Energy and Climate Action Plan

for

The Town and Villages of Red Hook and Tivoli, NY

Prepared by Erika H. Maher & Courtney Strong, Inc., July 2012.

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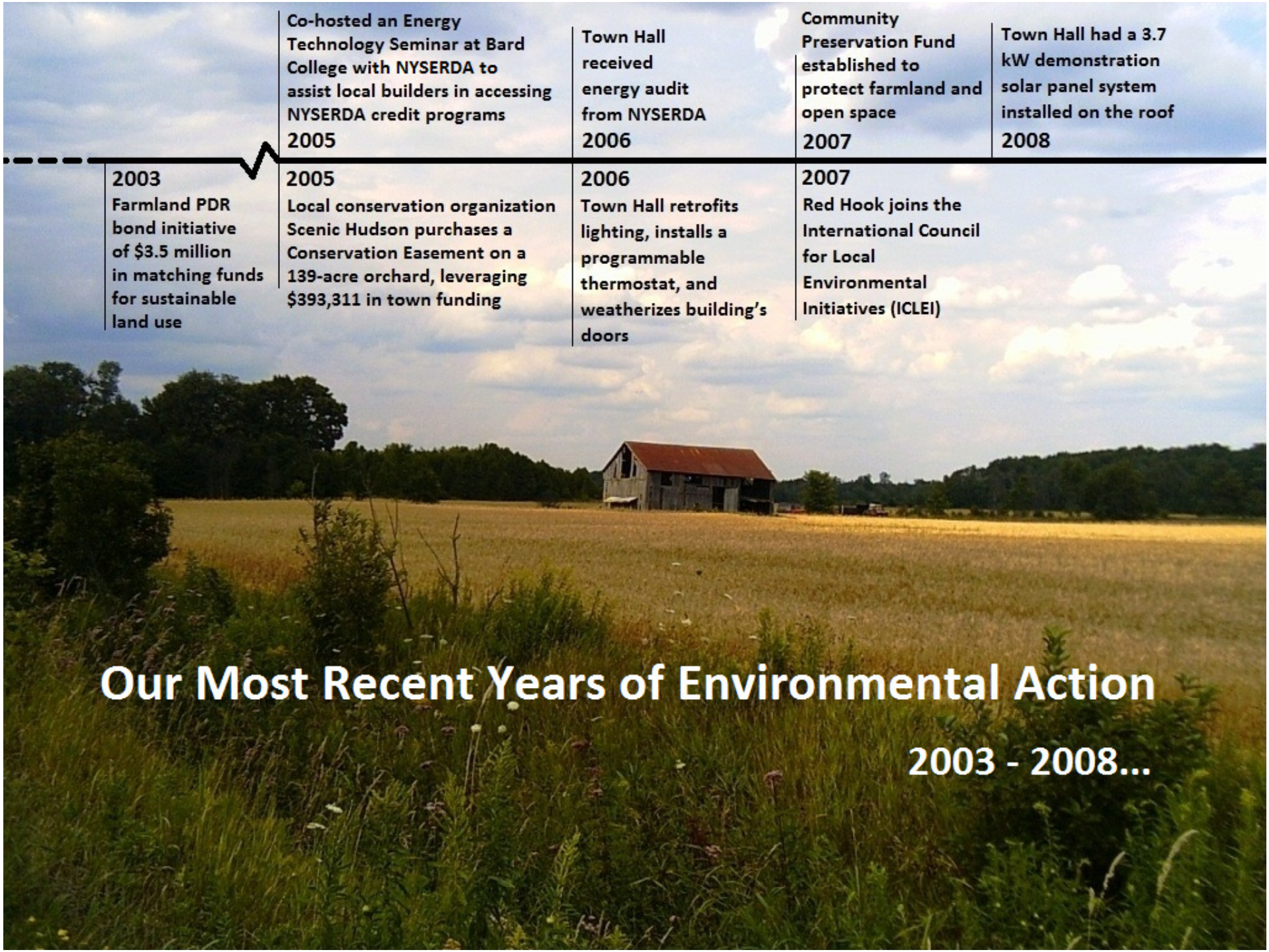
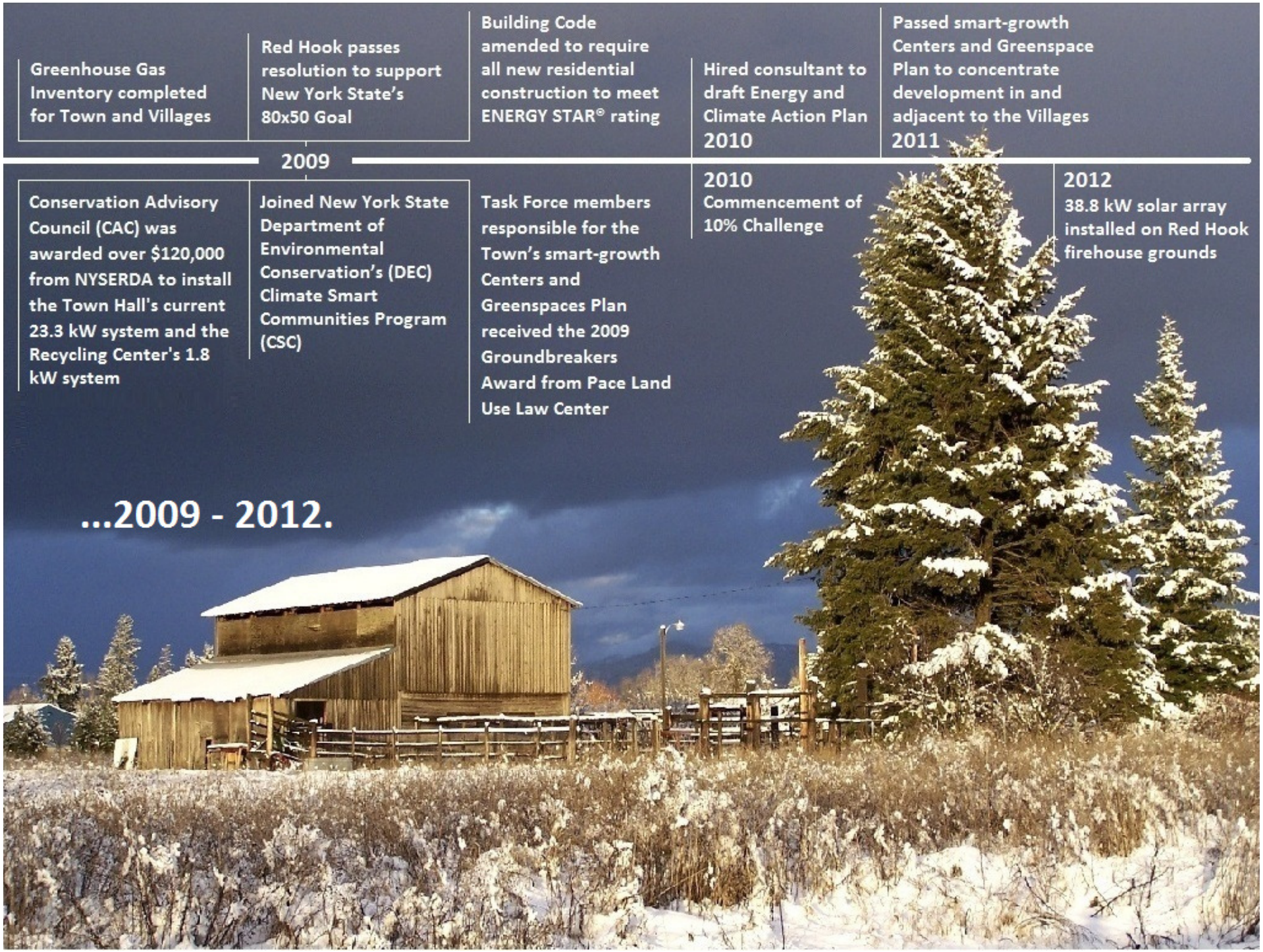

2003
Farmland PDR bond initiative of $3.5 million in matching funds for sustainable land use
2005
Local conservation organization Scenic Hudson purchases a Conservation Easement on a 139-acre orchard, leveraging $393,311 in town funding
Co-hosted an Energy Technology Seminar at Bard College with NYSERDA to assist local builders in accessing NYSERDA credit programs
2005
2006
Town Hall retrofits lighting, installs a programmable thermostat, and weatherizes building's doors
Town Hall received energy audit from NYSERDA
2006
2007
Red Hook joins the International Council for Local Environmental Initiatives (ICLEI)
Community Preservation Fund established to protect farmland and open space
2007
Town Hall had a 3.7 kW demonstration solar panel system installed on the roof
2008
Our Most Recent Years of Environmental Action
2003 - 2008...


Greenhouse Gas Inventory completed for Town and Villages
Red Hook passes resolution to support New York State's 80x50 Goal
2009
Conservation Advisory Council (CAC) was awarded over $120,000 from NYSERDA to install the Town Hall's current 23.3 kW system and the Recycling Center's 1.8 kW system
Joined New York State Department of Environmental Conservation's (DEC) Climate Smart Communities Program (CSC)
Building Code amended to require all new residential construction to meet ENERGY STAR® rating
Task Force members responsible for the Town's smart-growth Centers and Greenspaces Plan received the 2009 Groundbreakers Award from Pace Land Use Law Center
Hired consultant to draft Energy and Climate Action Plan
2010
2010
Commencement of 10% Challenge
Passed smart-growth Centers and Greenspace Plan to concentrate development in and adjacent to the Villages
2011
2012
38.8 kW solar array installed on Red Hook firehouse grounds
...2009 - 2012.

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EXECUTIVE SUMMARY

In 2010, Red Hook took steps toward constructing an Energy and Climate Action Plan (ECAP). The purpose of this document is to continue our journey toward sustainability by focusing on climate change, and to support a trajectory for achieving the goal of a 20 percent total emissions reduction by 2020. This mission has been named the "20/20 Goal."

The Town and Villages of Red Hook and Tivoli have been watchful of and concerned about the processes of climate change for more than a decade. Protection of the land, water, and air has been the goal of many actions taken by the local government, starting in 2003 with a PDR bond initiative of $3.5 million in matching funds for sustainable land use. This was only the beginning of a series of efforts through the following years to reduce carbon emissions through energy use reduction, land use guidance, and green building policies. While carbon reduction is the initial goal of these projects and policies, these efforts will also benefit Red Hook's economy and general community well-being.

Climate change is likely to be one of society's greatest challenges in the coming decades. The Earth's climate is changing in both temperature and weather patterns due to the effects of carbon emissions from human activities. Extreme weather events around the world have already begun to affect many populations. But not all the global effects of climate change will be limited to weather events – they will also have unprecedented effects on human health, large and small economies, and supplies of food, fresh water, and conventional energy resources.

While greenhouse gas emissions in the United States have climbed steadily over the past decades, Red Hook is at the forefront of towns across the country and globe who are committed to taking responsibility for our relationship with the environment. Setting an example for other towns and cities across the country is a very important role to play in the ongoing sustainability transformation, and Red Hook's involvement with the International Council for Local Environmental Initiatives (ICLEI) speaks to this commitment.

The Town and Villages should continue to chart a clear path toward reducing the emissions that contribute to global climate change, and

also to prepare for the consequences of climate change that are now inevitable. A small municipality such as ours can take control of our own emissions, but cannot assume such responsibility will be taken by our global neighbors. It must be accepted that global emissions will continue to rise for some time before a globally effective effort can be enacted and bring results. Meanwhile, the effects of climate change will manifest around the world in various forms, requiring adaptation to higher temperatures and unusual weather patterns affecting the land, water, and human populations.

Red Hook's positive actions of today will enable our future generations to experience improvements in their quality of life.

Aside from the environmental impacts of climate change, Red Hook must also build better understanding of the social issues that will result from a changing climate, including the possibility of rising energy prices[1]. For example, low-income and physically vulnerable residents might experience the impacts of climate change more severely due to limits on their financial resources or physical ability to respond to changes in weather or energy prices.

Natural areas across the verdant Red Hook and greater Mid-Hudson areas also will be affected by climate change. Altered weather patterns caused by a changing climate will affect streams, groundwater, and flood risk, and may increase risks of wildfire, drought, and invasive plant and animal species in addition to threatening the habitats of wildlife.

The Mid-Hudson Valley offers rich and variable farmland that feeds not only its local residents, but its neighbors in surrounding metropolitan areas such as New York City. Changes to the land brought on by extreme weather and a changing climate have the potential to affect not just wildlife, but also the domesticated crops, herds, and flocks that feed the region. If global leaders are not able to effectively act to address climate change, it is possible that fresh water and food resources will become scarce in the coming decades, leading to famine caused not only by food shortage but by soaring prices for staple crops. Maintaining local food growing capacity will help to protect the region from the worst of these effects; the sooner local leaders act, the more likely Red Hook's food and water resources will be reliably and equitably distributed in coming decades.

To confront these overlapping problems caused or worsened by climate change will require a unified response that *begins* with reducing carbon emissions but must also look further. Red Hook's actions to address climate change must always simultaneously focus on making the community a better place to live.

This means Red Hook should implement this ECAP in ways that will also encourage job creation and maintenance, improve public health, foster social equity, and nurture its natural areas such as streams, rivers, forests, and fields.

[1] If New York continues to develop natural gas drilling and utilize more natural gas as an energy source, it is much less likely that energy prices will continue to rise.

Red Hook's Efforts Against Climate Change Should Include:

The Reduction of Fossil Fuel Use and Rise in Energy Self-Sufficiency: This plan's initial goal is to reduce reliance on fossil fuels. The ability to rely more on more stable, local energy sources such as the sun and wind will diminish the financial burden on residents to pay for expensive energy fuels, and address energy supply risks due to possible future fuel resource scarcity. Most importantly, generating local, clean energy will greatly reduce Red Hook's carbon emissions.

The Protection and Improvement of the Natural Environment: Aside from the responsibility of strong stewardship of the natural environment, building strong, sustained natural areas is an essential strategy that can reduce emissions, remove carbon from the atmosphere, and finally prepare the community for climate change.

Reducing Energy Expenses: Using less energy in our homes, buildings, and vehicles means lower energy and transportation bills for residents, businesses, and government.

The Creation/Maintenance of Local Jobs: Red Hook area companies already provide the expertise and many of the products, services, and technologies that will help the area build a sustainable future. Instead of spending money on fossil fuels shipped into New York State, residents can instead support their local economy by purchasing/commissioning energy efficiency and renewable energy projects with local companies. The Town Board should work over the coming years to adopt an economic development strategy that prioritizes sustainability as the key economic engine of the Red Hook area. Because of Red Hook's rural characteristics, efforts should focus on building sustainable agricultural practices and the "greening"[2] of existing businesses.

Improving Social Equity: In addition to including and engaging communities likely to be most heavily impacted by climate change in the implementation of the ECAP projects, Red Hook should work to ensure that these community members have access to energy efficient homes, and accessible, efficient, and low-carbon transportation.

Improving Community Health: Developing neighborhoods that are more likely to be biked or walked, supporting the growth of local fresh foods, and the maintaining clean air will lead to better health for residents. Overall community health has the potential to dramatically affect the economic viability of a community. When residents are healthier and overall incurred medical costs remain low, access to healthcare becomes more equitable.

[2] "Greening" of businesses includes improved building efficiency through renovations and retrofits, adoption of on-site renewable energy installations, and Environmentally Preferred Purchasing in addition to promoting the growth of businesses who provide services and products associated with carbon emissions reduction.

How to use and modify this ECAP in the future:

In 2010, Red Hook's Conservation Advisory Council secured funds to work with a consultant to design a strategy to reduce local carbon emissions 20 percent by 2020, named the 20/20 Goal. The 2012 Energy and Climate Action Plan will guide future efforts by the Town and Villages of Red Hook and Tivoli and their hamlets, and suggest feasible and effective pathways toward the area's transition to a more sustainable future.

As this Energy and Climate Action Plan will report, the Residential and Transportation emissions sectors outlined in the 2009 GHG inventory were the largest sources of energy consumption and GHG emissions for the Town and Villages of Red Hook and Tivoli. The local governments have been active in reducing their own operational emissions: but they could play even more impactful roles in shaping local Town and Village communities by influencing transportation systems and helping individuals make informed decisions about energy use at work and at home. In this way, Red Hook will address the bulk of its total emissions.

This draft of the ECAP should guide the decisions of local governments in the near future. But as they move toward their 20/20 Goal, the document should be modified to address new information and the changing economic, demographic, and natural landscape of the area. In other words, the ECAP is meant to be a "Living Document" and will be most effective if kept up-to-date and relevant.

In order to best inform these adjustments, subsequent greenhouse gas inventories should be conducted to provide continuous data benchmarking and progress tracking of emissions reductions. The CAC and Town Board should take strides now to determine how often GHG inventories should be conducted in the next eight years and initiate plans for identifying researchers, desired data, and also areas of influence not addressed in the 2009 inventory.

The deep coordination and planning required to achieve the 20 percent carbon reduction goal over the next eight years will rely heavily on governments, businesses, community organizations, and local residents both to collaborate extensively *and* to take the initiative in greening their own activities. In this way, Red Hook will be able to achieve its 20/20 Goal and chart a path for future residents to continue along as the Town and Villages approach an eventual zero emissions scenario.

Background: Greenhouse Gases (GHGs) and Climate Change

What are greenhouse gases?

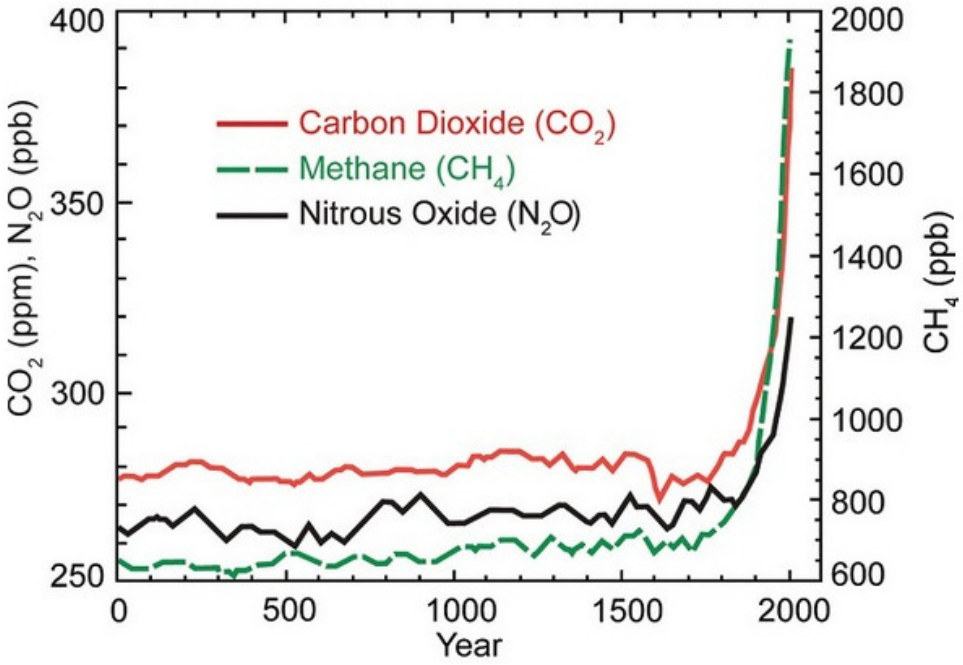
Earth's climate is kept at a suitable temperature for life by the gases of which it is composed. These gases absorb harmful solar radiation (rays from the sun) and heat, and regulate extreme temperatures; life on Earth has evolved to rely on the resulting mild climate and fairly predictable weather patterns. Although Earth's atmospheric makeup and average surface temperature have changed cyclically over long periods of time throughout its history, today we see an unprecedented buildup of these heat-trapping gases and resulting increases in surface temperature. These changes cannot be explained by natural processes.

