance of local trails, parks, and recreation. "Measure R" was placed on the ballot in June 2008 and received the necessary two-thirds majority to pass. The measure increased the local sales tax by half a percent. By law, this increased revenue can only be used for the planning, construction, operation, and maintenance of the recreational infrastructure of Mammoth Lakes.

Examples of Other Funding Sources

- **Bikes Belong Grant Program** – The Bikes Belong Grant Program "funds influential projects that leverage federal funding and build momentum for bicycling in communities across the U.S. These projects include bike paths and rail trails, as well as mountain bike trails, bike parks, BMX facilities, and large-scale bicycle advocacy initiatives.
- **PepsiCo Grants** – Submitted through PepsiCo's Letter of Interest process, highly competitive PepsiCo Contributions' goal is to strengthen the communities where we live and work through community investment.

General Recommendations for Sustainability Initiatives

In addition to the previously made recommendations the Town should also consider the following actions to further promote energy efficiency and sustainable development within the town.

The Town of Bethlehem can also develop ways for businesses to overcome the financial barriers to making energy efficiency improvements to their businesses. The New York State Legislature has passed enabling legislation for local governments to create a Property Assessed Clean Energy (PACE) program within their jurisdictions.

PACE is a mechanism for financing energy efficiency building renovations (and small scale renewable energy systems.) Property owners who opt to use a PACE program to finance these projects agree to an incremental charge on their property taxes over an extended term of up to 20 years. PACE financing is an improvement on traditional lending because no upfront costs are incurred, and the property owners' annual energy savings typically exceed the annual additional property tax assessment charge. When business moves or the property is transferred, the new owner picks up the payments—and the energy savings—where the previous owner left off.

Municipalities are permitted to fund these programs using federal grant assistance or federal credit support mechanisms including direct loans, loan guarantees, and debt instruments. Municipalities may, but are not required, to provide for repayment of the loan through a charge on the real property which benefits from the loan. If the Town of Bethlehem chooses this option, the charge must be collected at the same time and in the same manner as taxes, but must be listed separately from other charges on the bill. The Town of Bethlehem should begin implementation by approving a Town Law creating a commercial PACE district and begin the seeking funds for the development of its own program. The Town of Bethlehem IDA could assist with the management and administration of such a program.

The Town should also lobby the Albany County Legislature to introduce a local law that would exempt residents of Albany County from the local sales tax associated with the sale and installation of residential solar energy systems. New York State enacted legislation in July 2005 exempting the sale and installation of residential solar-energy systems from the state's sales and compensating use taxes. The exemption applies to solar-energy systems that utilize solar radiation to produce energy designed to provide heating, cooling, hot water and/or electricity. The law also permits local governments (municipalities and counties) to grant an exemption from local sales taxes. Since local sales taxes are imposed at the County level it would be up to the Albany County Legislature to pass the necessary Local Law. Sales tax exemptions on the sale of renewable energy infrastructure have been continuously promoted by the State of New York and encouraged at the Local Level. This imitative should garner support from County Legislators and State Representatives.