Gases that trap heat and solar radiation in the atmosphere are called "greenhouse gases" or "GHGs." The most impactful of these gases are carbon dioxide, methane, nitrous oxide, and fluorinated gases. While we need some of these gases to survive, the saying "all things in moderation" applies – when these gases become too abundant, too much of the sun's energy remains trapped in our atmosphere, resulting in unnatural warming of air and surface temperatures. Scientists now refer to this process as "climate change." Climate change is expected to have severe effects on natural and human systems around the globe, hence efforts by towns, cities, and nations to change the human activities that contribute to it.

The more harmful of these human activities is the burning of fossil fuels for energy. Fossil fuels are materials like oil, coal, and natural gas that are made up of the ancient decayed bodies of long-dead organisms, buried deep in the ground for millions of years, and chemically converted to rich substances. Because the bodies of all Earth's organisms are made up of a carbon base, these fossil fuels are carbon rich…making them effective sources of fuel. Unfortunately, when these fossil fuels are burned, all the carbon that was once stored away beneath the earth ("sequestered" carbon) is released as gases into the atmosphere. These gases are the greenhouse gases discussed in this section.

In the mid-1700s, human society underwent a dramatic change. This period, which lasted through the middle of the 1800s is now called the Industrial Revolution. This "revolution" was fueled, in large part, by the invention of new technologies that used fossil fuel combustion to power machines for manufacturing, transportation, and agricultural practices. The efficiency of these machines and the cheap availability of the fossil fuels used to power them resulted in the rapid spread of these technologies around the world and resulting dramatic changes in human lifestyles, including rapid population growth. This positive feedback loop resulted in exponential growth in industry,

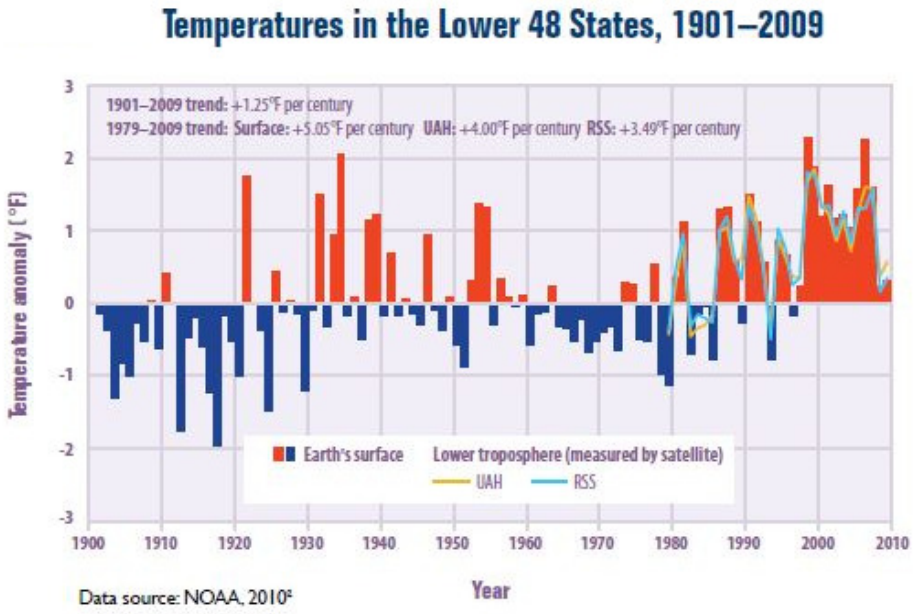
economies, population, and importantly for this report, the emission of GHGs into Earth's atmosphere.



The graph above shows the increase in greenhouse gas (GHG) concentrations in our atmosphere over the last 2,000 years. Those increases since 1750 are due to human activities during and after the Industrial Revolution.[3]

Because scientists can directly trace the rise of carbon levels in Earth's atmosphere, resulting increases in Earth's air and surface temperatures, and the continued development of industrial practices around the globe, the changes to Earth's climate are called "anthropogenic."

The term "anthropogenic" means "generated by humans." "Anthropogenic Climate Change" describes changes to Earth's climate that are directly caused by human activities, primarily the burning of fossil fuels. In contrast, natural climate change, which is slower, cyclic, and more predictable, results from Earth's varying distance from the sun and the changing tilt of the Earth's axis.



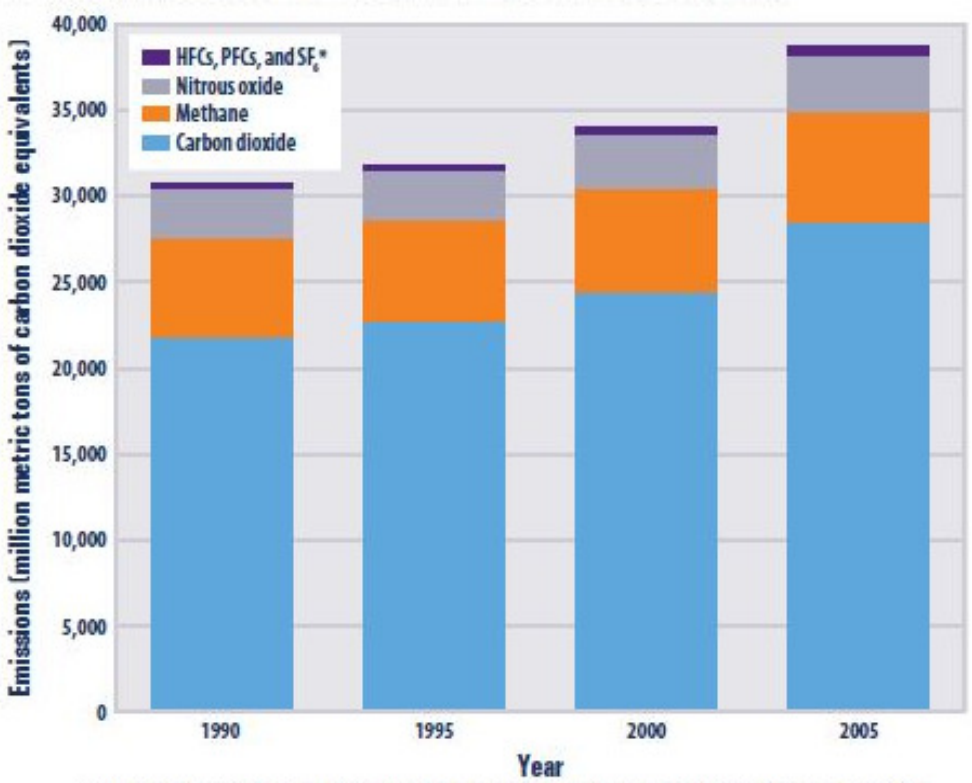
This graph shows changing average temperature trends from 1901 to 2009 in the U.S. using 1901 to 2009 averages as a baseline to depict change. (From Environmental Protection Agency, "Climate Change Indicators in the United States," April, 2010. Pg. 22.)

The GHGs primarily accounted for in most GHG inventories are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (see example below). Others, such as nitric oxide,

[3] "Concentration units are parts per million (ppm) or parts per billion (ppb), indicating the number of molecules of the greenhouse gas per million or billion molecules of air." http://www.epa.gov/climatechange/science/causes.html#greenhouseeffect

nitrogen dioxide, sulfur oxides, carbon monoxide, and volatile organic compounds may be included.

Global Greenhouse Gas Emissions by Gas, 1990-2005[4]



* HFCs are hydrofluorocarbons, PFCs are perfluorocarbons, and SF_6 is sulfur hexafluoride.

Data source: World Resources Institute, 2009[4]

In contrast with the EPA's national GHG inventory, the Red Hook's includes those others, but did not account for fluorinated gases.

The table below displays Red Hook's total, absolute emissions in 2008. This data is *not expressed carbon-dioxide equivalents*[5], another difference with the EPA's national GHG inventory.

Town's & Villages' 2008 GHG & Pollutant Emissions

Pollutant	Symbol	2008 Emissions
carbon dioxide	CO_2	134,627 tons
nitrous oxide	N_2O	9,583 lbs
methane	CH_4	431,835 lbs
nitric oxide & nitrogen dioxide	NO_X	2,407,747 lbs
sulfur oxides	SO_X	328,718 lbs
carbon monoxide	CO	4,439,063 lbs
volatile organic compounds	VOC	557,687 lbs

[4] "Emissions are expressed in million metric tons of **carbon dioxide equivalents**. These totals do not include emissions due to land use change or forestry because estimates are not available for the most recent years." EPA, Climate Change Indicators in the United States, Pg. 12; 2010.

[5] For an explanation of carbon dioxide equivalents, see the end of this section, page 17.

This section will describe the most powerful of these greenhouse gases and why they are building up so quickly in our atmosphere. For each gas, information is provided about its:

a) **Lifetime in the atmosphere**: how long the gas will stay in our atmosphere before natural "**sinks**" **or absorption sources** – such as photosynthesis and permafrost – can remove it.

b) **Global Warming Potential or GWP**: a number assigned by scientists that describes how strongly a gas can affect warming depending on its lifetime in the atmosphere and how powerfully it absorbs the sun's rays. Gases with higher GWP are more harmful in terms of global warming.

Carbon dioxide (CO_2):

Lifetime in atmosphere: 50-200 years

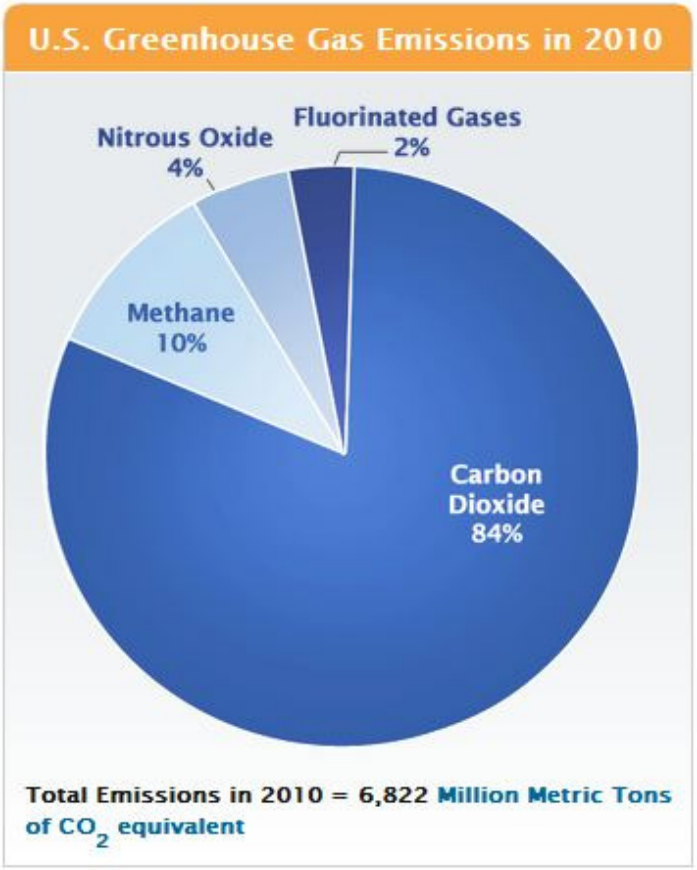
Global Warming Potential: 1

Carbon cycles through Earth's natural systems primarily in the CO_2 molecule through respiration, decomposition, and waste elimination. It also enters the atmosphere through volcanic activity and natural erosion/weathering processes.

However, especially since the beginning of the Industrial Revolution, human activity has begun to contribute never-before-seen levels of CO_2 to the atmosphere every year. These activities include the burning of fossil fuels, the generation and disposal of solid waste, the felling of trees, and also certain chemical manufacturing processes (for example, the manufacture of cement). Carbon dioxide is removed from the atmosphere (or "**sequestered**") when it is absorbed by plants as part of the biological carbon cycle or absorbed by seawater. The speed at which human activity is emitting CO_2 has now

overwhelmed nature's ability to reabsorb it. The result is growing atmospheric concentrations of CO_2[6].

In greenhouse gas analyses and climate action plans, CO_2 is the GHG most targeted for GHG emissions reductions. This is not because CO_2 is the most harmful gas; instead, it is because it is the GHG emitted in the highest volume.[7] However, scientists are now beginning to become more concerned about global methane emissions as well.



[6] http://www.epa.gov/climatechange/ghgemissions/gases/co2.html
[7] Graph from http://www.epa.gov/climatechange/ghgemissions/gases.html

The chart at left[8] is another visual representation of the volume made up by CO_2 compared to total GHG emissions and other GHGs. In 2010, 84 percent of total emitted GHGs was CO_2.

Methane (CH_4):

Lifetime in atmosphere: 12 years

Global Warming Potential: 21

Methane enters the Earth's atmosphere naturally through the digestive processes of animals and bacteria (during decomposition of rotting organic matter) and through volcanic activity. Natural processes in the Earth's air and soil help remove methane from the Earth's atmosphere, and it remains in our air for only about 12 years

[8] http://www.epa.gov/climatechange/ghgemissions/gases/fgases.html

as opposed to CO_2's 50-200 years. However, it traps heat far more efficiently than carbon dioxide, so while it is in the air, its ability to warm the atmosphere is far greater. It is the second most abundant GHG in Earth's atmosphere.

Human activities such as the mining and drilling and transport of coal, natural gas, and oil contribute to the emission of CH_4 into our atmosphere. Additionally, a large portion of our waste sector emissions are in the form of CH_4[9]. Since humans have begun the large-scale domestication of animals for food, animal waste has also contributed to methane emissions over the past 10 thousand years[10].

Furthermore, as a result of global climate change and the warming in regions of the world that are natural "sinks" for carbon, large amounts of methane have begun to be released. For example, in the Earth's permafrost areas (places where soils stay permanently frozen) of the northern latitudes, warming surface temperatures have begun to thaw soils and dead organic materials which then rot and release methane[11]. In fact, the effects of this process are considered such a threat by permafrost scientists in a recent survey, 41 scientists came to a consensus that "if human fossil-fuel burning remain[s] high and the planet warm[s] sharply, the gases from permafrost could eventually equal 35 percent of today's annual human emissions."[12]

[9] http://www.epa.gov/climatechange/ghgemissions/gases/ch4.html
[10] William F. Ruddiman, *Plows, Plagues, and Petroleum: How Humans Took Control of the Climate*; 2009
[11] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch8s8-7-2-4.html
[12] http://www.nytimes.com/2011/12/17/science/earth/warming-arctic-permafrost-fuels-climate-change-worries.html?pagewanted=all

Since methane's GWP is 21 times higher than that of carbon dioxide, allowing this process to continue unmitigated would have severe consequences.

Nitrous Oxide (N_2O):

Lifetime in atmosphere: 120 years

Global Warming Potential: 310

Nitrous oxide is another natural component of Earth's atmosphere, and is contributed mainly by the metabolic processes of microscopic organisms.

However, since the Industrial Revolution and the development of synthetic fertilizers, human activity has been contributing disproportionate amounts of nitrogen to the atmosphere. As evident by nitrous oxide's lifetime in the atmosphere and GWP, artificial

additions of N_2O to the atmosphere have a very strong influence on the greenhouse effect.

The human activity most responsible for the release of N_2O is large-scale agriculture, which accounts for 68% of anthropogenic N_2O emissions[13]. The synthetic fertilizers used on crops and the breakdown of manure and urine from domesticated animals are these agricultural sources.

Transportation and the burning of gasoline in motor vehicles and the incineration of solid waste are the second largest contributors of N_2O. Lastly, industrial processes in manufacturing certain manmade materials such as nylon and synthetic fertilizers also release N_2O.

Fluorinated Gases - Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (HFCs, PFCs, and SF_6):

Lifetime in atmosphere:

HFCs: 1-270 years

PFCs: 800-50,000 years

SF_6: 3,200 years

Global Warming Potential:

HFCs: 140-11,700

PFCs: 6,500-9,200

SF_6: 23,900

Fluorinated gases include hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, and do not have natural sources. They are manmade gases used to replace another kind of gas, chlorofluorocarbons (often called CFCs), that were discovered to have

[13] http://www.epa.gov/climatechange/ghgemissions/gases/n2o.html

severe ozone-depleting effects. They are used in refrigerants, aerosols, solvents, and fire retardants and also in the manufacturing or aluminum products. Although they do not deplete the ozone, HFCs, PFCs, and SF_6 still have an impact on the Earth's atmosphere. They are extremely powerful greenhouse gases. Their GWPs are hundreds to tens of thousands times greater than that of CO_2.[14]

Making smart purchasing choices, cutting back on the use of air conditioners, safely disposing of equipment containing coolant, and recycling aluminum products for reuse are good ways to help cut down the emissions of fluorinated gases.

In order to account for all GHGs and their effects properly, scientists must perform calculations to assign magnitudes of impact to each gas. This number calculated for each gas is called the "carbon dioxide equivalent," or "CO_2e."

CO_2e is calculated by multiplying the weight of the gas being measured by its estimated global warming potential (GWP)[15], discussed earlier in this section. This is why methane (CH_4), while emitted in smaller amounts than CO_2, can produce significant amounts of warming in the atmosphere – its GWP is much higher than that of CO_2.

This report will refer to all of Red Hook's emissions in terms of CO2e, instead of referring to different gases separately.

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[14] http://www.epa.gov/climatechange/ghgemissions/gases/fgases.html

[15] http://www.eia.gov/oiaf/1605/FAQ_Estimating_GWPsA.htm

In 2007 the Northeast Climate Impact Assessment (NECIA) was published to assess the effects of climate change specifically for the Northeast region. This document, entitled "Confronting Climate Change in the Northeast: Science, Impacts, and Solutions" is an excellent resource for Red Hook planners who will be required to look to the future to plan for extreme weather and changing conditions in the Mid-Hudson Valley.

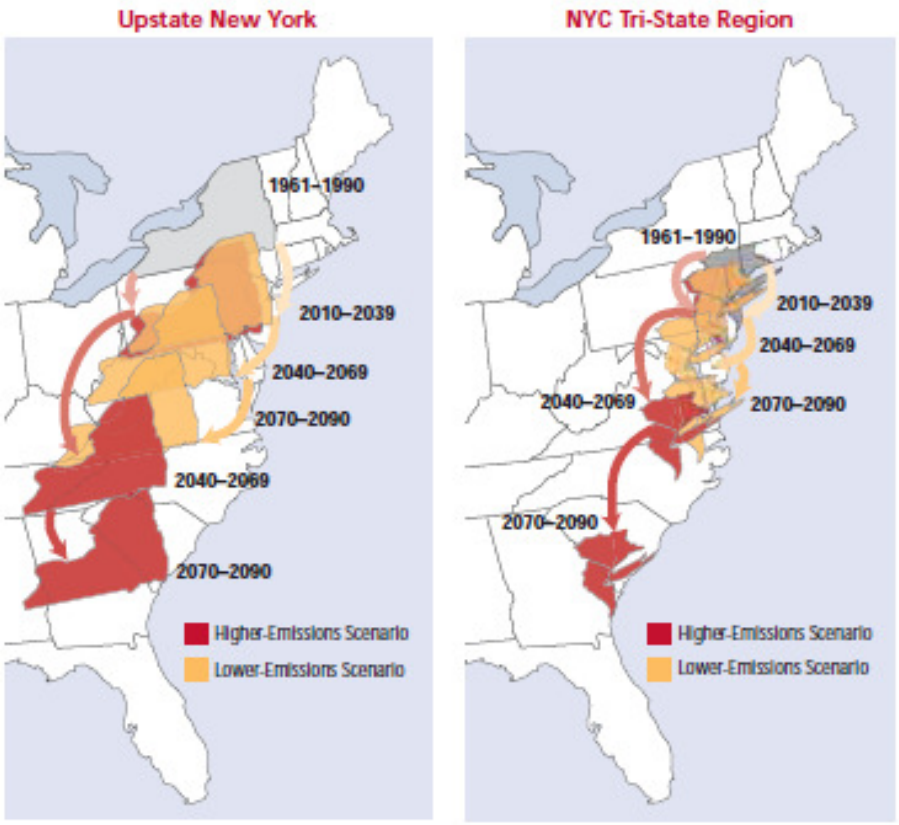
For example, NECIA states that since 1970 this part of the country has been warming almost 0.5 degrees Fahrenheit (°F) per decade. Winter temperatures rose even faster between 1970 and 2000, at a rate of 1.3°F per decade.[16]

Based on work by the Intergovernmental Panel on Climate Change (IPCC), NECIA uses a system of lower- and higher-emissions scenarios to discuss the potentiality of various climate impacts. The scenarios discussed in this document are mostly the high-emissions scenarios. This is because a) global emissions continue to rise unabated, b) there is no current international plan to seriously confront activities that result in these emissions, and c) over-preparing for impacts will help Red Hook to face the smallest possible risk of negative effects on its residents, economy, and lands.

Furthermore, NECIA points out, regardless of the actions we take now, global temperature will rise 2.5°F to 4°F in winter and 1.5°F to 3.5°F in summer over the next several decades due to the greenhouse gases released over the past several decades. As discussed in the greenhouse gas section of this report, many GHGs remain in our atmosphere for tens to tens of thousands of years.

[16] Northeast Climate Impacts Assessment Synthesis Team, "Confronting Climate Change in the Northeast: Science, Impacts, and Solutions"; 2007.

"Migrating Climates"[17]



The graphic at left shows the temperature changes for Upstate and Downstate New York expected under both the lower- and higher-emissions scenarios. Under the lower emissions scenario, Red Hook (approximately at the line separating Upstate and Downstate in these images) will, late in this century, experience average temperatures more like those of eastern North Carolina's were between 1961 and 1990. Under a higher-emissions scenario, Red Hook's average temperatures would be more like those of South Carolina/ Georgia during those three decades.

The itemized list of local impacts to be expected from global climate change in the coming decades follow on the next pages. All impacts are quoted directly from NECIA's impact assessment, cited on the previous page.

[17] United States Global Change Research Program, "Global Climate Change Impacts in the United States"; 2009.

NECIA High Emissions Scenario Impacts	Relevance for Red Hook
Winters in the Northeast could warm by 8°F to 12°F and summers by 6°F to 14°F above historic levels.	Increased energy use, impacts on agriculture, impacts on vulnerable populations.
The length of the winter snow season could be cut in half across northern New York, Vermont, New Hampshire, and Maine, and reduced to a week or two in southern parts of the region.	Impacts on local plant and animal wildlife, the winter recreation economy, groundwater availability.
Short-term (one- to three-month) droughts could occur as frequently as once each summer in the area of the Catskills and the Adirondacks, and across the New England states.	Impacts on agriculture and drinking water supply.
Hot summer conditions could arrive three weeks earlier and last three weeks longer into the fall.	Impacts on growing season, impacts on populations vulnerable to heat.
Global average sea level is conservatively projected to rise one to two feet.	Impacts for coastal populations, including New York City and Boston, with possible repercussions of human migration inland to nearby areas such as Red Hook.

NECIA High Emissions Scenario Impacts	Relevance for Red Hook
The extreme coastal flooding that now occurs only once a century could strike New York City on average once every decade.	Impacts on population migration away from coasts toward inland areas as costs and risks of floods escalate
Climate conditions suitable for maple/beech/birch forests are projected to shift dramatically northward, while conditions suitable for spruce/fir forests—a primary source of sawlogs and pulpwood as well as a favored recreation destination— would all but disappear from the region.	Impacts on tourism
As their forest habitat changes, many migratory songbirds such as the Baltimore oriole, American goldfinch, and song sparrow are expected to become less abundant.	Impacts on ecosystem health, possibility for pest insect infestation
Unless farmers can afford cooling technologies, milk production across much of the region is projected to decline 5 to 20 [percent] in certain months.	Impacts on farmers and supply/price of dairy products
Hotter, longer, drier summers punctuated by heavy rainstorms may create favorable conditions for more frequent outbreaks of mosquitoborne disease such as West Nile virus.	Impacts on human health

NECIA High Emissions Scenario Impacts	Relevance for Red Hook
Weed problems and pest-related damage are expected to escalate, increasing pressures on farmers to use more herbicides and pesticides.	Impacts on agriculture, and human and ecosystem health
Late-century summers in the Tri-State region around New York City could resemble those of South Carolina today under the higher-emissions scenario, and those of Virginia under the lower-emissions scenario.	Impacts on energy consumption and severely increased load on the electrical grid, impacts on agriculture, impacts on heat-vulnerable populations, impacts on natural ecosystems
By late-century, many northeastern cities can expect 60 or more days per year over 90° F under the higher-emissions scenario and 30 or more such days under the lower-emissions scenario.	Impacts on energy consumption and severely increased load on the electrical grid, impacts on agriculture, impacts on heat-vulnerable populations
The number of days per summer over 100 degrees Fahrenheit could increase by late-century to between 14 and 28 days under the higher-emissions scenario and between 3 and 9 days under the lower-emissions scenario.	Impacts on energy consumption and severely increased load on the electrical grid, impacts on agriculture, impacts on heat-vulnerable populations
By the end of the century, winter precipitation could increase an average of 20 to 30 percent, with the greatest increases under the higher-emissions scenario A much greater proportion of winter precipitation would be expected to fall as rain rather than as snow.	Impacts on flood risk, impacts on soil stability, impacts on streamflow in spring due to reduced snow melt

NECIA High Emissions Scenario Impacts	Relevance for Red Hook
Overall, little change in summer rainfall is expected [despite expected increases in temperature], although projections are highly variable.	Impacts on water supply for agriculture
Increases in precipitation intensity of 8 to 9 percent are projected by mid-century, and 10 to 15 percent by the end of the century. In other words, wet days will become wetter.	Impacts on flash flood risk and soil erosion
The number of heavy-precipitation events is projected to increase 8 percent by mid-century, and 12 to 13 percent by the end of the century. So in addition to having more rain when it does rain, there will also be more two-day periods with heavy downpours.	Impacts on flash flood risk and soil erosion, impacts on frequency of severe storms including nor'easters
Increases are also projected for the wettest five day period of each year. By mid-century, 10 percent more rain is projected to fall during these events; by the end of the century, 20 percent more rain is projected.	Impacts on flash flood risk and soil erosion, impacts on frequency of severe storms including nor'easters

A commonly discussed effect of global climate change is the rising of sea levels around the world. Although the Mid-Hudson Valley is not located on a sea coast, rising water levels will still make an impact. The New York Department of Environmental Conservation (NYDEC) reports that the State Sea Level Rise Task Force, in developing recommendations for adapting to sea level rise, used projections below for our region. The DEC considers them the best available projections for planning purposes.

Sea level rise in Red Hook would have an effect on the average water level of the Hudson River and its tributary rivers, kills, and streams, increasing the risk of flooding and the contamination of groundwater used for drinking.

Mid-Hudson Valley & Capital Region	2020s	2050s	2080s
Sea level rise	1 to 4 in	5 to 9 in	8 to 18 in
Sea level rise with rapid ice-melt scenario	4 to 9 in	17 to 26 in	37 to 50 in

"The figures for ***sea level rise*** represent the central range (middle 67%) of values from model-based probabilities (16 global climate models by 3 greenhouse gas emissions scenarios) rounded to the nearest inch.

The figures for ***sea level rise with rapid ice-melt scenario*** are based on acceleration of recent rates of ice melt in the Greenland and west Antarctic ice sheets and paleoclimate studies."[18]

[18] http://www.dec.ny.gov/energy/45202.html

CHAPTER 1: BACKGROUND ON RED HOOK AND TIVOLI

Local Demographics

Before local governments and residents can organize an effective strategy to cut greenhouse gas emissions, it is important to understand the local characteristics of the Town and Villages of Red Hook and Tivoli. Using this information, locally relevant and appropriate plans can be laid out.

Town and Villages of Red Hook and Tivoli		
2005 Population	10,864 People	
Number of Households	**2005**	**2008**
Town of Red Hook	3840 Homes	3877 Homes
Village of Red Hook	765 Homes	765 Homes
Village of Tivoli	487 Homes	487 Homes
Total	**5,092 Homes**	**5,129 Homes**
Number of Homes Built Before 1939	1815 Homes	
2005 Percentage of Homes Built Before 1939	35.6% of Homes	
2008 Percentage of Homes Built Before 1939	35.4% of Homes	
2012 Parcels of Farmland	118 Parcels	
2012 Acreage of Farmland	5008.05 Acres	
2012 Percent Land Area Composed of Farmland	20.2%	

Community Resources in Red Hook

Community stakeholders whose support could enhance the efficacy of public outreach efforts and implementation measures recommended in this ECAP will be invaluable resources to the CAC. A list of these potential supporters has been compiled and attached in Appendix C.

Historically, two active partners for the CAC have been Bard College and Sustainable Hudson Valley. The CAC will be working with these groups in the future to implement energy reduction strategies.

An introduction letter and Certificate of Support have been included in Appendix D for future stakeholder outreach efforts.

The Conservation Advisory Council

The Conservation Advisory Council was formed in 1976 to build a unified front against environmental challenges. The CAC is the group responsible for supporting the development of the first greenhouse gas inventory in 2009 by Bard Graduate Lindsay Chapman. The Town of Red Hook obtained a grant from the New York State Energy Research and Development Authority to commission Red Hook's first Energy and Climate Action Plan under the leadership of the CAC.

In the near future, subcommittees will be named and heads will be assigned. Subcommittees will be designated as deemed appropriate by the CAC to meet the goals of this ECAP.

History of efforts to protect local environment

As the timelines on the first pages of this ECAP highlight, Red Hook has a long history of working to protect its environmental integrity and the beauty and richness of its land and water. Since 1993, many tracts of land have been placed under conservation easement. In 2003 Red Hook passed the Farmland PDR bond initiative of $3.5 million in matching funds for sustainable land use. Additionally, the Community Preservation Plan was adopted in 2007 to guide the usage of Community Preservation Fund monies. The Plan established the priorities for preservation and includes the preservation of farmland as its highest priority. Focus is also given to lands with scenic, recreational, historical and ecological value. This legislation allows the Town of Red Hook to protect its farmland and open space, which is vital to the future social, economic and environmental health of the Town.

In fact, more than 4000 acres have been placed under conservation easement to preserve agricultural lands and open space with the PDR program, the Community Preservation Fund, and landowner donations.

In 2011, the Town passed a smart-growth Centers and Greenspaces Plan, an incentive zoning initiative to concentrate development in and adjacent to the Villages of Red Hook and Tivoli. The Centers and Greenspaces plan was intended to enhance the Town's small town character, with close-knit villages surrounded by rural countryside ("centers and greenspaces"). Its overall vision, based on public input, is to reinforce Red Hook as a rural community, while allowing for a diversity of housing options. The Proposed Action will guide growth into an appropriate center immediately adjacent to the Village of Red Hook and allow for preservation of farmland and open space throughout other areas of the community. The Task Force members responsible for the Town's smart-growth Centers and Greenspaces

Plan received the 2009 Groundbreakers Award from Pace Land Use Law Center.

Effects on greenhouse gas emissions were never a consideration in these actions, but we now have an opportunity to quantify their benefits for helping to mitigate climate change through future GHG inventories and drafts of the ECAP.

In addition to passing the various land protection initiatives, Red Hook has also made strides to connect with the greater global sustainability community, joining the group of towns and cities across the world who have made commitments to environmental protection and climate change mitigation. In 2007 Red Hook joined the International Council for Local Environmental Initiatives (ICLEI)[19], and in 2009, the town joined the New York State Department of Environmental Conservation's (DEC) Climate Smart Communities Program (CSC)[20]. Also in 2009, Red Hook passed a resolution to support New York State's 80x50 Goal (80% carbon reduction by 2050).

Red Hook has also taken action over the past several years to initiate important energy reduction work at the municipal level. This has been an important first step in reducing Red Hook's overall carbon footprint, not only because of the direct emissions reductions that resulted from the work, but also by setting an example for other sectors within the community.

In 2006 the Red Hook Town Hall received an energy audit from NYSERDA, and followed up the audit with a lighting retrofit, the installation of a programmable thermostat, and the weatherization of the building's doors. In 2008 the Town Hall had a 3.7 kW demonstration solar panel system installed on the roof. Then, in 2009, the Conservation Advisory Council (CAC) was awarded over $120,000 from NYSERDA to install the Town Hall's current 23.27 kW system, which once connected to the grid in 2011, would provide approximately half the Town Hall's electricity, and a 1.8 kW system on the Recycling Center's roof.

In 2010, the recycling center also installed a solar array. In 2012, the firehouse installed a 38.77 kW ground-mounted system.

The town passed an amendment to the Building Code in 2009 to require all new residential construction to meet ENERGY STAR® ratings[21].

Also in 2009, Red Hook initiated the performance of its first Greenhouse Gas Inventory, performed by Bard Graduate Lindsay Chapman. This was an essential first step in moving forward with an effective carbon reduction plan, as it established a baseline emissions profile for the Town and Villages and allowed for the later drafting of a climate action plan, which was begun in 2010 with the hiring of a consultant.

[19] http://iclei.org/index.php?id=about
[20] http://www.dec.ny.gov/energy/50845.html

[21] "ENERGY STAR certified new homes must meet strict energy efficiency guidelines set by the U.S. Environmental Protection Agency. These homes are independently verified to be at least 15% more energy efficient than homes built to the 2009 International Energy Conservation Code (IECC), and feature additional measures that deliver a total energy efficiency improvement of up to 30 percent compared to typical new homes and even more compared to most resale homes." http://www.energystar.gov/index.cfm?c=new_homes.hm_index

Red Hook has also begun the very important work of public outreach to bring the goal of carbon reductions and energy saving into community sectors outside the municipal government. In 2010, Red Hook became the pilot community for the 10% Challenge, a local initiative headed by not-for-profit organization Sustainable Hudson Valley. The goal of the campaign was to involve 10 percent of the community and achieve a 10 percent overall energy use reduction. Between October 2010 and October 2011, Red Hook's electricity use decreased by 3 percent. Although this is a smaller result than hoped for, it is still a decrease, and experiences throughout the first year of the campaign were excellent learning opportunities for future public outreach efforts. Red Hook plans to continue the 10% Challenge into the future partially as a mechanism for connecting with the public about the goals of the ECAP.

From 2005 until the present, Red Hook has hosted a variety of workshops including those for local businesses about energy efficiency programs, about the New York ENERGY STAR® program, and about the Property Assessed Clean Energy (PACE) financing program. The Town also co-hosted an Energy Technology Seminar at Bard College with the New York State Energy Research and Development Authority (NYSERDA) to assist local builders in accessing NYSERDA credit programs in 2005.

Effective community outreach will be key to the success of this ECAP and continued efforts should be made to support initiatives such as the 10% Challenge campaign.

Natural Resources in Red Hook

A Focus on Water

Given the impacts of climate change on our natural and man-made hydrology – enumerated in the table on pages 79 and 80 in Chapter 4: Preparation for Climate Change (Adaptation) – it becomes all more necessary to put in place and, over time, adapt policies and practices which will insure the health and longevity of our ground and surface water bodies.

The Town and Village of Red Hook draw sustenance from a relatively small, centrally located, area of sand and gravel deposits formed during the retreat of the most recent glaciation, approximately 11,000 before present (BP). These deposits, underlying portions of the Village and Town, fed by precipitation, snowmelt and onsite septic systems, are rich in potable water, and comprise an aquifer. Underlying these deposits is a fractured bedrock layer, which is also rich in potable water, comprising a second aquifer. In Red Hook, the groundwater travels freely between the unconsolidated upper layer and the deeper bedrock layer. From this we can conclude that all surface contaminants in the recharge area will reach the sand and gravel aquifer, and then the bedrock aquifer below it, thus compromising our drinking water supply.

With climate change we can expect to see an annual increase in 90+ and 100+ degree days, and a change in precipitation patterns in which periods of little or no rain (short term droughts) are interspersed with rain events of greater intensity (storms), than those we currently experience on average. This scenario leads to increased risk of flooding because upper soil layers, hardened and impacted during hot, dry periods, are unable to absorb the larger volume of the storm

water flows. An increase in temperatures, dry periods, storm water flows and flooding creates the right conditions for an increase in contaminants in our ground and surface water bodies, as groundwater recharge from onsite septic systems experiences less dilution, and larger storm water flows carry greater contaminant loads due to their intensity and the longer period between precipitation events. Floodwaters also carry higher contaminant loads, and can foul surface water bodies prior to infiltrating the upper soil layers.

It is therefore imperative that Red Hook adopt appropriate water resource protection to mitigate the impacts of climate change.

We recommend the adoption of an aquifer protection overlay (APO) in the Town and Village of Red Hook and the Village of Tivoli, which will delineate various zones within the central aquifer area, according to each soil type's capacity to absorb and release groundwater in the soil pores (hydrologic conductivity). Within the APO, permitted land use activities will be determined according to the importance of a given parcel's soils to aquifer recharge, parcel size, and contaminant potential. This measure will ensure adequate recharge to the central aquifer area, and decrease the potential for contamination. This is vitally important now, even before we experience the greater impacts of climate change, and even more so in the face of changes to aquifer recharge due to changing weather patterns, an increase in the number and size of onsite septic systems within the municipality, and an increase in impervious surface cover, such as parking lots, roads, driveways and roofs.