General Sustainability					
City	**State**	**Type of Policy**	**Tool**	**Commercial/ Residential/ Both**	**Description**
Arlington County	Virginia	Density Incentive	Zoning Incentives	Both	Arlington County created a green building density bonus program that allows builders to request a lager building than is normally allowed by County Code if the project gains official LEED certification at any of the four levels. The amount of the bonus depends on the award level of the project.
Cleveland	Ohio	Green Zoning	Zoning Ordinance	Both	The City of Cleveland Planning Commission has developed a Green Design Overlay District that incorporates green design guidelines.
New York	New York	Shade Access	Zoning Ordinance	Both	Proposed changes to the New York City Zoning Code include allowing sun control devices (i.e. shades or screens) to project from building facades over required open areas.
Statewide	New York	Solar Access	Solar Easements	Both	New York's real property laws allow for the creation of solar easements. These are voluntary contracts which must be entered into in order to ensure uninterrupted solar access for solar energy devices. New York General City, Town, and Village codes allow also local zoning districts to make regulations regarding solar access.
Boulder	Colorado	Solar Access	Solar Access Ordinance	Both	Limits have been set on the amount of permitted shading by new construction. For new developments, all units which are not planned to incorporate solar features must be sited to provide good solar access and not shade adjacent structures. In addition, they must also have roofs capable of supporting at least 75 square feet of solar collectors per unit.
Austin	Texas	Solar Access	Zoning Ordinance	Both	Provides a height limitation exemption for solar installations. Solar installations may exceed the district height limit by 15% or the amount necessary to comply with federal or state regulation whichever is greater.
New York	New York	Solar Access	Zoning Ordinance	Both	Proposed changes to the New York City Zoning Code include allowing solar panels to be installed on any building roof, by allowing them as a "permitted obstruction" above the corresponding height limit.
Gainesville	Florida	Solar Access	Zoning Ordinance	Both	The City of Gainesville requires the design process for public facilities within city limits to take into consideration current and future solar access. In addition, regulated trees may be removed to allow for the reasonable development sites, including the installation of solar energy equipment.
Statewide	New York	Solar Access	Sales Tax Exemption	Both	New York enacted legislation in July 2005 exempting the sale and installation of residential solar-energy systems from the state's sales and compensating use taxes. The law also permits local governments (municipalities and counties) to grant an exemption from local sales taxes.
East Lansing	Michigan	Sustainable Development	Building Code	Both	Created a Green Building Ordinance requiring public development projects with multiple buildings receiving over 15% municipal incentives to achieve a minimum LEED for Neighborhood Development Silver Certification with at least one point earned under Green Infrastructure and Building Credit.
Oakland	California	Sustainable Development	Building Code	Both	New Planned Unit Developments (PUDs) or projects with phased entitlements or subdivision of parcels greater than 60,000 sq. ft. must submit a LEED for Neighborhood Development checklist to the city for review.
Penfield	New York	Sustainable Development	Town Ordinance	Both	The Town of Penfield, New York has adopted a sidewalk policy that encourages the installation of sidewalks on specifically identified areas of the town. In order to fund the sidewalk installations and improvements the Town has created a payment in lieu of sidewalk fee for developers proposing new construction within Penfield.
Greenburgh	New York	Sustainable Development	Green Building Construction Standards	Both	Every applicant who files an application for site plan review for construction shall make a good faith effort to achieve LEED certification by providing a completed LEED-NC checklist
High Energy Efficient Construction					
City	**State**	**Type of Policy**	**Tool**	**Commercial/ Residential/ Both**	**Description**
Statewide	New York	Energy Efficiency Building Financing	Property Assessed Clean Energy (PACE)	Residential	PACE is a mechanism for financing energy efficiency building renovations (and small scale renewable energy systems.) Property owners who opt to use a PACE program to finance these projects agree to an incremental charge on their property taxes over an extended term of up to 20 years.
Riverhead	New York	Energy Efficiency Building Incentives	Energy Conservation Device Permitting Fees	Both	A special allowance has been made in the building permit fee structure to provide a discount to people wishing to install energy conservation devices on residential or commercial buildings. Those wishing to install such devices now pay a flat permitting fee.
Indianapolis	Indiana	Energy Efficiency Building Incentives	Green Building Incentive Policy	Both	Property owners and developers constructing new buildings or completing major renovations on existing buildings are eligible to receive the incentive. Meeting the minimum criteria for three categories qualifies the project for a 30% rebate on permit fees. For each additional category that the project meets, it will receive an additional 10% off permit fees. The maximum rebate amount is 50%.
Sarasota	Florida	Energy Efficiency Building Incentives	Permitting Fees	Both	Sarasota County approved a Green Development Imitative that provides fast-track permitting for residential and commercial green developments incentives apply to projects pursing LEED-ND.
Berkley	California	Energy Efficiency Building Requirements	Town Ordinance	Residential	The City of Berkeley has passed an Energy Conservation Ordinance which requires that every home or apartment building sold or transferred in Berkeley or undergoing renovations valued at $50,000 or more must meet energy or water efficiency requirements to improve the energy and water efficiency of the home.
Santé Fe	New Mexico	Energy Efficiency Building Requirements	Building Code	Residential	Requires all new single family residential units to be tested and certified according to the Enhancements to the National Home Energy Rating Standards (HERS) as adopted by the Residential Energy Services Network (RESNET).
Monroe County	New York	Energy Efficiency Building Requirements	Industrial Development Agency Incentives	Commercial	All projects receiving IDA benefits or incentives must rated as Certified, Gold, Silver or Platinum by the United States Green Building Council's Leadership in Energy and Environmental Design (LEED ®) Green Building Rating System.