The implementation of LID (Low Impact Design) for as much of the impervious surface cover as possible, especially in and around the Village of Red Hook, ensures the containment, infiltration and filtering of storm water flows. This will have the benefit of decreasing erosion and other damage caused by flooding, lowering contaminant loads in the storm water flows, and converting the storm water flows to recharge in the central aquifer area. The plantings used in LID mitigate temperature extremes, rather than exacerbate them as do currently used impervious surface covers (asphalt, cement, roofing materials). A plan for increasing appropriate plantings in flood prone areas will mitigate the impacts of increased flooding. For example, it is well known that the turf used in a typical lawn is quite impervious. The Town could establish a program for encouraging property owners to replace it with other plants that allow for better infiltration, in order to mitigate flooding impacts. The plantings used in LID and flood management also capture carbon from the atmosphere.

A watershed protection plan for the Town will secure our water resources for both the built and natural environments, and will help mitigate the impacts of climate change.

A Focus on Farms

The farms of the larger Dutchess County area offer a diverse array of agricultural crops and products including: tree fruits, berries, grapes, vegetables, grains, biofuel crops, maple syrup, dairy, meat, poultry, eggs, bedding materials, garden plants, Christmas trees, and horses. In the Town and Villages of Red Hook and Tivoli, local farms produce a similarly rich variety of products; agriculture is a defining characteristic of this area, and while emissions estimates for agricultural land use are difficult to establish, these should be

examined more closely in future GHG inventories and iterations of the ECAP.

In 2007, there were 656 farms in Dutchess County; today, the Red Hook area contains 118 parcels of farmland totaling over 5000 acres and 20 percent of total land area. Additionally, there are approximately 100 horse farms in Dutchess County, several in the Red Hook area. Interestingly, Dutchess County now ranks first in New York State for both the number and sales value of horses and ponies. This has clearly contributed to the "dramatic 41 percent increase in the overall market value of agricultural production in Dutchess County from $31,712,000 in 2002 to $44,866,000 in 2007." The land use impacts of raising horses must be examined in order to discern how Red Hook's horse farms influence the agricultural sector's emissions.

In 2006, New York Governor George Pataki launched a $20 million program as part of a larger initiative to reduce the state's dependence on imported energy. The initiative aimed to help the farm economy by promoting new business opportunities in alternative fuel production, specifically switchgrass, a native grass crop which can be processed to produce ethanol. A cost-benefit analysis of this program should be undertaken in coordination with Cornell Cooperative Extension of Dutchess County which administered test sites for switchgrass cultivation.

Continuing to protect existing farm land around Red Hook will have positive effects on the community, especially during an era affected by natural and social changes brought about by climate change. The economic benefits are as follows:

- Agricultural lands use fewer services per acre than residential developments[22], so the cost of services are less likely to escalate.[23]

- Family farms return 60-70% of their revenues to the local economy.

Working to preserve farm land and to keep Red Hook's farms productive will also help secure Red Hook's access to food resources in the event of severe food shortage/price inflation resulting from global climate change .[24]

[22] http://www.farmlandinfo.org/documents/27757/FS_COCS_11-02.pdf

[23] Agriculture is more likely to incur greater risk as a business industry in coming decades if severe weather intensifies. In the future, balancing the existing farming sector with other economic engines, such as a robust service sector, could help to establish a more stable whole economic framework.

[24] Dutchess County agricultural data taken from http://www.ccedutchess.org/aghort/agriculture and http://www.co.dutchess.ny.us/Business/BUSagrindex.htm

CHAPTER 2: MAJOR EMISSIONS BY SOURCE AND LOCAL SECTOR

LOCAL SECTOR EMISSIONS BREAKDOWN AND ANALYSIS:

The 2009 greenhouse gas inventory included the following sector breakdown: Government Operations, School District, Waste, Commercial, Bard College, Residential, and Transportation. The following graphic shows the percentages of total emissions represented by each sector.

Sector	Total Tons CO2e
Gov. Operations	755
School District	2,791
Waste	3,488
Commercial	8,334
Bard College	16,571
Residential	45,929
Transportation	57,672
Total	**135,540**
20% Reduction	**108,432**

The table at left shows the 2005 emissions by ton CO_2e from each sector. The bottom row shows the resulting total emissions after a 20 percent reduction. Some sectors will be more feasible to work within to achieve reductions. Sectors with larger overall emissions offer much greater room for improvement and opportunity for greater total reductions.

For example, initiatives focusing on Residential reductions may be able to achieve much greater overall reductions than efforts focused within the Waste sector. Even if 100 percent of all emissions from Waste were abated, the total emissions reductions would only be 2.6 percent. On the other hand, if the Residential sector emissions were reduced by only 30 percent, this would achieve a 10.2 percent overall reduction. This is because the Residential sector likely offers many "low-hanging fruit" reductions opportunities, such as home energy efficiency, that could be achieved with little or no financial input from the Town. However, within the Waste sector, one of the greatest "low-hanging fruit" opportunities – recycling – has already been partially implemented.

Table: Additional Perspectives on Major Emissions Sources

Red Hook		US	
Carbon Emissions per Person	12.5 tons/year		
Estimated Miles Driven per Year per Person	10,768 miles/year	Average Miles Driven per Year per Person	9,332 miles/year
Estimated Miles Driven per Day per Person	29.5 miles/day	Average Miles Driven per Day per Person	25.6 miles/day
Estimated Gasoline Consumed per Year per Person	533 gallons/year	Average Gasoline Consumed per Year per Person	461 gallons/year
Estimated Gasoline Consumed per Day per Person	1.5 gallons/day	Average Gasoline Consumed per Day per Person	1.3 gallons/day
Electricity Used per Year per Person	3,566 kWh/year		
Electricity Used per Day per Person	9.8 kWh/day		
Fuel Oil Consumed per Year per Person	232 gallons/year		
Fuel Oil Consumed per Day per Person	0.6 gallons/day		

The table above offers additional perspectives on the sources of Red Hook's major emissions. "Carbon Emissions per Person" accounts for Red Hook's absolute total carbon emissions as reported by the 2009 GHG inventory divided by its 2005 population. Otherwise, this table focuses on Residential energy use only, and fuel use in the Transportation sector, because, as evident from the sector emissions breakdown charts on the previous page, the majority of Red Hook's emissions come from these two sectors. A breakdown of US averages for transportation has been provided next to Red Hook's averages[25]. In 2005, Red Hook residents drove more than the average American and used more gasoline per year[26]. This is likely due to Red Hook's rural nature and lack of public transportation options.

The table on the following page (green) is a further breakdown of the various types of fuel used by residents in Red Hook. Electricity and fuel oil are the most widely consumed fuels in Red Hook's homes. A breakdown of the tons of CO_2e emitted per unit consumed for each fuel type follows.

[25] Red Hook's transportation data has been calculated using Vehicle Miles Traveled for Dutchess County as a whole, divided by Red Hook's population.
[26] Based on estimates for annual U.S. VMT and average U.S. vehicle fuel efficiency from 2005. Data from the U.S. Department of Energy's Alternative Fuel Data Center (AFDC), http://www.afdc.energy.gov/data/tab/vehicles/data_set/10307

Fuel Use per Fuel Type					
	Unit	Tivoli	VRH	TRH	Totals
Electricity	kWh	6,098,518	6,877,886	25,766,149	**38,742,553**
Fuel Oil	Gallons	201,608	373,230	1,951,004	**2,525,842**
Natural Gas	Thousand Cubic Feet	325	130	3055	**3510**
Residential Coal	Tons	5	23	27	**55**
Stationary LPG	Gallons	27,612	10,620	115,404	**153,636**
Wood 12 pct Moisture	MMBtu	725	857	3561	**5,143**

Tons CO2e	per
0.000412	kWh electricity
0.0113	Gallon fuel oil
0.00006	Thousand Cubic Feet natural gas
2.48	Ton coal
0.0064	Gallon stationary LPG
0.00871	MMBtu wood
0.00892	Gallon gasoline

Building energy fuel emissions calculations performed based on ICLEI's CACP software outputs; gasoline emissions calculated using equation from the EPA (see Appendix A).

Tons CO_2e per Source					
	Unit	Tivoli	VRH	TRH	Totals
Electricity	Tons CO2e	2,511	2832	10,611	15,954
Fuel Oil	Tons CO2e	2,282	4225	22,085	28,592
Natural Gas	Tons CO2e	20	8	184	212
Residential Coal	Tons CO2e	12	57	67	136
Stationary LPG	Tons CO2e	178	68	744	990
Wood 12 pct Moisture	Tons CO2e	6	7	31	44
		5010	7198	33,721	**45,929 tons**

The table at left shows CO_2e emissions per fuel source. Most of Red Hook's Residential emissions come from electricity and fuel oil consumption. In fact, although the total units of fuel oil consumed were far fewer, a much greater percentage of Red Hook's Residential carbon footprint in 2005 came from fuel oil as opposed to electricity (despite fuel oil's higher efficiency per unit). This indicates an opportunity for significant emissions reductions by replacing oil-burning furnaces with renewable heating installations such as solar thermal or geothermal.

CHAPTER 3: MAJOR EMISSIONS SOURCES ADDRESSED IN THIS REPORT AND OPPORTUNITIES FOR REDUCTIONS

HOW THIS CHAPTER IS ORGANIZED:

To put the Town and Villages of Red Hook and Tivoli on track to reach the 2020 goal of an 20 percent reduction in carbon emissions, this document targets four areas of concern – already discovered or potentially major sources of emissions. It then notes general goals to consider within each area, and lists suggested actions or strategies intended to achieve incremental steps over the next eight years toward completing this goal.

The accompanying actions are not intended to be an exhaustive list of every effort that Red Hook could undertake to achieve the 20/20 Goal. Rather, the actions identified here are those with highest priority based their ability to achieve emissions reductions simultaneously with improving the Red Hook community's character, health, and preparedness for climate change.

While the Town and Villages' local governments will have a major, direct role in carrying out many of the following goals and actions, successful implementation will require many diverse partners, including not-for-profit and other community organizations, business leaders, neighborhood associations, and individual residents.

The areas of concern, or emissions sources, are grouped into the following sections with their respective goals and suggested actions:

Energy (Consumption by Buildings and Infrastructure)

Town Planning and Mobility (Transportation)

Solid Waste

Land Use, including:

Forestry Management

Food and Agriculture

The goals and actions were suggested based on their ability to fulfill the following:

Emissions reductions: Red Hook must work to ensure significant strides are made each year to build up to a 20 percent emissions reduction by 2020. General suggestions have been listed in this chapter to fulfill the various goals noted for each area. First, though, some quantitative measures have been outlined to give planners an estimate of the magnitude of emissions reductions that should be expected from various actions. These measures/achievements are

meant to be used as examples, or guidelines for future actions. Since quantitative measures are generally more available in the categories of **Energy** and **Town Planning and Mobility**, the specific measures listed focus on those emissions sources.

The numbers used in the emission reductions calculations are sometimes best estimates; this means some numbers may have been extrapolated based on past trends, particularly the transportation estimates.

The table outlining these quantifiable actions/achievements appears on the following page. It does not include many of the measures that could have significant impact on emissions reductions, such as the installation of other renewable energy systems like geothermal and solar thermal systems. Those measures could be considered to be part of the improved general energy efficiency rates for residences and businesses.

In the future, the CAC should work with experts to develop a more systematic approach to inventorying emissions that attempts to account for full lifecycle emissions for products and practices.

Community benefits: Although the Town and Villages must take some actions with results exclusively based on emissions reductions, actions that also generate strong community benefits, such as local jobs, public health, and neighborhood livability should be prioritized.

While Emissions Reductions are more easily quantified than Community Benefits, the latter will be very important to improving the livability of Red Hook as it takes actions to reduce emissions. Some of the actions associated with the Community Benefits criterion reflect large-scale, long-term behavioral or cultural changes that are foundational to achieving meaningful climate action goals, and are not necessarily measurable.

Despite this, their importance should not be discounted – cultural change around an issue can be every bit as powerful as a technological or infrastructure change.

Some of the suggested actions within the emissions sources sections will be appropriate for all or many sectors of the Red Hook Community (such as energy audits for buildings), and others will be actions limited to specific sectors (such as adopting a school bus fleet that runs on biodiesel fuel).

The ends of the Energy and Solid waste sections provide overviews of and case studies on the following renewable technologies:

Geothermal (Energy)
Solar Thermal (Energy)
Passive Solar (Energy)
Solar Electric (Energy)
Small Wind (Energy)
Anaerobic Digestion (Solid Waste)

Detailed information on these technologies is provided in Appendix E.

The table on the following page outlines several hypothetical or already planned measures in various sectors that Red Hook could implement to achieve portions of its 20/20 Goal. Some are merely examples of total reductions that could result from specified participation levels: for example, improved energy efficiency in the Commercial and Residential sectors.

Sector	Total Tons CO2e per Sector	Tons Reduced per Hypothetical Measure	% Reduction for Sector	% Red. Of Total
Gov. Operations	755		0	0
School District	2,791	**759** (All schools replace 100% of electricity needs with solar electric)	27.00%	0.56%
Waste	3,488	n/a*	0	0
Commercial	8,334	**666.7** (40% businesses improve overall efficiency by 20%)	8.00%	0.49%
Bard College	16,571	**1,002** (Completed/ Commissioned GHG reduction projects)**	6.70%	0.74%
Residential	45,929	**1,596.2** (10% households replace 100% of electricity with solar electric)	3.50%	1.20%
		3,674.2 (40% other households improve overall efficiency by 20%)	8.00%	2.70%
Transportation	57,672	**16,634.9** (Reduce driving to 20 miles/day/person)	28.80%	12.30%
		17,223.5 (Improve average fuel efficiency to 25 miles per gallon)***	29.90%	12.70%
		1,153.4 (2% pop. buys 100% elec. vehicle)	2.00%	0.85%
Area-Wide	135,540	**2,004** (Solar farm constructed, producing 3 million kWh electricity/year)****	1.20%	1.20%
Total	**135,540**			**33.10%**

*Do not have data on rates for various disposal methods

**Based on information regarding Bard College's GHG reduction goals and plans from Laurie Husted and Daniel Smith, Energy Efficiency Coordinator at Bard College.

***Based on 2005 Fuel Efficiency estimate from AFDC (20.2 mpg) (http://www.afdc.energy.gov/data/tab/vehicles/data_set/10307)

****Assumed: production capacity of solar array would scale in a linear fashion; since Bard's proposed 1 MW array will produce 1.5 million kWh, a 2 MW array would hypothetically produce 3 million kWh. This is likely not realistic. Consult solar installer. To remain consistent in this assumption, Bard's estimate for tons CO2e emissions avoided / kWh was used to calculate emissions tons avoided from the theoretical community solar array. Bard's estimate is 0.000668 tons per kWh, while ICLEI's is 0.000412.

ENERGY
(CONSUMPTION BY BUILDINGS AND INFRASTRUCTURE)

Buildings are some of the largest contributors to carbon emissions in the Town and Villages of Red Hook. The two changes that will reduce carbon emissions from building energy use are the improvement of building energy efficiency, and the increased adoption of non-carbon-emitting energy installations. These renewable energy sources are discussed at the end of this chapter and include solar, wind, geothermal, and biogas technologies.

In the Northeast United States, despite abundant hydropower[27] and nuclear power, nearly 36 percent of all electricity is from petroleum, natural gas, and coal sources. On-site solar power generation has spread more rapidly in recent years, but in 2009 solar and wind still provided less than three percent of all electricity (see Table at right).

Although hydropower and nuclear generation do not emit carbon like the burning of coal and natural gas, they still have environmental impacts including the disruption of natural water habitats (via dam building) and the risk of nuclear contamination which could harm humans and the natural environment alike.

2009 Electrical Generation

U.S.	New York	Energy Source
1%	2%	Petroleum
23%	26%	Natural Gas
20%	27%	Nuclear
45%	8%	Coal
7%	18%	Hydropower
4%	19%*	Other

*19% includes net imported electricity (16%), wind (1%), and other renewables (2%)

Source: NYSERDA, Patterns and Trends, 2011

Data table from Energy at Home, NYSERDA 2010/11, page 5.

The Public Service Commission (now unwasteNY), the New York State Energy Research and Development Authority, and governor Andrew Cuomo already have initiated or undertaken important projects to increase energy efficiency and to decrease energy-related carbon

[27] The U.S. Energy Information Administration reports that New York produces more hydropower than any other state east of the Rocky Mountains. (Energy at Home, NYSERDA 2010/11, page 3)

emissions in New York State. In fact, New York State ranks 51st of U.S. States (including the District of Columbia) in total energy consumption per capita. This ranking could be partially attributable to New York City's massive public transportation network[28]. However, much work remains to be done especially in small towns and villages outside the major New York City metropolitan area that lack such efficient transportation infrastructure, and it will be important in this and future drafts of the ECAP to acknowledge this limitation brought about by the rural characteristic, small size, and low population of the Red Hook area.

However, Red Hook does have the uncommon ability to take advantage of local assets for renewable energy generation. The Hudson Valley is home to a large number of local and national solar panel installers and solar-powered equipment manufacturers; encouraging building owners to purchase or lease solar or other renewable equipment from local companies not only will play a role in emissions reductions, but also will be a boon to the local economy.

Additionally, Red Hook residents, business owners, and governments have the opportunity to access programs heavily subsidized by the state and offered through the New York State Energy Research and Development Authority (NYSERDA) to purchase and install solar arrays and wind turbines.

Renewable energy installations are only one way building energy consumption should be addressed. **Energy efficiency should be the cornerstone of any effort to reduce building emissions, both from existing structures and new construction**. Over 35 percent of the residential homes in the Town and Villages of Red Hook and Tivoli are over 76 years old, and new residential construction has been relatively slow in recent years. Because of Red Hook's Conservation Easement Program, Community Preservation Fund, and smart-growth Centers and Greenspaces Plan[29] it is likely that as the Town and Village populations increase over the years, purchases of existing homes will be more frequent than the building of new ones. In fact, the U.S. Department of Energy predicts that for the U.S. as a whole, more than half the buildings that will be standing in 2050 already exist today[30].

Red Hook has already instituted a Building Code requirement for all new residential construction to meet the ENERGY STAR® rating, but since so many current and future residents live and are likely to live in already extant homes, the Town and Village governments must consider how to encourage voluntary (or enforce required) building performance and energy efficiency work in existing buildings. This could be done on a graduated schedule to allow extra time and resources for owners of the oldest buildings.

Finally, energy efficiency projects can be more financially feasible to building owners and are possible for every building, while not all buildings are suitable for some kinds of renewable energy installations, especially solar and wind. For locations with feasibility for renewable energy installations, ensuring that buildings are

[28] Energy at Home, NYSERDA 2010/11, page 4.

[29] More than 4,000 acres have been placed under conservation easement to preserve agricultural lands and open space using the PDR program, the Community Preservation Fund, and landowner donations. (Brenda Cagle, email 6/26/12)

[30] U.S. Department of Energy, Annual Energy Outlook 2009, Supplemental Tables 82 and 98.

working at optimal efficiency for drawing power can significantly reduce the cost of these systems.