Reduce Impervious Construction					
City	**State**	**Type of Policy**	**Tool**	**Commercial/ Residential/ Both**	**Description**
Kansas City	Missouri	Green Parking	Zoning Ordinance	Both	New parking ordinance allows less parking, increases shared parking options, allows for impervious surfaces and mandates certain landscape requirements for parking lots.
New York	New York	Green Infrastructure	Zoning Ordinance	Both	Proposed changes to the New York City Zoning Code include accommodating a broad range of rooftop green features, including green roofs, wastewater management equipment, boilers or cogeneration facilities, and recreational decks.
Portland	Oregon	Green Infrastructure	Zoning Ordinance	Commercial	Portland requires that all new municipal buildings have a green roof covering at least 70% of area. In addition Portland offers zoning density bonuses for the inclusion of a green roofs on new development.
Chicago	Illinois	Green Permitting	Zoning Ordinance	Both	Chicago offers incentives to developers by offering an expedited permitting process and lower permit fees to qualifying projects. The incentives are intended to promote the development of Green Roofs, Rain Gardens, Vegetated Swales & Landscaping, Porous Pavement; Downspout Disconnection, Rain Barrels & Cisterns.
Water Reduction or Gray Water Use Incentives					
City	**State**	**Type of Policy**	**Tool**	**Commercial/ Residential/ Both**	**Description**
Seattle	Washington	Green Infrastructure	Local Law	Residential	Offers a subsidized rain barrel program to encourage rain water harvesting.
Milwaukee	Wisconsin	Green Infrastructure	Local Law	Residential	Milwaukee's downspout disconnection program promotes disconnecting downspouts and connecting them to rain barrels and rain gardens.
Portland	Oregon	Green Infrastructure	Local Law	Residential	Portland pays residents to disconnect their existing downspouts.
Parking Requirements					
City	**State**	**Type of Policy**	**Tool**	**Commercial/ Residential/ Both**	**Description**
Scottsdale	Arizona	Parking Requirements	Zoning Ordinance	Both	Scottsdale Arizona created programs and incentives within its zoning code to reduce parking requirement where it was determined to be a detriment to the goals and policies of the city relating to the down town areas. These programs include granting credit for on street and bicycle parking and mixed use shared parking programs.
Davis	California	Parking Requirements	Zoning District	Both	Davis established a payment in lieu of parking fee for core commercial and mixed use zoning districts.
Grand Rapids	Michigan	Parking Requirements	Zoning Ordinance	Both	Grand Rapids Michigan adopted a new zoning ordinance that allows of street parking requirements to be reduced based on the meeting certain requirements. These requirements include incorporating alternative modes of transportation, using on street business parking and payment in lieu of parking.
Salt Lake City	Utah	Parking Requirements	Zoning Ordinance	Both	Salt Lake City Utah used parking as a way to promote Transportation Demand Management (TDM) policies. These policies include requiring bicycle parking, incentives for car pooling, establishing special minimum and maximum parking for certain districts and granting credit for on street parking.

Bicycle and Pedestrian Program

PaTHs 4 Bethlehem Committee Vision, Mission, Goals

Sustainable Bethlehem

PaTHs 4 Bethlehem Committee

Pathways to Homes, Hamlets & Health Hearts

Vision, Mission, & Goals

Vision

Residents and visitors in Bethlehem live and work in a sustainable community that has a diversity of transportation options, and they routinely choose bicycling and walking for safe and efficient transportation and as a healthy option for recreation.

Mission

The PaTHs 4 Bethlehem Committee is a resource that effectively uses a 5E approach *(Engineering, Education & Enforcement, and Engagement & Encouragement)* to advise the Town, educate the community, and advocate for opportunities to improve mobility and connectivity for bicyclists and pedestrians.

Goals

Engineering

Bethlehem offers safe and efficient infrastructure to ensure accessibility, connectivity, and mobility for bicyclists and pedestrians

Education & Enforcement

The Bethlehem community is aware of and actively exhibits safe bicycling, walking, and driving behavior. A share the road approach is respected among all travel modes and reinforced through enforcement of traffic laws.

Engagement & Encouragement

The Bethlehem community is utilizing its bicycle and pedestrian network to the full extent and is empowered to drive new programs in the town

Bicycle and Pedestrian Program

Greenhouse Gas Emissions Reduction from
Proposed On-Street Bikeways

Sustainable Bethlehem

Sustainable Bethlehem

An Assessment of Potential Greenhouse Gas Emissions Reductions from Proposed On-Street Bikeways

Through the Sustainable Bethlehem Initiative, the Town of Bethlehem has identified both the improvement of bicycle and pedestrian facilities and the reduction of greenhouse gas emissions as priorities. This assessment aims to provide some guidance and some initial estimates on potential greenhouse gas (GHG) benefits from the Town's growing bicycle facility network. There are many benefits to bicycling, such as improved health and fitness and reduced GHG emissions and criteria air pollutants from avoided vehicle travel. According to the 2006-2010 American Community Survey, 70 of Bethlehem's 16,851 commuters currently bicycle to work as a primary means of commuting (see Table 1). Bethlehem currently has five miles of on-road bikeways and plans to increase that number to 13 by adding more shared lane markings, and improved signage (bike route and/or share the road signs) (see Table 2).

Depending on the methodology utilized, these bicycle infrastructure improvements could increase the number of bicycle commuters in Bethlehem by as many as 14 (a 20 percent increase) and reduce vehicle miles traveled (VMT) by gasoline passenger cars by 6,720 miles (a 0.0076 percent reduction in VMT by gasoline passenger cars in Bethlehem) (see Table 3). This reduction in VMT translates to a GHG emissions reduction of 2.2 metric tons of carbon dioxide equivalent (metric tons CO_2e) or 0.0076 percent of GHG emissions generated by gasoline passenger cars traveling within Bethlehem.

While an increase of approximately fourteen bicycle commuters may seem small, actual ridership numbers will be determined by a number of factors including education, weather, bicycle infrastructure, and the routes selected for bikeway improvement. Below are some recommendations on how the Town of Bethlehem can obtain more accurate data and further reduce VMT and associated GHGs through the addition of bicycle infrastructure.

Table 1. Bethlehem 2010 Bicycle and Pedestrian Commuters

Commuter Type	Number of Commuters 16 years and older	% Total Commuters 16 years and older
Bike	70	0.4%
Walk	217	1.3%
Total Commuters	16,851	100.0%

Source: U.S. Census Bureau, 2006-2010 American Community Survey

Table 2. Bethlehem 2010 Existing and Proposed Miles of On-Street Bikeways		
Existing	**Proposed**	**Existing and Proposed**
5	8	13
Source: Planning Department, Town of Bethlehem		