Because building efficiency projects are likely to be more widespread compared with the purchase of renewable energy systems, and because building efficiency is a recommended first step before installing such systems, **Goals 1** and **2** focus on energy efficiency. Goal **1** calls for improvement of energy efficiency for *existing* buildings, while **Goal 2** calls for all *new* buildings to maximize energy efficiency. In conjunction with these improvements to existing buildings and new construction, **Goal 3** calls for an increased amount of energy to be provided by clean renewable sources, focusing on small-scale, on-site installations. **Goal 4** works to prepare building and infrastructure construction projects to be adaptive to a changing climate.

ENERGY 20/20 GOAL 1

Improve existing building energy efficiency. The table at the beginning of this chapter shows that if 40 percent of businesses and 40 percent of households improve energy efficiency by 20 percent, approximately 3.2 percent of total emissions reductions would be achieved.

By 2020, some new buildings will have been built that will consume less energy compared to today's buildings. However, because it is likely that the majority of the buildings that will exist in 2020 are in place today[31], aggressive efforts to retrofit existing buildings with energy-saving measures must be undertaken.

Suggested Actions:

1) Work with state and regional organizations (and establish Red Hook-based outreach coordinators group) to provide information and easy access to free and reduced-cost programs, grants, and low-interest financing to residents, businesses and not-for-profits, the school district, and municipal groups for energy performance improvements[32].

2) Work with these organizations to promote behavior changes for occupants of homes and commercial buildings to improve energy savings.

3) Phase in a requirement for energy performance ratings (home energy audits) to be included in the transfer of all homes and buildings for the benefit of owners, tenants, and prospective buyers.

4) Phase in requirements for energy performance benchmarking for all commercial and multi-family buildings.

5) Establish a business tax credit for installing solar panels and other renewable systems like geothermal.

[31] For example, the charts in the Red Hook demographics chapter show that new home building is very slow and that most homes in Red Hook are a number of decades old.

[32] A list of these programs offered by NYSERDA and PACE is provided in Appendix E

ENERGY 20/20 GOAL 2

Strive for zero net greenhouse gas emissions in all new buildings and homes.

First, addressing building efficiency in the initial building design stage is preferential to building conventional structures and retrofitting them later for energy efficiency. When buildings are designed and built with a focus on high performing energy efficiency, they are likely to much more effectively minimize energy consumption than existing buildings that have been retrofitted. Red Hook has already instituted specifications in the Building Code to require new residential buildings to meet ENERGY STAR® requirements.

Second, Red Hook may explore co-generation of electricity and heat. In co-generation, the heat by-product of electricity generation is used to warm buildings. Co-generation also complements solar installations as a renewable energy sources, with solar electricity available in the summer and co-generated electricity and heat in the winter.

Suggested actions:

1) Extend existing Building Code specifications requiring ENERGY STAR® rating to include all new building projects, not just residential ones. Require all non-residential new construction projects to access NYSERDA's New Construction program[33].

2) Adopt or help owners identify already existing incentives for high performance new construction projects.

3) Initiate efforts to interface with residents, contractors, designers, and builders for information and assistance on green building design.

4) For larger institutions such as the Red Hook school buildings and Bard College, Idea: Explore co-generation whenever major changes to building infrastructure are planned.

ENERGY 20/20 GOAL 3

Produce more energy within the Town and Villages of Red Hook and Tivoli from on-site renewable sources. The table at the beginning of this chapter shows that if all three schools replaced all electricity needs with solar electric, 10 percent of homes replaced all electricity needs with solar electric, and the town produced 3 million kWh of electricity each year with solar electric, the total emissions reduction would be approximately 3 percent.

To meet higher demands for energy associated with a growing population without increasing carbon emissions, Red Hook will need to initiate more and larger renewable energy projects. Some of these projects might take the form of municipal-scale wind farms or solar facilities. It will be up to the Town and Villages to decide what is feasible depending on budgetary limitations and zoning. Smaller scale on-site renewables, such as those currently installed at the Town Hall, recycling center, and firehouse also provide opportunities for clean electrical generation gains. Currently, solar technology has not advanced enough to make disconnection from the main electricity grid feasible – the current intermittency of solar power and

[33] New Construction Program overview: http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Programs/New-Construction-Program.aspx

Suggested actions:

1) Make an investment fund available to finance community-scale renewable energy installation.

2) Facilitate the installation of at least 2 megawatts of on-site solar energy.

3) Investigate solar leasing and/or power purchase agreements (PPAs) for large-scale solar installations, and how to distribute the power and refund local investors for the electricity produced.

4) Organize outreach events to inform the public about the strong incentives offered by New York State to purchase renewable energy systems for homes and businesses. Partner with local outreach organizations to organize and implement these events

ENERGY 20/20 GOAL 4

Prepare buildings for the effects of our changing climate, including higher temperatures and more severe storms with stronger winds and greater rainfall.

In addition, buildings must be able to cope with the possibility of rising energy prices by minimizing their need to draw power from the grid. Newly constructed buildings should be built on an axis to optimize cross-breezes for cooling and angles for rooftop solar arrays. Windows should be installed on the coolest/shadiest sides of buildings. Additionally, building shells should be built more robustly or reinforced in order to withstand strong winds and rains from amplified storms.

Suggested actions:

1) Amend Building Codes to encourage new building construction to anticipate the need for adaptation to the adverse effects of a changing and unpredictable climate.

2) Encourage the retrofit of existing buildings to reinforce roofs and insulation for both safety and comfort.

3) If not already in place, recommend protocol to prevent new building construction in flood plains.

RENEWABLE TECHNOLOGIES FOR BUILDINGS

Geothermal Heat Pumps

Geothermal heat pumps (also called GeoExchange, earth-coupled, ground-source, or water-source heat pumps) are not a brand new technology; in fact, geothermal heat pumps have been used since the late 1940s.

These heat pumps use underground or underwater temperatures – which remain constant throughout the year – to heat buildings in winter and cool them in the summer, and can also be used to heat water. Because underground temperatures are more consistent than those of outside air, geothermal systems reach higher efficiencies (300 – 600 percent) on even the coldest winter nights, compared to the efficiency (175 – 250 percent) of air-source heat pumps on milder cool days.

Approximately 50,000 geothermal heat pumps are installed in the United States every year.

Some of New York State's incentives: [34]

**There currently are no NYSERDA programs to specifically incentivize geothermal heat pumps, but they may be considered an eligible home performance measure within the Home Performance with ENERGY STAR® and Assisted Home Performance with ENERGY STAR® programs*[35]*. In these programs, participants can receive up to 10 percent or 50 percent off the total cost of efficiency measures, respectively. If a heat pump is installed as part of this work, the cost of the heat pump will be included in the total cost of the efficiency measures. However, the AHPwES 50 percent rebate is capped at $5,000 for single family homes.*

- PACE Financing loans up to 10% of total property value for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors
- Energy Conservation Improvements Property Tax Exemption of 100% of the value added to residence
- financing through Home Performance with ENERGY STAR®[36] program

[34] Refer to this webpage for more information on rebates and incentives for renewable energy and energy efficiency: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=0&state=NY

[35] http://www.nyserda.ny.gov/en/Page-Sections/Renewables/Geothermal-Heat-Pumps.aspx

[36] http://www.nyserda.ny.gov/en/Page-Sections/Residential/Programs/Existing-Home-Renovations.aspx

Case Study: Geothermal Heat Pump System:

The Collet home in Red Hook, purchased in 1999, is a conventional 2-story, 2,600 square foot modern house that was consuming 1100 gallons fuel oil for heat and hot water per year. In September, 2005 (after significant insulation work was done in ceilings between the bedrooms and the attic) the Collets had a geothermal heat pump installed.

The system is a standing column open-loop system, and recycles water back into the domestic water well. It extracts heat out of the well in winter and drives heat out of the house in summer. Although most people think of heat pumps as utilities to heat homes in winter, Denis Collet points out that their use for cooling homes is typically understated in the Northeast, especially now that the region is moving toward more severe weather patterns due to climate change. In hot weather, the system returns heated water from the interior of the house to the well to cool, where it is usually only about 70 degrees even during 100 degree weather. It is therefore much more efficient than a conventional forced air cooling system which in such weather has to work much harder to pump hot air from the house back out into the outside 100 degree air.

The family is able to use the geothermal system for 95 to 98 percent of its heating requirements in winter. Occasionally with very cold weather the system's thermostat must switch over to turn on the oil furnace as a supplement. They have gone from using 1,100 gallons to 200 gallons of oil per year, which mostly goes toward their hot water use.

Geothermal System Breakdown:

- Installed in 2005.

- Standing column, open-loop system with discharge into domestic water well.

- Provides 95 – 98 percent of home's heat in winter.

- Has reduced annual fuel oil use by 900 gallons.

- Family has saved $21,466 in fuel oil since installation.

- System will pay itself off by approximately 2014.

Solar Thermal (Active Solar Heating)[37]

Solar Thermal (also called Active Solar Heating) technology uses energy from the sun's rays (solar radiation) to heat building interiors and to heat water.

Some of New York State's incentives[38]:

- cash back incentive from NYSERDA of up to $4,000 per residential site and up to $25,000 per commercial site (15-20 percent of total cost)[39]
- a Residential Solar Tax Credit up to $5,000
- an Energy Conservation Improvements Property Tax Exemption of 100% of value added to property through addition of system (solar water heating only)
- residential State and Local Sales Tax exemptions of 100 percent of sales taxes
- commercial, industrial, residential, and agricultural sector Solar, Wind, and Biomass Energy Systems Exemptions of 100 percent exemption for 15 years.
- PACE Financing loans up to 10% of total property value for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors
- financing through Home Performance with ENERGY STAR® program
- *Investigate the requirements for receiving rebates and incentives before moving forward with the purchase and installation of a solar thermal system to ensure compliance and that rebates/incentives will be received.*

Case Study: Residential Solar Thermal

The Collet household in Red Hook purchased a solar thermal system in 2009 to supplant a portion of its use of a conventional water heater. Denis Collet estimates the system saves the family approximately 75 gallons of fuel oil annually. For reference, Red Hook residents used an average of 496 gallons of fuel oil per household in 2005.

Solar thermal system breakdown:

- System installed 2009

- System consists of 2 panels at 120 square feet total

[37] US Department of Energy's page on solar thermal: http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12490

[38] Refer to this webpage for more information on rebates and incentives for renewable technologies and energy efficiency: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=0&state=NY

[39] Scroll to the bottom of this webpage for information on NYSERDA's Solar Thermal program: http://www.nyserda.ny.gov/Page-Sections/Renewables/Solar-Technologies.aspx

- Tank size is 105.67 gallons

- Produces 60-65% of the household's hot water

- Cost for this system $11,000 and no NYSERDA incentives were used because the installer was not eligible.

- System purchase was eligible for 30% federal tax credits.

- Denis feels more time is required to evaluate the payback period for system.

Passive Solar Heating[40]

Passive solar heating technology is employed directly in the construction of a building. A building constructed with significant southern exposure with lots of south-facing windows and built with heat absorbent materials can convert sunlight to heat without special electronic components or other technology. Those materials collect heat during the day and slowly radiate it at night in a process called direct gain.

Features involved in the actual architecture of a building that can passively harness the power of the sun's heat are sunspaces and trombe walls. These features collect sunlight and heat from sunlight and allow it to be vented throughout the building or slowly released throughout the day, respectively. In addition, a building may be designed to employ daylighting, or using open floor plans and strategically placed windows to allow all rooms of the house to receive light and heat from the sun's rays.

During the summer months when the building does not need extra heat from sunlight, overhangs built into the structure can shade windows, and sunspaces can be closed off from the rest of the building.

This renewable technology is most feasible for new construction. NYSERDA offers a few programs for green building and ENERGY STAR® building for new construction. Consult these programs before designing and constructing a new building to ensure compliance if certification is desired.

Investigate NYSERDA's Residential New Construction Program[41] and Commercial/Not-for-Profit/Institutional New Construction Program[42].

Solar Electric (or Photo-Voltaic)[43]

Solar electric technology (also called photo-voltaic technology, or PV) employs the sun's rays (solar radiation) to create electricity for a building. New York State has plenty of sunshine to make

[40] Information on passive solar heating from the National Renewable Energy Laboratories http://www.nrel.gov/learning/re_passive_solar.html

[41] http://www.nyserda.ny.gov/en/Page-Sections/Residential/Programs/New-Construction.aspx

[42] http://www.nyserda.ny.gov/en/Page-Sections/Commercial-and-Industrial/Programs/New-Construction-Program.aspx

[43] Information on solar electric technology from the U.S. Department of Energy http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10710

solar electric installations effective electricity generators for homes, businesses, and larger facilities.

Over the past years and months, some solar companies have begun to offer large and small-scale leases and Power Purchase Agreements (PPAs) to residential, commercial, and institutional customers.

Some of New York State's Incentives[44] (for purchased systems only):

- cash back incentive from NYSERDA of $1.50 per watt ($1,500 per kW-generating capacity of system), capped at 7kW for residential, 25kW for not-for-profit, and 50kW for commercial sites. Total rebate capped at 40% percent of total cost[45].
  - For example, if a home in New York state will need a 4 – 5 kW system to supply most or all of its electricity needs, this NYSERDA program will reduce the total system cost by $6000 - $7,500, or 40% of the total cost of the system, whichever is less.
- a Residential Solar Tax Credit up to $5,000
- residential State and Local Sales Tax exemptions of 100 percent of sales taxes
- commercial, industrial, residential, and agricultural sector Solar, Wind, and Biomass Energy Systems Exemptions of 100 percent exemption for 15 years.
- PACE Financing loans up to 10% of total property value for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors

Case Study: Solar Electric Leasing

The Taylor-Bartons, who live in the Town of Red Hook, have been interested in installing a solar electric system for their home for some time, and started actively investigating their options last fall. The Taylor-Bartons wanted a system that would provide 100 to 110 percent of their electricity needs.

First they consulted a local solar installer for a proposal for a system to purchase. The installer submitted two proposals, each for different grades of converters and sizes of panels. Unfortunately, even after all available incentives were incorporated into the system cost, the out-of-pocket expense for the system would have been over $20,000. The Taylor-Bartons decided this cost was too prohibitive and decided against purchasing a system.

Meanwhile, through Denise Barton's work at IBM and from local advertisements, the family learned about another solar company that offers residential solar leases. This company visited the house and submitted a proposal. The family had the choice of prepaying from zero to 100 percent down on the total system 20-year lease cost, and chose to prepay 100 percent. That cost was $8,000. They will have their system for twenty years with no monthly payments to the leasing company. Their only monthly payments for electricity will be the connection charge from Central Hudson, and for any electricity their home uses over and

[44] For more information about incentives and rebates for solar electric: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=0&state=NY

[45] NYSERDA's Solar Electric program: http://www.nyserda.ny.gov/Page-Sections/Renewables/Solar-Technologies.aspx

above what the solar system produces. However, their system was designed to provide 100 to 110 percent of the house's needs.

The leasing company took care of all the paperwork for having the system approved by the Town Inspector and Central Hudson. After the system was installed, it took about seven weeks for all the approvals and inspections to be completed before it was officially live and producing power. Despite the house's old age, the only change to the property that was required was the removal of a large tree blocking the southern face of the house.

Solar Lease Case Study Breakdown:

- system capacity: 7.75 kW

- 100 percent electricity needs covered by system

- system installed March 2012

- 20-year lease

- lessee paid 100 percent of lease cost up front, or $8,000.

- no monthly payments on lease

- option to buy, remove at no cost, or re-sign with a new lease and new equipment after twenty years

- if family sells house, system can be purchased and added to the asking price of the house

- leasing company maintains system for no extra charge – maintenance is incorporated in the lease payments. Company also provides web-connected real time monitoring of the system performance and a performance guarantee.

Case Study: Large-Scale Solar Electric Power Purchase Agreements (PPAs)

BJ's Wholesale Club's Deer Park, NY location completed a rooftop solar electric system in early 2012 through a company that offers a trademarked solar power purchase agreement (PPA), employing financial incentives from NYSERDA. The array has a 249 kW capacity. Through their 20-year PPA, the solar company will sell the generated electricity back to BJ's Wholesale Club at low, predictable rates. Aside from avoiding potentially volatile energy prices, BJ's was able to employ a large solar array without significant upfront capital costs associated with purchasing such large systems.

For more detailed information on the technical, legal, and financial aspects of commercial/institutional PPAs, see http://courtneystrong.com/home/solar-power-purchase-agreements-webinar/ for expert presentations on the subject.

Case Study: Purchased Residential Solar Electric System

The Collet household has also installed a purchased system on the property's studio building, which is approximately 1,300 square feet, to supply all its electricity needs. The building was already very well insulated before the system was installed. The system is a recent installation – the service contract was signed in November, 2011 and the system went live in February, 2012. Denis reports it has already produced 1MWh surplus electricity since February.

Solar Electric System Breakdown:

- 7.2 kW

- has microinverters which allows the system to be easily expanded or reconfigured.

- total pre-incentive sales price was $32,485

- received federal tax credit of $9744

- received state tax credit of $5000

- received NYSERDA incentive at $1.75 per watt $12,250 (NYSERDA incentive has since dropped to $1.50 per watt)

- net cost to customer was **$5,486**

Case Study: Large-Scale Solar Electric System for a Farm

The Biezinski family's Northwind Farms in Tivoli employs a 28 kW solar electric system, installed in late March/early April of 2012, to power all its farm facilities. The system was designed to produce at least 100 percent of the farm's electric needs, and the installer advised that if the panels are rotated at various times throughout the year to maximize sun exposure, production could increase to 120%. The installer also predicted the system to produce $14,000 to $16,000 worth of electricity per year, bringing the "payback period" (the amount of time it will take for the capital cost to be offset by savings on electricity purchases from Central Hudson) for the system down to 10 years.

The facility at Northwind Farms that uses the most power is the farm's slaughterhouse, because of its various refrigerators, ice machines, freezers, plucking machine, scalding machine, well, and fans. Rich Biezinski reports that although the installer predicted post-installation bills to be around $100, the bill for April was only $25. In May, when the weather was a bit more cloudy, the bill was only $90.

The total system cost before incentives was $182,000 plus a $4,000 fee for the grant writer employed to apply for incentives from NYSERDA and the USDA. After the NYSERDA incentives were applied, the out-of-pocket expense for Northwind Farms was $137,000; they are currently waiting on the USDA to deliver its $47,000 incentive, which would bring the total out-of-pocket system cost to $90,000. Even without the USDA grant, as mentioned before, Rich expects the system to pay itself off in 10 years. Rich says, "If every farmer put these units in and all produced 120 percent – and of 197 acres, we just put 1 acre aside – think of all the fuel we could produce."

Solar Electric Purchase Breakdown:

- system capacity: 28 kW

- system size: about 1 acre of land for ground-mounted system with 150 panels

- system installed late March/early April 2012

- system will pay for itself in approximately 10 years

- owner received $49,000 from NYSERDA to subsidize purchase of system

- $47,000 grant from USDA pending

- out-of-pocket cost for system was $137,000 plus $4,000 for a grant writer (with USDA grant, out-of-pocket cost will be $90,000)

- at least 100 percent electricity needs covered by system

Small Wind[46]

Wind turbines use the renewable energy source of moving air to generate electricity. If a site is suitable for a wind turbine, many benefits can be gained. "Small wind" refers to systems that power residential or small business/institutional sites as opposed to large wind farms that supplement regional power providers.