Table 3. Projected Gasoline Passenger Vehicle Miles Traveled (VMT) and Greenhouse Gas (GHG) Emissions Reductions from Proposed On-Street Bikeways in Bethlehem				
METHODOLOGY 1				
	Miles of On-Street Bike Ways	**Number of Bicycle Commuters**	**Gasoline Passenger Car VMT**	**GHG Emissions from Gasoline Passenger Cars (metric tons CO_2e)**
Current (2010)	5	70	88,774,091	29,204.05
Projected	13	84	88,737,371	29,201.85
Change	**+ 8**	**+14**	**-6,720**	**-2.2**
% Change	**+ 160 %**	**+20 %**	**-0.0076 %**	**-0.0076 %**
METHODOLOGY 2				
	Miles of On-Street Bike Ways	**Number of Bicycle Commuters**	**Gasoline Passenger Car VMT**	**GHG Emissions from Gasoline Passenger Cars (metric tons CO_2e)**
Current (2010)	5	70	88,774,091	29,204.05
Projected	13	74.4	88,771,967	29,203.36
Change	**+ 8**	**+4.4**	**-2,124**	**-0.70**
% Change	**+ 160 %**	**+6.3 %**	**-0.0024 %**	**-0.0024 %**
Sources: U.S. Census Bureau, 2006-2010 American Community Survey Planning Department, Town of Bethlehem Town of Bethlehem 2010 Greenhouse Gas Emissions Inventory				

Recommendations for Bethlehem

Bicycle Counting

As previously stated, actual ridership numbers are determined by a number of factors and the methodologies used in this document are based on a number of assumptions from data extrapolated from Minneapolis, MN and from the American Community Survey. Additionally, due to the fact that Bethlehem does not have shared lane markings on a primary commuting artery, it is particularly difficult to link miles of on-road bicycle roadways with potential reductions in VMT and associated GHG emissions. Therefore, it is highly recommended that the Town initiate a bicycle count program to determine how many bike commuters there actually are in Bethlehem and what roads they are utilizing. Given that Bethlehem has placed a significant focus on creating a bicycle friendly community, the Town may want to work with its PaTHs 4 Bethlehem Committee to develop the bicycle count program utilizing volunteers on a quarterly basis. The City of Chicago, IL has developed a very successful volunteer bicycle count program that has resulted in the collection of essential data to determine how and where current bicycle commuters are travelling and what improvements can be made to increase ridership.[1] Bethlehem could significantly enhance the effectiveness of its bicycle programs through obtaining data such as this.

[1] Chicago Bicycle Program-Bicycle Counts. http://www.chicagobikes.org/public/bikecounts.php. Accessed April 3, 2012.

Create Bikeways along Commuter Routes

The Town should apply bicycle facility improvements to principal roadways that serve as commuter routes to the City of Albany. Commuter routes were selected and are included in the Town's Bicycle and Pedestrian Network. For example, a bicycle route along Delaware Avenue (NYS Rt. 443) to connect to existing bicycle facility treatments (shared lane markings) along Delaware Avenue in the City of Albany would certainly help to increase actual ridership levels since a large portion of Town residents work in Albany. Creating bikeways along commuter routes will also allow the Town to more accurately determine the VMT and GHG reduced through its bicycle program as it can be reasonably assumed that a bicyclist on a commuter route during rush hour is most likely going to work and therefore replacing their car with a bicycle, rather than just riding their bicycle for recreation and not actually displacing VMT.

Furthermore, the majority of attendees at a Town Sustainable Bethlehem workshop on bicycle and pedestrian mobility, held in March 2012, identified "safety concerns, being on road with cars" as the greatest barrier to bicycling in Bethlehem. The City of Albany Planning Department Staff have indicated that the primary response they have received from the public regarding the shared lane markings on Delaware Avenue is that they actually feel safer riding their bicycle on that road now. Bicycle facility improvements in the form of shared lane markings and bicycle signs help to alert road users of bicycle presence on the roadway, and assist bicyclists with the lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane (NYSMUTCD Section 9C.07). The Town has made strides to work with the New York State Department of Transportation (NYS DOT) on this opportunity (Delaware Avenue is a state owned road in portions of Bethlehem), but to date has not been successful in garnering support for the installation of shared lane markings. It is recommended that the Town continue to impress upon the NYS DOT the value that shared lane markings on Delaware Avenue could bring to create a safer, more bicycle friendly Bethlehem.

Methodology

Due to the fact that Bethlehem does not have shared lane markings on a primary commuting artery and that there is no current bicycle count program for Bethlehem, it is particularly difficult to link miles of on-road bicycle roadways with potential reductions in VMT and associated GHG emissions. Therefore, two methodologies were developed to attempt to make this linkage for Bethlehem. Both methodologies are described below and are based on bicycle ridership and on-street bikeway data from the City of Minneapolis, MN. Minneapolis has one of the most advanced bicycle and pedestrian networks in the United States and publishes a variety of data including miles of bikeways, bicycle counts, and bicycle commuter statistics. Vehicle miles traveled GHG reductions were extrapolated based on the results of the Town of Bethlehem 2010 Greenhouse Gas Emissions Inventory. Both approaches focused on three primary steps to project bicycle commuters, VMT reductions, and GHG emissions reductions from increased on-street bikeway mileage:

1. **Project the number of bicycle commuters in Bethlehem resulting from eight additional miles of on-street bikeways.**
2. **Estimate Reduction in VMT**
3. **Calculate the Reduction in Greenhouse Gas Emissions from Avoided VMT**

Methodology 1

Step 1: Project the number of bicycle commuters in Bethlehem resulting from eight additional miles of on-street bikeways

The first approach utilized the percentage change in bicycle commuters and in miles of bikeways from 2010 to 2011 in Minneapolis, MN.

Table 4. Minneapolis Bicycle Ridership, Bicycle Commuters, and Miles of On-Street Bikeways 2007, 2010, 2011

Year	2007	2010	2011	Source
All Bicyclists	21,790	27,580	34,475	2010 Minneapolis Bicyclist and Pedestrian Count Report; 2011 City of Minneapolis Bicycling Account http://www.minneapolismn.gov/bicycles/data/index.htm
Bicycle Commuters	7198	6969	8,711*	U.S. Census Bureau, 2010 American Community Survey
Miles of On-Street Bikeways	41	45	80	2011 City of Minneapolis Bicycling Account; Miles of Bikeways, Bicyclist Traffic and Bicycle Commuters (1998 to 2011) http://www.minneapolismn.gov/bicycles/data/reports

*Estimated value. It was assumed that the percentage of bicyclists that were commuters in 2010 (25.3 percent) remained the same in 2011

Based on the information outlined in Table 4 above, Minneapolis showed an approximate 78% increase in miles of bikeways and a corresponding approximate 25% increase in bicycle commuters. In other words, for every 3% (3.11%) increase in bikeway mileage, there was a 1% increase in bicycle commuters.

The next step was to apply this percentage change to Bethlehem. Bethlehem is proposing an increase from 5 to 13 miles or a 62.5% increase in bikeways. Applying the same 1% increase in bicycle commuters for every 3% increase in bicycle miles from Minneapolis, the equation is as follows:

62.5% / 3.11 = 20.1%

Therefore, this increase in bikeway miles in Bethlehem would result in a 20% increase in commuters, or 14 additional commuters, for a total of 84 bicycle commuters.

Step 2: Estimate Reduction in VMT

It was then assumed that each new bicycle commuter displaced a single occupancy vehicle commute of 10 miles round trip, three days a week, four months out of the year. The reduction in VMT was calculated as shown below:

Annual Vehicle Miles Reduced = 14 new bicycle commuters x 10 vehicle miles reduced/bicycle commuter/day x 3 days/week x 4 weeks/month x 4 months/year

Table 5	
Number of New Bicycle Commuters	Vehicle Miles Reduced
14	6,720

Step 3: Calculate the Reduction in Greenhouse Gas Emissions from Avoided VMT

For the purposes of calculating GHG emissions reductions, it was also assumed that the vehicle miles avoided by new bicycle commuters were from single occupancy gasoline passenger cars. According to the Bethlehem 2010 Greenhouse Gas Inventory, 88,774,090.75 vehicle miles were traveled by gasoline passenger cars within the geographic boundaries in Bethlehem. These vehicle miles resulted in the emission of 29,204.05 metric tons of carbon dioxide equivalent (metric tons CO_2e).