Some of New York State's Incentives:

- NYSERDA Small Wind program[47] offers the following incentive levels based on **Annual Energy Output** (**AEO**):
  - If the AEO is 10,000 kWh or less, than the NYSERDA incentive is **$3.50 per kWh**. For example: for a turbine with an AEO of 7,400 kWh, the incentive is $25,900 (7,400 kWh x $3.50/kWh).

  - If the AEO is greater than 10,000 kWh, but not greater than 125,000 kWh, the incentive is **$35,000 plus $1.00 per kWh for every kWh greater than 10,000 kWh**. For example: for a turbine with an AEO of 32,500 kWh, the incentive is $57,500 {$35,000 + [(32,500 kWh – 10,000 kWh) x $1.00/kWh]}.

  - If the AEO is greater than 125,000 kWh, the incentive is **$150,000 plus $.30 per kWh for every kWh greater than 125,000 kWh**. For example: for a turbine with an AEO of 200,000 kWh, the NYSERDA incentive is $172,500 {$150,000 + [(200,000 kWh – 125,000 kWh) x $.30/kWh]}.

- PACE Financing for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors – loans up to 10% of the appraised real property value or cost of system.
- Energy Conservation Improvements Property Tax Exemption of 100% the value added to the property by addition of wind system for residential sector
- Local Option Solar, Wind & Biomass Energy Systems Exemption for 15 years from property tax of 100% the value added to the property by addition of wind system for Commercial, Industrial, Residential, and Agricultural sectors.

[46] Information on Small Wind Technology from the U.S. Department of Energy: http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10880

[47] NYSERDA's Small Wind program: http://www.nyserda.ny.gov/Page-Sections/Renewables/Small-Wind.aspx

Cars and trucks account for 34 percent of total carbon emissions in the New York State, even with New York City's high population density and low motor vehicle use. New York State has adopted California's tailpipe emissions standards, which require emissions reductions of 30 percent below 2002 levels by 2016, beginning with the 2009 model year vehicles[48].

In the Red Hook area, the transportation sector accounts for the largest source of carbon emissions – 57,672 tons[49] or 42.5 percent of the total carbon emissions. This is because Red Hook's transportation profile primarily consists of private vehicles with limited public transportation provided by the Dutchess County Loop buses. Additionally, the school district offers school bus routes and Bard College has a shuttle service that serves students and faculty on campus, various locations in Dutchess and Ulster counties in the vicinity of Bard College, and to train stations and airports as far afield as New York City.

A source of transportation emissions not included in the GHG inventory that informs this ECAP is product transport and tractor use within the agricultural sector. These sources must be included in future studies.

Red Hook's small population and rural character pose challenges to instituting a deep and wide-ranging public transportation system. Effecting change in the commuting habits of residents and commercial traffic patterns will require creativity in both funding and land-use planning on the part of town planners in years to come. While this will be a difficult undertaking, if successful, significant reductions can be achieved, air quality will improve, and risks to human health due to air pollution will decline.

Planners must take a multi-faceted approach to reduce Red Hook's vehicle miles traveled including changes to transportation infrastructure such as intersection and road construction, and smart traffic lights; increased availability of public transit; and incentives for individuals to change personal transportation habits and choose biking, walking, carpooling, or use of mass transit.

The table at the beginning of this chapter shows that if Red Hook residents reduce their daily miles traveled from 29.5 to 20 miles a day per person, a 12.3 percent total CO_2e reduction can be achieved.

Planners should access programs offered by federal agencies like Housing and Urban Development, the Environmental Protection

[48] Confronting Climate Change in the U.S. Northeast, Union of Concerned Scientists http://www.climatechoices.org/assets/documents/climatechoices/new-york_necia.pdf

[49] Calculations to reach this number explained in Appendix A

Agency, and the Department of Transportation, and state/regional agencies such as unwasteNY, the Mid-Hudson Regional Economic Development Council, and NYSERDA to locate funding and other resources for sustainable development in Red Hook.[50]

This plan looks at transportation from two perspectives. **Goal 1** addresses emissions reductions opportunities that come from strategic town planning and neighborhood configuration. **Goal 2** addresses emissions reductions opportunities from the perspective of minimizing vehicle-miles traveled through the expansion of public transportation and the improvement of traffic infrastructure. While the two Goals overlap in some areas, they provide a somewhat clear breakdown of the causes of transportation emissions: in the first case, the requirement of driving to access daily needs located too far from home for walking or biking, and in the second, the requirement to drive because of a lack of other transportation options.

TRANSPORTATION 20/20 GOAL 1

Community construction must be planned so that all residents can access daily needs (other than attending work and school) with a 20-minute-or-less walk, or a safe, brief bicycle ride. Residents of Red Hook and Tivoli are more dependent on cars than individuals living in our larger neighboring cities that are able to support robust mass transit systems, and even drive more per day than the average American. In 2005, Red Hook residents drove 29.5 miles per day compared to 25.6 miles per day for the average American. Re-planning certain neighborhoods in the Town and Villages (within the specifications of the Centers and Greenspaces Plan) will enable residents to reduce their dependence on personal vehicles for daily tasks.

In addition to reducing the emissions created by Red Hook's transportation sector, creating neighborhoods that can be easily biked or walked can also build community cohesion and improve residents' sense of place in their areas. Although Red Hook and Tivoli are small, close-knit communities already, creating the opportunity to appreciate neighborhoods and neighbors on a smaller scale can build pride in a community's human and natural landscapes, making enacting the larger-scale lifestyle changes necessary to build a more sustainable community less challenging.

Daily places to go:

- Grocery stores
- Restaurants and Bars
- Drug stores
- Convenience stores
- Laundromats
- Transit stops
- Parks
- Post Office
- Library

[50] For example, investigate the Interagency Partnership for Sustainable Communities: "In 2009, DOT, HUD and EPA established a high-level interagency partnership to improve access to affordable housing, more transportation options, and lower transportation costs while protecting the environment in communities nationwide. Through a set of guiding livability principles to guide the agencies' efforts, this partnership will coordinate federal housing, transportation, and other infrastructure investments to protect the environment, promote equitable development, and help to address the challenges of climate change."

Recommendations can also be made through public outreach for residents to replace older vehicles with more fuel efficient models, or hybrid and electric models.

Limitations:

Although it would be ideal if children in Red Hook and Tivoli could walk or bike to school, it is not realistic, nor is it reasonable to expect the construction of additional school buildings to accommodate this transit change. Instead, Red Hook must work to encourage school bus ridership, discouraging parents from driving children in private vehicles and high school students from driving themselves to school. Additionally, a plan should be implemented to convert existing school buses to biodiesel or electric vehicles.

It is not realistic to expect a high percentage of residents to change commuting habits to jobs located outside of Red Hook and Tivoli because of the lack of mass transit in this region. Alternative suggestions include encouraging telecommuting, working from home, and carpooling with others whose places of work are in a similar vicinity.

Suggested Actions:

1) The Town and Villages should encourage all residential and commercial business construction to occur within the limits set forth by the Centers and Greenspaces Plan.

2) In coming decades, for all residential neighborhoods, work to identify necessary land use changes and investments in infrastructure that would be needed to achieve layouts for each neighborhood that allow walking and biking to all non-work and non-school services, and assign a task force to work on implementation.

3) Maintain a focus on the walkable/bike-able neighborhood goal in all future zoning, construction, and business attraction projects throughout the implementation of this plan and its future iterations, and after 2020. Suggestions to improve walking and biking experience, and to encourage walking and biking:

a) Improve existing sidewalks and bike lanes.

b) Install sidewalks and bike lanes where there are none.

c) Improve pedestrian safety and comfort at traffic intersections with crossing lights.

d) Educate pedestrians and motorists on State and local laws for right-of-way for pedestrian, bike, and motor vehicle traffic.

e) Educate bicyclists on proper bike safety including traffic rules and signaling.

f) Ensure proper lighting at night (using light and motion sensors to maximize energy efficiency).

g) Expand installation of bike racks.

h) Improve access to public transportation stops.

i) Change local traffic laws to give pedestrians and bicyclists right-of-way in crosswalks (long term).

j) Encourage ride-sharing within families in place of driving a second car.

4) Require highway planning to include analysis of resulting carbon emissions, for example by designing roads projects to minimize

engine idling. Avoid or revise plans that would not result in a net reduction of traffic-related carbon emissions.

b) Work with county and state entities on highway planning projects.

TRANSPORTATION 20/20 GOAL 2

Red Hook and Tivoli must work to significantly reduce per capita daily vehicle-miles traveled (VMT) from 2005 levels. As of 2005, the per capita daily passenger vehicle-miles traveled (VMT) in Red Hook and Tivoli were 29.5 miles. Emissions from vehicles will also be reduced with improvements to vehicle fuel efficiency and the adoption of cleaner fuels and electric vehicles.

It is currently difficult to assign a reduction percentage goal for Red Hook for VMT. Although this ECAP does use an estimate for 2005 VMT based on Dutchess County data, it is not currently known exactly where people are driving and how often people are driving. A specific plan for reducing VMT needs to be developed in conjunction with this ECAP that takes into consideration the effect localized public transportation and walking/biking would have on total VMT in light of the distance and frequency commuters travel outside of Red Hook.

Suggested actions:

1) Begin planning future studies to enhance ability to address transportation emissions

a) Develop a feasibility and benefits analysis of investing in public transportation and other transportation emissions abatement projects within the Red Hook/Tivoli localities (see 3, below).

b) Gather data on greenhouse gas emissions to form a more reliable baseline for future analyses of the performance of the transportation system.

c) Gather in-depth data on commuter habits aside from simple VMT, including destinations, commuting requirements (i.e. how necessary is the commute?), willingness to carpool, vehicle type with fuel efficiency, routes to work and average traffic flow on those routes, and existing public transportation infrastructure to these locations.

d) Develop a method for projecting the life cycle carbon footprint of transportation investments, including embodied energy, operations (VMT and flow), and maintenance.

2) Pass resolutions, codes, and laws to support changes to transportation infrastructure, funding, and regulations that will result in lower transportation emissions. Work with national partners such as the Clean Cities project[51], and regional partners including the New York Department of Transportation, regional cities and counties, and the Red Hook Planning and Highway Departments to reduce VMT through strategic investments and policies.

a) Require transportation planning to include analysis of resulting carbon emissions. Avoid or revise plans that would not result in a net reduction of carbon emissions from traffic.

[51] U.S. Department of Energy, Clean Cities initiative: http://www1.eere.energy.gov/cleancities/

b) Identify funding sources for maintaining existing and building new transportation and transportation abatement projects that effectively reduce carbon emissions.

c) Institute and enforce a municipal anti-idling law.

d) Incentivize quantified VMT reductions for residents and businesses.

e) Adopt a renewable fuel standard for gasoline and diesel sold within Town/Village Limits (for example, require all diesel to contain at least 5% biodiesel, and gasoline 10% ethanol)

f) Assemble a multi-stakeholder group that includes town planners, car dealers, utilities, infrastructure suppliers, academic and research institutions, and county and state officials. Work together to create a plan for electric vehicle readiness that "considers all stakeholder perspectives and seeks to identify and address technical, economic, and regulatory barriers to electric vehicle adoption and integration."[52]

3) Implement infrastructure and paradigm shift investment plans, if studies indicate feasibility and benefits are favorable.

a) Consider investment in high-speed broadband internet connectivity to every business and residence to encourage e-commerce and telecommuting.

b) Work with Red Hook area, state, regional, and federal agencies to develop a strategy for expanded public rail service between Poughkeepsie and Albany.

c) Install sensors at intersections to monitor and respond to traffic flow in real time to prevent idling at lights.

d) Replace traffic lights and multi-way traffic stops with traffic circles where possible.

e) Install electric vehicle charging stations.

f) Retrofit/replace municipal vehicles for biodiesel/electric fuel.

g) Refit police fleet with bicycles (where appropriate) and electric vehicles.

h) Expand public transportation fleet with appropriately-sized, hybrid or electric vehicles running at a frequency that optimizes the ridership : accessibility ratio.

i) Expand public transportation route coverage.

j) Install additional ride-sharing/park-and-ride lots to encourage and support growing ride-sharing networks and park-and-ride participation.

4) Implement public outreach to educate and encourage behavior changes that will result in lower transportation emissions.

a) Support ride-sharing networks.

b) Hold workshops to discuss user-end fuel efficiency measures such as tire pressure, optimal highway driving speeds, fuel types, ride-sharing, etc.

[52] Top EV-Friendly Cities: What are they doing right? Max Frankel, Climate Progress, http://thinkprogress.org/climate/2012/07/03/510344/top-ev-friendly-cities-what-are-they-doing-right/

c) Hold workshops in cooperation with local car dealers to discuss the current state of hybrid/electric vehicles – many residents make vehicle buying decisions (and choose not to purchase hybrid/electric models) based on outdated information.

Transportation Case Study[53]:

In the early 1990s Cornell University recognized a need for 2,500 new parking spaces to accommodate students and staff. Instead, Cornell worked with local authorities to enhance the region's public transportation system by combining service improvements, incentives, and support for carpooling and use of public transportation. Cornell estimates that by 2005 it had saved more than $40 million in construction, infrastructure, and transportation costs while enhancing air quality and preserving open space on campus.

[53] Campus Consortium for Environmental Excellence. 2006. *Transportation: If You Build It They Will Come (and Other Tales of How Free-Fare Transit Saved $40 Million at Cornell)*.

Another significant emissions source – and source of reductions opportunities – for Red Hook is the waste sector. In addition to the carbon dioxide emitted by transport and incineration, rotting waste also emits the powerful greenhouse gas methane (CH_4). The US EPA reports, "Landfills accounted for approximately 16.2 percent of total U.S. anthropogenic methane (CH_4) emissions in 2010, the third largest contribution of any CH_4 source in the United States." As mentioned earlier in this report, while methane remains in the atmosphere for a shorter time than carbon dioxide, while it is present, it is much more efficient at trapping solar radiation. Compared to carbon dioxide, the global warming impact of an equivalent amount of methane is 20 times stronger over a period of 100 years[54]. Aside from landfill emissions, other waste-related sources of methane from human activities include the raising of domestic animals such as cattle, sheep, and horses, and the treatment of wastewater.

Waste also contributes to CO_2 emissions, specifically when it is incinerated. In 2005, EPA's Waste Reduction Model (WARM) showed that GHGs equivalent to 99 million metric tons of CO_2 were released as a consequence of discarded packaging alone[55].

In addition to the negative impacts of emissions produced by materials as they break down in landfills, there are other consequences of depositing these items in dumps. Disposing waste in landfills removes the materials from the manufacturing system for good. In other words, when reusable material is not available, industry must use more raw materials in order to manufacture new products. Extraction of raw materials and the associated manufacturing activities of these products requires energy and produces emissions, most often in the form of the combustion of fossil fuels. So, although Red Hook is not necessarily a manufacturing center, its waste disposal and processing habits can have ramifications far outside its town and village limits. Although processing recycled materials and converting them into new products still requires energy, the amounts of energy required are far lower and the environmental impacts in raw material extraction zones much less widespread than those involved with the extraction and processing of raw materials.

In the future, GHG inventories must seek to include the impacts of the agricultural sector on Red Hook's carbon emissions. Because of Red Hook's large percentage of total land area taken up by

[54] http://www.epa.gov/climatechange/ghgemissions/gases/ch4.html
[55] http://www.epa.gov/region4/rcra/mgtoolkit/Climate_Change.html

agricultural parcels (20.2 percent[56]), it is likely that waste products (such as rejected plant material and waste from farm animals) generated by Red Hook's farms have a significant and not-before-considered impact on its total GHG emissions.

This section will also suggest ways to reduce emissions in the collection system itself, such as retrofits/replacements to collection trucks. Red Hook's recycling center has already installed a 1.8 kW solar electric system on its roof (2010).

The goals in this section aim to reduce waste emissions by reducing the total amount of solid waste generated (**Goal 1**), recover more of the solid waste that is generated (**Goal 2**), and to reduce the greenhouse gases emitted by the waste collection system, e.g. vehicles and storage facilities (**Goal 3**).

SOLID WASTE 20/20 GOAL 1

Reduce total solid waste generated. Red Hook and Tivoli both participate in recycling, however "waste" must refer to all solid waste collected, regardless of its destination.

The EPA estimates that reducing our national waste generation to a level consistent with 1990 could decrease GHG emissions by 11.6 million metric tons of carbon equivalent (MMTCE) – total GHG emissions in the US were 6,821.8 MMTCE in 2010. Increasing our national recycling rate from the 2011 level of 28 percent to 35 percent would reduce GHG emissions by 9.8 MMTCE, compared to sending the same material to landfills.

[56] According to total land area data from the U.S. Census Bureau and Red Hook agricultural land area data from Red Hook Assessor Scott Hobson.

Together, these waste reductions and recycling increases would cut emissions by over 21.4 MMTCE. This would be like removing 11 million American households[57] from our overall national GHG emissions totals. All municipalities must play a part in these improvements and waste reductions, no matter how small their populations.

The EPA reports that "**source reduction**" is the most effective way to prevent waste. When a material is source reduced, it means that GHG emissions normally associated with producing that material and the amount of post-consumer waste it produces are avoided. Although these products are not necessarily manufactured in Red Hook, residents, businesses, and the municipalities can engage in **Environmentally Preferred Purchasing** practices to choose products that have been source reduced, and change the way these products are disposed. Environmentally Preferred Purchasing has relevance for waste reduction in the following ways:

- waste is reduced on the manufacturing end (significant whether manufactured in the local vicinity or not)

- a signal is sent to the marketplace that EP products are in demand, encouraging more manufacturers to move toward this practice

- once used, options for disposing of products in Red Hook are more environmentally friendly, reducing the load on landfills and resulting in lower GHG emissions.

Source reduced materials are:

- Light-weight (less material was used in production).

[57] http://www.epa.gov/region4/rcra/mgtoolkit/Climate_Change.html

- Made partially or completely of recycled materials.
- Made of environmentally preferable material.
- Have utility in **by-product synergy** (see Goal 2, below).

Suggested Actions:

1) Work with partner organizations to encourage businesses and residents to purchase durable, repairable and reusable goods; to reduce the amount of materials that go to waste, including food; and to reduce consumption of carbon-intensive consumer goods and services.

2) Develop a measurement and evaluation mechanism to better track waste a) produced by all sectors, including the agricultural sector (not net inventoried), b) disposal trends in the community, and c) prevented through conscientious consumption and re-use.

3) Ban disposable plastic bags and require to-go containers for foods and beverages to be 100% recyclable.

SOLID WASTE 20/20 GOAL 2

Red Hook should work to recover more of its generated waste. A more detailed analysis needs to be carried out to determine how much waste is currently recovered and why the waste that goes to landfills is not recovered (e.g., lack of recycling technology, non-compliance with recycling requirements, etc.). For example, studies show that the less frequently recycling is collected, the lower the participation rate, the fewer recyclables are collected, and the more likely materials are to be contaminated[58].

Additionally, more ambitious waste recovery methods should be adopted, such as municipality-wide composting and by-product synergy implementation.