A reduction of 6,720 gasoline passenger car vehicle miles is equivalent to 0.0076 percent of all gasoline passenger car VMT within Bethlehem during 2010 and GHG emissions are proportional to VMT. GHG emissions avoided from the projected reduction in VMT by gasoline passenger cars were calculated as shown below:

GHG emissions avoided from new bicycle commuters = (6,720 miles reduced/2010 gasoline passenger car VMT)*2010 passenger car gasoline GHG emissions

Where:

2010 passenger car gasoline miles traveled = 88,774,091miles

2010 passenger car gasoline GHG emissions = 29,204 metric tons CO_2e

Table 6. Projected Bethlehem Gasoline VMT and GHG Emissions Reductions		
	Gasoline Passenger Car VMT	**GHG Emissions from Gasoline Passenger Cars (metric tons CO_2e)**
Current (2010)	88,774,091	29,204.05
Projected	88,737,371	29,201.85
Change	**-6,720**	**-2.2**
% Change	**-0.0076 %**	**-0.0076 %**

Methodology 2

1. **Project the number of bicycle commuters in Bethlehem resulting from eight additional miles of on-street bikeways.**

Using 2007, 2010, and 2011 bicycle commuter statistics and miles of on-street bikeway data from the City of Minneapolis (see Table 4 below), a linear regression analysis was conducted to predict the number of bicycle commuters present from a given number of on-street bicycle miles. The linear regression was run in Excel by plotting 2007, 2010, and 2011 miles of on-street bikeways and number of bicycle commuters

in a chart and selecting the "Linear Trendline" option in the Layout menu -> Trendlines menu. The resulting formula and R^2 value are shown below:

Y = 43.11X + 5240.5; Where:

Y = number of bicycle commuters

X = miles of on-street bikeways

R^2 = 0.9547, indicating that 95.47 percent of the variation in bicycle commuters in Minneapolis is due to variation in the miles of on-street bikeways.

Figure 1

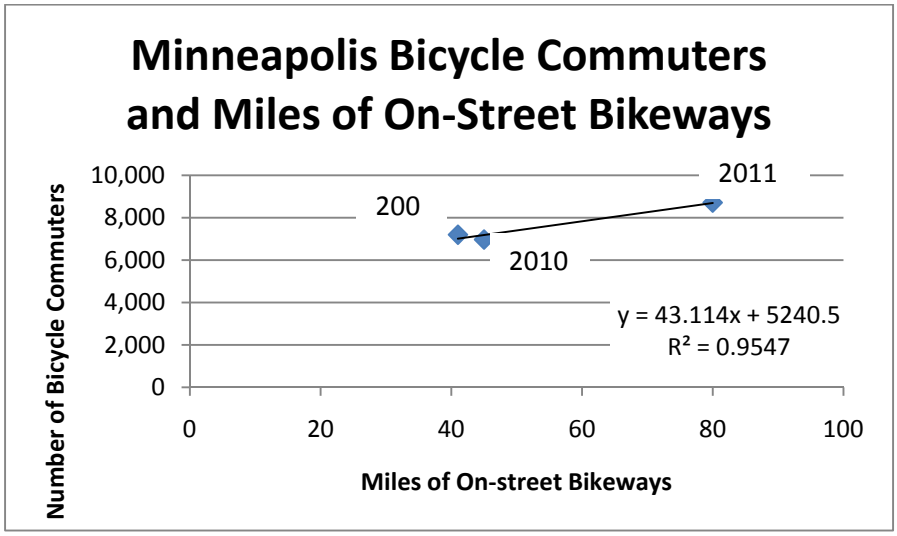

Table 7. Minneapolis Bicycle Ridership, Bicycle Commuters, and Miles of On-Street Bikeways 2007, 2010, 2011				
Year	**2007**	**2010**	**2011**	**Source**
All Bicyclists	21,790	27,580	34,475	2010 Minneapolis Bicyclist and Pedestrian Count Report; 2011 City of Minneapolis Bicycling Account http://www.minneapolismn.gov/bicycles/data/index.htm
Bicycle Commuters	7198	6969	8,711*	U.S. Census Bureau, 2010 American Community Survey
Miles of On-Street Bikeways	41	45	80	2011 City of Minneapolis Bicycling Account; Miles of Bikeways, Bicyclist Traffic and Bicycle Commuters (1998 to 2011) http://www.minneapolismn.gov/bicycles/data/reports
*Estimated value. It was assumed that the percentage of bicyclists that were commuters in 2010 (25.3 percent) remained the same in 2011				