In **by-product synergy**, waste from one source can be used by other producers in manufacturing/production processes. An example of this practice is the combustion of used cooking oil for heat, power, or transport. Red Hook could work to develop partnerships/networks for by-product synergy and prevent a significant amount of waste materials from entering landfills[59].

Composting is the controlled decomposition of organic matter into humus, a soil-like material that can be used to enrich existing soils for the growing of crops and gardens. The EPA states that 2006 data on U.S. Municipal Solid Waste generation show that 12.9% and 12.4% of the 251 million tons of the country's solid waste is yard waste and food residuals, respectively. When yard waste and food residuals are composted rather than sent to landfills, the nature and volume of the GHGs emitted is augmented. While landfills primarily generate CH_4, the bacteria active in composting (when done properly) use aerobic processes to break down materials, resulting primarily in CO_2. However, since this CO2 is considered to be naturally occurring as

[58] "Although you may think that every other week collection of recycling saves energy by reducing fossil fuel combustion from trucks by 50%, the Oregon Department of Environmental Quality found that the consequences of this collection method actually outweighs the benefits. Less frequent collection leads to 9 to 20% fewer participants, fewer recyclables, and greater time for contamination of recycled materials."
http://www.epa.gov/region4/rcra/mgtoolkit/Climate_Change.html

[59] http://www.epa.gov/region4/rcra/mgtoolkit/Climate_Change.html

opposed to anthropogenic (a result of human activities), it is not counted as a GHG in the Inventory of U.S. GHG Emissions and Sinks[60]. Composting could therefore be act as a GHG reduction method for Red Hook, as its emissions would partially reduce landfill emissions in future GHG inventories.

Furthermore, although it is preferable to reduce GHGs across the board by reducing the total amount of waste produced, since composting organic waste produces CO_2 instead of CH_4, composting produces GHGs with far lower global warming potential (see beginning of this section).

Suggested Actions:

1) Conduct a detailed study on the availability of technology to recycle various materials – determine what percentage of materials cannot be recycled. Take advantage of volunteer programs to assist in a waste inventory[61]. Use this information to set an ambitious goal for how much total recyclable waste should be recovered in 2020.

a) Adopt plans to help residents, businesses, and municipal buildings comply with this goal.

2) Initiate a single-stream recycling program. Other U.S. cities have initiated these programs with significant cost reductions and increases in recycling rates[62].

a) Begin now to upgrade older recycling vehicles to single-stream models to speed the conversion process toward a totally single-stream program[63].

b) Examine programs initiated by other rural towns to ensure success in a program in Red Hook.

3) Plan for future drafts of the ECAP to include an area-wide waste management analysis that reflects energy use and greenhouse gas emissions as key factors in prioritizing plans like area composting and by-product synergy systems.

4) Begin development of Town- and Village-wide composting sites. A yard waste dumping site could be an opportunity for Red Hook and Tivoli to develop inter-municipal "shared services, and to address

[60] EPA. 2005. Inventory of U.S. GHG Emissions and Sinks: 1990-2003, Environmental Protection Agency, Office of Policy, Planning and Evaluation, Washington, DC. EPA 430-R-05-003

[61] Programs include: WasteWise, a voluntary partnership between EPA and U.S. businesses, Federal, tribal, state and local governments, and institutions to prevent waste, recycle, and buy and manufacture products made with recycled materials. Currently, more than 1,900 partners are participating in the WasteWise program. See: http://www.epa.gov/epawaste/conserve/smm/wastewise/index.htm

[62] See program details for Ann Arbor, Michigan's single-stream recycling: http://www.a2gov.org/government/publicservices/fieldoperations/solidwasteunit/Pages/Single-StreamRecycling.aspx

[63] In a webinar sponsored by the U.S. Environmental Protection Agency in February 2010, Jerry Powell, owner and publisher editor of recycling trade journals *Resource Recycling* and *Plastics Recycling Update*, stated that within the next 4-5 years, he anticipates that more than 80% of the U.S. recycling plants serving non-rural communities will switch to single-stream because co-mingled collection and processing represent the future of recycling markets. The only delays to having this changeover happen more quickly is budgeting the purchase of new collection vehicles in coordination with recycling plant (MRF) building improvements. As older recycling vehicles reach their service expectancy and are upgraded to single-stream collection models, most MRFs will upgrade to single-stream. http://www.epa.gov/epawaste/conserve/smm/web-academy/2010/feb10.htm

resident concern that there is no place for yard-waste dumping for those lacking yard space.

a) Partner with local farmers for composting materials.

5) Pass a resolution/code for the mandatory collection of commercial and residential food waste.

6) Ban yard waste from entering landfills so that plant clippings, wood chips, and other vegetative waste can be reused as mulch, fuel, or compost.

7) Incentivize materials salvage and reuse activities in the construction sector with plans to move toward adopting a requirement or Building Code amendment for the use of a certain percentage of reused construction materials.

8) Plan public outreach events to educate on waste disposal options and requirements, including public awareness for by-product synergy networks and home composting or composting networks.

SOLID WASTE 20/20 GOAL 3

Reduce the greenhouse gas impacts of the waste sector by adjusting collecting practices, and reducing direct impacts by collection vehicles, processing centers, and landfills.

Suggested Actions:

1) Shift waste pickup schedule to provide recycling and compost pickup once per week and garbage pickup every two weeks to increase participation and amounts of materials recycled, and to reduce contamination of materials.

2) Retrofit collection trucks to use biodiesel and/or install particulate filters on exhaust systems.

3) Additional waste facility buildings should follow the recycling center's lead and access state incentives programs for installing solar electric systems to partially supplant electricity drawn from the traditional grid.

4) Investigate the feasibility of a biogas plant that uses land-fill and agricultural waste to produce electricity.

RENEWABLE TECHNOLOGIES

Anaerobic Digestion (Methane Recovery)[64]

Appliances called biodigesters recover methane from animal manure or landfill material through a process called anaerobic digestion. The gas recovered from this process produces heat.

Case Study: Anaerobic Digester Project[65]

Synergy Dairy, in Wyoming County, NY employed $1 million in incentives from NYSERDA and a $750,000 grant from National Grid power company to create a biogas (CH4) power project that is large enough to power 1,000 homes, or 1.4 Megawatts of

[64] Information on anaerobic digestion from the U.S. Department of Energy: http://www.energysavers.gov/your_workplace/farms_ranches/index.cfm/mytopic=30003

[65] http://www.nyserda.ny.gov/About/Newsroom/2012-Announcements/2012-05-01-NY-Largest-On-Farm-Biogas-Power-Project-Generates-Renewable-Energy-for-Nearly-1000-Homes.aspx

renewable energy. This is New York's largest on-farm biogas power project to date. The grant from National Grid, who will now be purchasing the power from the biogas generator, allowed for the building of a substation to direct the power into the local electricity grid.

The project, which had its "grand opening" on May 1, 2012, is based on a 2,000 animal dairy farm. It is owned and operated by a private company. It is the state's first biogas project specifically designed for the co-digestion of animal and food wastes. By combining both animal and local food waste, the 425 ton per day facility helps the farm reduce its GHG emissions, supplies several new jobs to local workers, and has increased the operating efficiency of the farm and local food manufacturers and haulers.

"This Synergy co-digestion biogas project is the cutting edge of energy technology and is an absolute revenue-producing game changer for our dairies and local economies. By recycling agricultural waste in biogas plants, dairies can reduces disposal costs, produce affordable renewable energy to run their operations and gain a revenue source by selling excess power to the grid. I've been proud to help keep this project on track to ensure it crossed the finish line," said Senator Charles Schumer, whose office helped coordinate federal and local funding for the project.

The Senator's office also worked with the Wyoming County Industrial Development Agency to help Synergy Biogas LLC complete the facility and partner with Cornell University and Rochester Institute of Technology to evaluate the project's performance.

Anaerobic Digester/Biogas Plant Breakdown:

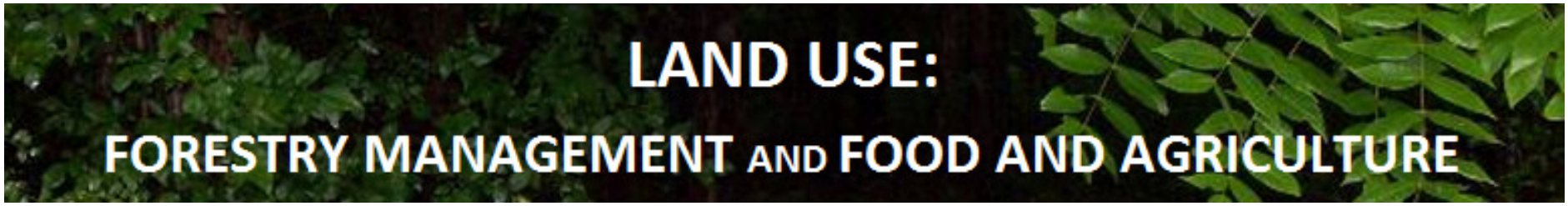
- 8,500 tons of CO2 reduction annually (equalling about 1,700 cars)

- production of 17,500 cubic yards of bedding for livestock annually

- management of nutrients to apply to cropland

- reduction of livestock odors

- diversion of millions of gallons of food waste from landfills and wastewater from treatment plants



FORESTRY MANAGEMENT

The maintenance of a healthy stock of trees can bring many benefits to Red Hook. Obvious benefits include shade and beauty, which can in turn improve property value and general quality of life for residents. On a deeper level, trees and the maintenance of natural lands offer environmental benefits ranging from the preservation of natural habitats for local wildlife to a source for carbon absorption. Trees absorb carbon dioxide for respiration and can act as a tremendous "sink" for carbon. In fact, the EPA states that sustainable land use and forestry offset of 15 percent of 2010 national greenhouse gas emissions (most of this reduction is thanks to vegetation, soils, and harvested wood[66].). Since 1990 in the U.S, managed forests and other lands have absorbed more CO2 from the atmosphere than they emit[67]. In addition, the shade they create can reduce loads on the electrical grid that would otherwise come from cooling systems for our buildings.

Red Hook has already enacted several land preservation initiatives including conservation easements and greenspaces plans. However, working to protect and enhance tree cover within the zones demarcated for development will enhance the Town's and Villages' ability to counter emissions from other sources and prevent future emissions rates from rising. Encouraging the preservation and planting of native species will provide habitats for native wildlife that coexist with humans in these areas.

General recommendations from the EPA to optimize carbon absorption by forests/lands[68]:

Changes in Uses of Land:

- Increasing carbon storage by using land differently or maintaining carbon storage by avoiding land degradation.

- Avoiding the conversion of forest land to settlements.

Changes in Land Management Practices

- Improving management practices on existing land-use types.

- Reducing soil erosion to minimize losses in soil carbon storage.

[66] http://www.epa.gov/climatechange/ghgemissions/sources/lulucf.html
[67] http://www.epa.gov/climatechange/ghgemissions/sources.html

[68] Taken directly from:
http://www.epa.gov/climatechange/ghgemissions/sources/lulucf.html

- Planting after natural or human-induced forest disturbances to accelerate vegetation growth and minimize soil carbon losses.

Goal 1, below, addresses these recommendations more specifically.

LAND USE 20/20 GOAL 1

Expand the forest canopy to cover one-third of the zones demarcated for development (areas not protected by easement/Centers and Greenspaces plan), concentrating plantings around:

- streams and rivers for watershed protection and to reduce soil erosion risks

- the sides of buildings exposed to afternoon sun to provide shade and reduce reliance on cooling systems

- sidewalks to enhance walkability in Town and Villages and provide shade for parked cars

Suggested actions:

1) Conduct a study on the total coverage area of forest in the Town and Villages, and analyze to determine the rate of carbon sequestration provided by that cover.

a) Include analysis of forested areas most vulnerable to decline due to development activity or climate impacts and focus management efforts on those areas.

2) Work with local organizations and develop a civilian volunteer corps to help with projects to control invasive plant species on both public and private lands AND/OR connect with regional AmeriCorps groups for special weekend projects.

3) Develop a community network of private land owners with interest in working to enhance and protect their lands, connecting them with local stewards of public lands, local organizations, and local volunteer groups who can assist with improvement projects.

4) Expand groups/programs to encourage planting, preserving, and maintaining trees and shrubs, focusing on a diverse array of native species natural to the area.

a) Perform and publicize a public tree health checkup with an arborist and encourage similar individual projects on private lands.

5) Connect local private land owners with stewardship resources[69].

6) Develop and implement an outreach campaign to provide educational resources to residents about the benefits of native trees and other plant cover.

7) Ensure codes and policies maximize the preservation of the largest, longest-living trees, and ensure expansion of the forest inside both easement/protected zones and inside developed zones over time.

LAND USE 20/20 GOAL 2

Reduce impacts from conventional lawn maintenance, including emissions from mowers and other machines and from chemicals

[69] For example, Scenic Hudson: http://www.scenichudson.org/work/landpreservation/privatelandowners/stewardshipresources and
Trees for Tribs (NYDEC): http://www.dec.ny.gov/animals/77710.html

applied as fertilizer and pesticides. Lawn care has a number of often unrealized environmental impacts.

ICLEI recommends "low-maintenance landscaping" for reducing GHG impacts of lawn care. Natural, or low-maintenance landscaping

- is less expensive to maintain than lawns.
- provides habitat for wildlife.
- avoids the high levels of pesticides and fertilizers used on lawns.
- reduces emissions from maintenance equipment engines – a lawnmower can produce as much pollution every year as 43 cars.
- reduces water use for lawn care – an average acre of lawn in the U.S. uses 652,000 gallons of water annually.[70]

Suggested Actions:

1) Conduct public outreach on the benefits of lawn conversion to natural landscapes AND/OR vegetable/fruit gardens.

2) Partner with Cornell Cooperative Extension to facilitate information sharing, regular practice workshops, etc.

[70] From ICLEI's CAPPA spreadsheet on impacts of actions, Landscaping tab.

FOOD AND AGRICULTURE

The EPA estimates that over 7 percent of total U.S. carbon emissions result from agriculture. That 7 percent is composed mostly of nitrous oxide (N_2O) emissions from management of agricultural soils, and methane (CH_4) and nitrous oxide (N_2O) emissions from the digestive systems and manure of livestock animals[71]. Certain other soil management practices[72] also release CO_2, but those emissions are considered by the EPA to be accounted for in the land use practices discussed in the Forestry Management section of this document. Those emissions are considered to be offset by the absorption of CO_2 by trees and other plants.

Since 1990, GHG emissions from agriculture have increased by approximately 13 percent. The EPA believes this growth should be attributed to the 51 percent increase in combined CH_4 and N_2O emissions from manure management systems for livestock, which are now more commonly emissions-intensive, liquid systems ("lagoons")[73].

Emissions from agriculture may be greater than 7 percent if emissions from agriculture related transportation (shipping) were taken into account.

This ECAP lacks data for Red Hook on agricultural emissions, either including or excluding emissions related to food transportation. *Since agriculture is such a large land and business sector of the area, future GHG inventories should be obligated to include agriculture*. It is difficult to accurately measure emissions for agricultural practices and

[71] http://www.epa.gov/climatechange/ghgemissions/sources/agriculture.html
[72] http://www.epa.gov/climatechange/ghgemissions/sources/lulucf.html

related land use, but an estimate will at least make the GHG inventory more accurate and the next drafts of the ECAP more robust and effective.

Goal 2 addresses carbon-intensive foods and focuses on encouraging consumption of lower carbon choices while **Goal 3** supports the increased consumption of local foods. **Goal 4** addresses land and livestock management practices that could impact emissions rates.

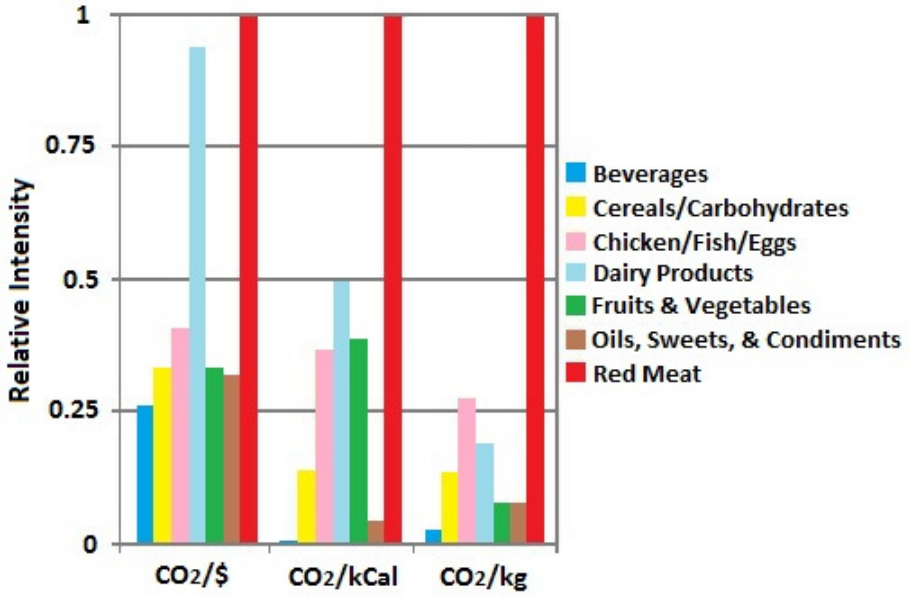
LAND USE 20/20 GOAL 2

Policy makers and residents alike should clearly understand the carbon impacts of different foods and choose those foods with the lowest associated lifecycle carbon emissions. Local food consumption has advantages, but as far as reducing the emissions associated with food choices, smart dietary choices can actually have a greater impact on emissions reductions[48].

While the local food movement often focuses on emissions from food transportation, or "food miles," in fact, the production of food contributes far greater GHG emissions. 83 percent of the average U.S. household's yearly footprint for food consumption is contributed by production phase carbon emissions. In contrast, only 15 percent of total life-cycle food emissions comes from the transportation of food[74]. The study cited does not, however, account for emissions produced by food storage (e.g. refrigeration) and waste, which would likely be similar for both local and non-local foods.

[74] Weber, C.L. and Matthews, H.S., "Food-miles and the relative climate impacts of food choices in the United States." Environmental Science & Technology, Vol. 42, No. 10, 2008, pgs. 3508-3513. http://pubs.acs.org/doi/pdfplus/10.1021/es702969f

Carbon Intensity for Various Food Types[75]



Different food products require different levels of carbon "input" to produce. The graph above shows the relative carbon intensity for the various classes of foods. Red meat is set at 1 or 100 percent intensity relative to other types of foods for each metric compared. The graph clearly shows we could maintain a balanced and healthy diet that is also far less carbon intense by focusing on fruits and vegetables, grains, and chicken/fish/eggs. **Changing one day's worth of eating per week from red meat or dairy to chicken/fish/eggs or vegetables per family results in a greater GHG reduction than buying all locally sourced foods, and would be equivalent to driving 10 percent less per year**[76].

[75] See footnote 78.
[76] See footnote 78.