However, this equation was not representative of bicycle conditions in Bethlehem. For example, when X = 5 miles of on-street bikeways (the current number of on-street bikeways in Bethlehem), the resulting number of bicycle commuters was 5,456. This value is much higher than the 70 bicycle commuters

reported by 2006-2010 American Community Survey for Bethlehem. A correction factor was applied to the equation above to account for circumstances in Bethlehem that differ from Minneapolis. The correction factor was calculated as follows:

(70 bicycle commuters in 2010) Z = 43.11 bike commuters/bikeway mile (5 bikeway miles) + 5240.5 bike commuters

Z = ((43.11*5)+5240.5)/70

Z = 0.12829747…; Where:

Z = Bethlehem correction factor

Using this correction factor, the final equation used to predict the number of bicycle commuters in Bethlehem from an increase in on-road bikeways is as follows:

Number of bicycle commuters = (43.11X + 5240.5)*Z; Where:

X = miles of on-street bikeways

Z= Bethlehem Correction Factor

The results of this equation are shown below:

Table 8	
Bethlehem Bike Miles	**Number of Bicycle Commuters**
5 (Existing)	70
13 (Existing and Proposed)	74.4
Change in Number of Bicycle Commuters	**Percent (%) Change in Bicycle Commuters**
+ 4.4	+6.3%

2. **Estimate Reduction in VMT**

It was then assumed that each new bicycle commuter displaced a single occupancy vehicle commute of 10 miles round trip, three days a week, four months out of the year. The reduction in VMT was calculated as shown below:

Annual Vehicle Miles Reduced = 4.4 new bicycle commuters x 10 vehicle miles reduced/bicycle commuter/day x 3 days/week x 4 weeks/month x 4 months/year

Table 9	
Number of New Bicycle Commuters	**Vehicle Miles Reduced**
4.4	2,123.7

3. **Calculate the Reduction in Greenhouse Gas Emissions from Avoided VMT**

For the purposes of calculating GHG emissions reductions, it was also assumed that the vehicle miles avoided by new bicycle commuters were from single occupancy gasoline passenger cars. According to the Bethlehem 2010 Greenhouse Gas Inventory, 88,774,090.75 vehicle miles were traveled by gasoline passenger cars within the geographic boundaries in Bethlehem. These vehicle miles resulted in the emission of 29,204.06 metric tons of carbon dioxide equivalent (metric tons CO_2e).

A reduction of 2,124 gasoline passenger car vehicle miles is equivalent to a reduction of 0.0024 percent of all gasoline passenger car VMT within Bethlehem during 2010 and GHG emissions are proportional to VMT. GHG emissions avoided from the projected reduction in VMT by gasoline passenger cars were calculated as shown below:

GHG emissions avoided from new bicycle commuters = (2,123.7 miles reduced/2010 gasoline passenger car VMT)*2010 passenger car gasoline GHG emissions

Where:

2010 passenger car gasoline miles traveled = 88,774,091 miles

2010 passenger car gasoline GHG emissions = 29,204 metric tons CO_2e

Table 10. Projected Bethlehem Gasoline VMT and GHG Emissions Reductions

	Gasoline Passenger Car VMT	GHG Emissions from Gasoline Passenger Cars (metric tons CO_2e)
Current (2010)	88,774,091	29,204.05
Projected	88,771,967	29,203.36
Change	**-2,124**	**-0.70**
% Change	**-0.0024 %**	**-0.0024 %**