Suggested actions:

1) Make a commitment to engage the public about food choice and its relation to a sustainable lifestyle. Large-scale behavior change is a difficult endeavor – focus the message on personal health and finances as well.

a) Create town and village partnerships with healthcare, schools, and other organizations to promote healthy, low-carbon diets.

b) Perform low- or no-cost carbon accounting at local farms to increase public awareness and support "carbon intensity labeling" for agricultural products. This could begin at farmers markets and over time become adopted by grocery stores.

LAND USE 20/20 GOAL 3

Although this report recommends a more intense focus on food-type choice to address GHG emissions, it is still recommended that residents of Red Hook increase the consumption of local foods in order to a) reduce their food's carbon footprint attributable to food shipment and b) support the local economy and local farmers.

While food-type choice is a change that can affect a greater percentage of food-related GHG emissions, increased support for and resulting growth of local food also has important economic and health implications for the future. A sustainable and vigorous local food supply may secure against potential widespread food shortages caused by future climate events. In the next century, if rates of global GHG emissions remain unmitigated, it is likely many places in the world will suffer debilitating food and water shortages due to frequent extreme weather events. If Red Hook works now to build its capacity for local agriculture, the worst effects of this scenario could be avoided.

In order for residents to increase local food consumption, they must not only have year-round access to local foods but also incentives to choose them over processed and imported options.

Suggested actions:

1) Increase the percentage of home-grown and locally sourced food by:

a) Increasing support of farmers markets and community supported agriculture (CSAs).

b) Increasing the use of public and private land and rooftops for growing food by

- performing public outreach and education events to connect individuals with local and regional resources for these projects;

- hosting workshops on gardening, backyard animal raising, food preservation (canning, jarring, etc.), and healthy cooking;

- developing new community garden plots.

c) Promoting fruit and nut trees as options for trees to be planted on public and private land;

d) Supporting lawn-to-garden initiatives.

2) Identify and implement Town and Village strategies to encourage local food production and distribution, including performing outreach and providing incentives.

3) Work with local large grocers (e.g. Hannaford) to encourage them to carry locally grown products; incentivize purchase by working to make these products price competitive with standard produce and animal products shipped from outside the state and country.

4) Establish quantitative methods to account for consumption of regionally sourced food, i.e. determine current rates of local food consumption, and recollect/reanalyze data in coming years after initiatives have taken effect.

LAND USE 20/20 GOAL 4

As stated in Goal 2, the vast majority of food-related emissions come from the production phase as opposed to the transportation of these products. Efforts can be made to change those practices that result in a portion of those emissions[77].

Suggestion actions:

1) Encourage farmers to fertilize crops with the precise amount of nitrogen required ("smart fertilizing"), since over-application of fertilizers can lead to higher nitrous oxide (N_2O) emissions.

a) Consider banning climate-active fumigants in farming and pest control.

2) Encourage farmers to adjust feeding and other management methods to reduce the emissions of methane (CH_4) from the digestion processes of livestock.

a) Encourage farmers to refer to best practices published by Cornell Cooperative Extension.

b) Improve pasture quality to increase animal productivity and reduce the amount of methane (CH_4) emitted per unit of animal product.

3) Encourage farmers to control the way in which manure decomposes to reduce nitrous oxide (N_2O) and methane (CH_4) emissions, for example, treating manure as a solid or depositing it on pasture rather than storing it in a liquid lagoon.

4) Encourage the capture of CH_4 emissions from manure decomposition to produce renewable energy by storing manure in enclosed anaerobic containment areas.

5) Connect farmers with local, state, and national organizations and programs to assist in making changes to farming practices, for example, the EPA's AgSTAR Program[78].

See the end of the section on Solid Waste (page 60) for an overview on Anaerobic Digestion as a renewable energy source, which can use waste from livestock as an energy fuel.

[77] http://www.epa.gov/climatechange/ghgemissions/sources/agriculture.html

[78] "A voluntary outreach and education program that promotes recovery and use of methane from animal manure." http://www.epa.gov/agstar/

CHAPTER 4: PREPARATION FOR CLIMATE CHANGE (ADAPTATION)

As discussed earlier in this report, building a strong plan to adapt to unavoidably changing conditions brought about by climate change is a necessary and obligatory part of any climate action plan. In fact, many towns, states, and countries develop separate climate adaptation plans to focus efforts on addressing experienced changes.

However, it is difficult to make concrete plans for effects that are not completely predictable. Scientists have an idea of what kinds of changes our warming climate will bring, but there is a large margin of uncertainty. The best climate adaptation plan for Red Hook will take that uncertainty into account and make general, wide-ranging recommendations that benefit communities regardless of the severity of the effect by improving economic prosperity, public health, and ecosystem health.

Moreover, many of the steps climate adaptation strategies recommend overlap with those appearing in climate action plans. Although we should be prepared to see inevitable changes in our climate, we must continue to mitigate greenhouse gas emissions in an attempt to slow or halt the development of these changes in the future.

The following list has been quoted directly from the Northeast Climate Impacts Assessment[79]. It is not useful as a concrete list of actions to take to prepare for climate change, but it is a good general summary of the forward-thinking behavior that will be required of policy makers in order to successfully implement adaptation strategies.

"How to Prioritize Adaptation Strategies:

The various strategies with which states, business sectors, and communities in the Northeast can prepare for climate change must be considered on a case-by-case basis. Each constituency is unique in the challenges it faces and its ability to adapt. However, the following principles can help set priorities:

1. Monitor the changing environment. Decision makers and resource managers must keep informed about the specific consequences of global warming for their region and areas of oversight. In particular, improved monitoring of both the climate and the condition of natural systems can give decision makers clearer signals about the need for action and more time to formulate appropriate adaptation strategies. [*In Red Hook, local farmers may be a good resource for understanding observed changes to the environment – although their knowledge will likely be more focused on their farmed land and less on natural areas, their dependence on the land and weather patterns for their livelihood could make them valuable assets as reporters to local policy makers. This plan recommends communicating regularly with the farming*

[79] Northeast Climate Impacts Assessment, 2007, pg. 124.

community about these matters in order to stay abreast of changes occurring in Red Hook.]

2. Track indicators of vulnerability and adaptation. Monitoring both the progress of specific adaptation strategies and the social factors that limit a community's ability to adapt can enable decision makers to modify adaptation strategies and improve outcomes.

3. Take the long view. Decisions with long-term implications (e.g., investments in infrastructure and capital-intensive equipment, irreversible land-use choices) must be considered in the context of climate projections.

4. Consider the most vulnerable first. Climate-sensitive species, ecosystems, economic sectors, communities, and populations that are already heavily stressed for non-climatic reasons should be given high priority in policy and management decisions.

5. Build on and strengthen social networks. Ties between trusted individuals and organizations are an asset for adaptation at the community level and within business sectors. Strong leaders can inspire organizations in times of difficult change, and well-connected and well-informed individuals can disseminate information that may be critical for effective adaptation.

6. Put regional assets to work. The Northeast has an enormous wealth of scientific and technological expertise in its universities and businesses that can be harnessed to improve our understanding of adaptation opportunities and challenges.

7. Improve public communication. Regular, effective communication with and engagement of the public on climate change helps build our regional capacity to adapt.

8. Act swiftly to reduce emissions. Strong, immediate action to reduce emissions, in the Northeast and globally, can slow climate change, limit its consequences, and give our society and ecosystems a better chance to successfully adapt to those changes we cannot avoid."

Specific recommendations for adapting to climate change:

Buildings:

- work hard now to adopt energy efficiency and renewable energy measures to safeguard against possibly rising energy prices or shortages.

- make air conditioning and Town/Village "cool spots" more widely available to cope with summer heat waves

- strictly enforce building codes and land use regulations to minimize risk of damage to personal health or property in the event of disaster

Agriculture:

- grow crop varieties better adapted to warmer conditions and longer growing seasons

- upgrade and add irrigation systems to prepare for droughts

- invest in cooling equipment for farms to preserve product, especially dairy

- encourage purchase of locally grown food to a) build strong local farms, and b) institute the behavior change early to ensure local food security in the event of widespread international food shortage/price increases due to drought and flood

Smart Land Use:

- maximize ground cover of plant mass to minimize erosion in the event of floods

- plant trees to maximize shade areas in several years

- build permanent embankments around homes and other buildings vulnerable to flooding in the event of severe storms

- apply "Ecosystem-based Approaches" which aim to increase ecosystem resilience and protect the critical ecosystem services on which humans depend, reducing vulnerability of human and natural systems to climate change[80]. EbAs offer a good complement to more common strategies such as infrastructure development[81].

Disaster Preparedness:

- work with existing Disaster Preparedness Committee to develop contingency plans and improve early warning systems[82] for potential events.

- prepare a contingency plan in the event of an influx of "climate refugees"/evacuees from coastal areas, including physical and mental health impacts[83] on these individuals in addition to providing temporary housing, food, and water supplies.

Community Institutions:

- build strong social institutions now for climate sensitivity, i.e. behaviors that support a sustainable community

- work with residents to update insurance policies to safeguard against the effects of climate-induced disasters

- foster strong and efficient mobilization of resources for adaptation measures, building a stable flow of financial and technical support to local actors[79].

Red Hook might investigate involvement in the EPA'S Climate Ready Water Utilities (CRWU) program[84] in the coming years to meet water supply and quality issues brought about by a changing climate. This initiative can assist in developing integrated water resources management and improved climate awareness among policy makers and utilities engineers.

Policy makers are beginning to recognize that in order to remain effective, water and natural systems policies must adjust in response to observable impacts on the environment. This is referred to as confronting the "stationarity" assumption in many of our natural resource policies, or the assumption that the meteorological and hydrological conditions underlying current water policies and utility planning practices will remain unchanged[85].

[80] http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation

[81] http://www.unep.org/climatechange/adaptation/EcosystemBasedAdaptation/tabid/29583/Default.aspx

[82] http://unfccc.int/resource/docs/2009/smsn/igo/054.pdf

[83] http://www.epa.gov/climatechange/impacts-adaptation/health.html

[84] For more information about CRWU, see: http://water.epa.gov/infrastructure/watersecurity/climate/

[85] http://water.epa.gov/drink/ndwac/climatechange/upload/CRWU-NDWAC-Final-Report-12-09-10-2.pdf

Table : *National Water Program Strategy* Potential Climate Change Impacts on Water Programs

Climate Change Impacts on Water Program (shaded area indicates program most impacted by climate change)	Air and Water Temperature Increase	Rainfall and Snowfall Levels/Distribution	Storm Intensity	Sea Level Rise	Changing Ocean Characteristics	Energy Generation Shifts
Drinking Water Standards	✓					
Drinking Water Planning		✓	✓	✓		✓
Underground Injection Control Permits		✓		✓		✓
Source Water Protection	✓	✓				✓
Drinking Water SRF	✓	✓	✓	✓		
Surface Water Standards	✓					✓
Clean Water Planning	✓			✓		
Discharge Permits	✓	✓	✓			
Nonpoint Pollution Control	✓	✓	✓			✓
Clean Water SRF	✓	✓	✓	✓		

Technology Based Standards						✓
Water Monitoring			✓		✓	
Stormwater Permits		✓	✓			
Coastal Zone			✓	✓	✓	
Ocean Protection			✓	✓	✓	✓
Emergency Planning			✓	✓		
Water Restoration/TMDLs	✓	✓	✓			
Wetlands Permits	✓		✓	✓	✓	
National Estuaries Program			✓	✓	✓	
Combined Sewer Overflow Plans		✓	✓			

Chart indicating programs most affected by climate change from Climate Ready Water Utilities, "Final Report of the National Drinking Water Advisory Council, 2010, Pg. 20. http://water.epa.gov/drink/ndwac/climatechange/upload/CRWU-NDWAC-Final-Report-12-09-10-2.pdf

This report recommends that Red Hook's local policy makers consult the "Final Report of the National Drinking Water Advisory Council" in order to prepare for inevitable environmental changes. Even if the effects of climate change are still years away, building awareness and understanding of the importance of acting appropriately in response, making the necessary policy changes, and building new/reinforcing existing infrastructure will be critical.

Policy makers should also consult ClimAid Integrated Assessment for Effective Climate-change Adaptation Strategies in New York State available from NYSERDA (http://www.nyserda.ny.gov/~/media/Files/Publications/Research/Environmental/EMEP/climaid/responding-to-climate-change-synthesis.ashx)

CHAPTER 5: COMMUNITY ENGAGEMENT

Red Hook residents' participation will be an essential part of the success of the 20/20 Goal. Over 30 percent of all carbon emissions result directly from household energy use, and over 40 percent of all carbon emissions come from the transportation sector, which is largely made up of personal vehicles. Citizens of Red Hook have already shown a commitment to reducing their carbon footprint by taking actions at home. For example, over 300 residents signed up for the 10% Challenge, and between 2010 and 2011, Red Hook's electricity use declined by 3 percent. Since this is an established program in Red Hook with continued forward momentum, Red Hook should take strides to continue the campaign with the help of Sustainable Hudson Valley and staff of entities such as unwasteNY and NYSERDA's Energy $mart Communities.

To build commitment and enthusiasm for this action, the Town and Villages will need to support a widespread public engagement campaign to educate residents on the purpose of the 20/20 Goal and the easy projects and changes they could undertake to make a contribution. As mentioned earlier in this document, meeting the 20/20 Goal will require the involvement of partners from all sectors of Red Hook. Planners and officials need to work together with residents and business people to develop a shared vision of Red Hook for the future. Community-wide goals and benchmarks must be established. Organizations must become strongly networked with one another and with residents and businesses in the community.

COMMUNITY ENGAGEMENT 20/20 GOAL 1

Connect effectively with all Red Hook residents and businesses and motivate them to change daily behaviors in ways that reduce individual carbon footprints. Incorporate participation by as many community stakeholders as possible, including residents, businesses and business organizations, not-for-profits, governmental bodies, State entities, religious groups, and civic organizations.

Suggested actions:

1. Continue to support the 10% Challenge Initiative by hosting/supporting outreach events.

    a) Take advantage of existing events as much as possible, and only focus resources on planning new events when necessary.

2. Work with local businesses to develop a green business network to further encourage other businesses to participate in carbon reduction measures.

3. Partner with Bard College to bring together academia, businesses, and government to encourage collaboration on sustainability policy development.

4. Partner with Bard College and the local school system to create student-led projects that can assist in the implementation of this ECAP document, the development of future GHG inventories, and the development of future additions to the ECAP.

5. Assist homeowners and businesses in learning how to understand the impacts of their energy use, to track and manage their energy use, and to improve energy efficiency.

6. Streamline the ECAP message to individuals by framing the language around clearly understandable benefits. ICLEI recommends emphasizing the following benefits of making efforts to reduce carbon reductions:

a) Saving money: Help individuals understand that saving energy saves money. For example, minor, inexpensive improvements to home energy efficiency can save hundreds of dollars every year on utility bills.

b) Improving air quality: Almost everything Red Hook does to reduce greenhouse gas emissions will improve air quality, making the community healthier and more pleasant to live in.

c) Reducing traffic: Aside from contributing to better air quality, residents' quality of life will improve with less time wasted sitting in traffic, and more time spent exercising while walking and biking.

d) Generally enhancing community quality of life: All of these aspects are part of a great quality of life that will be possible with a participation from everyone.

7. Support sustainability and climate change education in school district K-12 curricula by working with the school board and local teachers.

- sustainability and climate change can be incorporated into almost all typical school subjects.

COMMUNITY ENGAGEMENT 20/20 GOAL 2

In order for community engagement to be effective and far-reaching, the municipalities of Red Hook and Tivoli will need to emphasize the need for intergovernmental entities to work together. This includes various committees, boards, and staff in the Town and Villages. Each group has a unique range of reach into the community, and combining these abilities will amplify the efficacy of outreach efforts.

Suggested Action:

1. Ensure outreach projects involve multiple public and private entities from across municipal lines in their planning and implementation processes.

2. Incorporate the core philosophy of this ECAP into the workings of town committees/boards.

3. Work inter-municipally among the 3 local governments and also regionally – for example, work with the Northern Dutchess Alliance to incorporate climate action into their agenda.

Appendix A: Greenhouse Gas Emissions Calculations Methodology

From the GHG Inventory Consultant:

The Greenhouse Gas Inventory (GHG inventory) is a calculation of all GHG emissions that have originated within a defined area over a specified period of time. The consultant (Bard Graduate Lindsay Chapman) who developed the GHG inventory for Red Hook in 2009 stated that estimations of Red Hook's annual greenhouse gas emissions were made from a combination of various methods. When available, data about buildings, vehicles, and fuel consumed were collected to estimate actual annual emissions. In cases where specific data did not exist or was unattainable, estimations were made to determine emission volumes.

The GHG inventory conducted in 2009 was for the Town and Village of Red Hook and the Village of Tivoli for the year 2008. Bard College, which had compiled its own greenhouse gas inventory in 2008, was also included in Red Hook's inventory. An ICLEI achievement award was presented to Red Hook in June of 2010 for the completion of Milestone 1, defined by ICLEI as "conducting a baseline greenhouse gas inventory and forecast."

Red Hook's GHG inventory was estimated using ICLEI's Clean Air and Climate Protection (CACP) 2009 software. Data regarding fuel usage, fuel type, electricity usage, and population from the years 2005 through 2008 were entered into the CACP database. The CACP software estimates emissions from various sectors based on inputs. Energy purchases and invoices were used to tabulate energy used. When records were not available, utility companies were able to provide records of energy use. In the absence of utility records, data gaps were filled with estimates using pre- and post- months and years.

County population data along with state and regional fuel use estimates were used to assemble data for residential and commercial sectors.

Emissions from Bard College were not entered into the ICLEI database, but are included when considering total emissions from the Red Hook. For the purposes of this ECAP, Bard College is considered as an individual sector, separate from the government, residential, and commercial sectors.

Red Hook elected for the 2005 emissions from the Town and Villages to become the baseline against which future emission changes will be measured. The adopted 20/20 Goal specifies a 20 percent reduction by 2020 of 2005 carbon emissions levels. This ECAP therefore focuses on an analysis of 2005 emissions rates and sources.

Transportation sector carbon emissions calculations:

Using a formula from the EPA[86], this author made her own calculations for transportations emissions.

[86] http://www.epa.gov/cleanenergy/energy-resources/refs.html

The transportation calculations in the current ECAP:

- Assume a 20 mpg fuel efficiency average for 2005 passenger vehicles (EPA lists 20.4 as the 2007 fuel efficiency average),

- Use a total of 117,310,000 vehicle miles traveled (VMT), extrapolated from Dutchess County VMT and population data (3,180,122,495 VMT and 294,509 people) and Red Hook's 2005 population (10,864 people).

Those calculations are below:

3,180,122,495 VMT per year / 294,509 people =

10,798 VMT per person per year.

(10,798 VMT per person per year)(10,864 people) =

117,310,000 VMT in Red Hook for 2005.

Carbon emissions from this number were calculated using the following EPA formula:

(8.92 x 10^{-3} metric tons CO2/gallon gasoline) (VMT) (1 gallon / average miles) =

metric tons CO_2 e /vehicle/year.

(8.92 x 10^{-3} metric tons/gallon)(117,310,000 VMT)(1 gallon / 20 miles) =

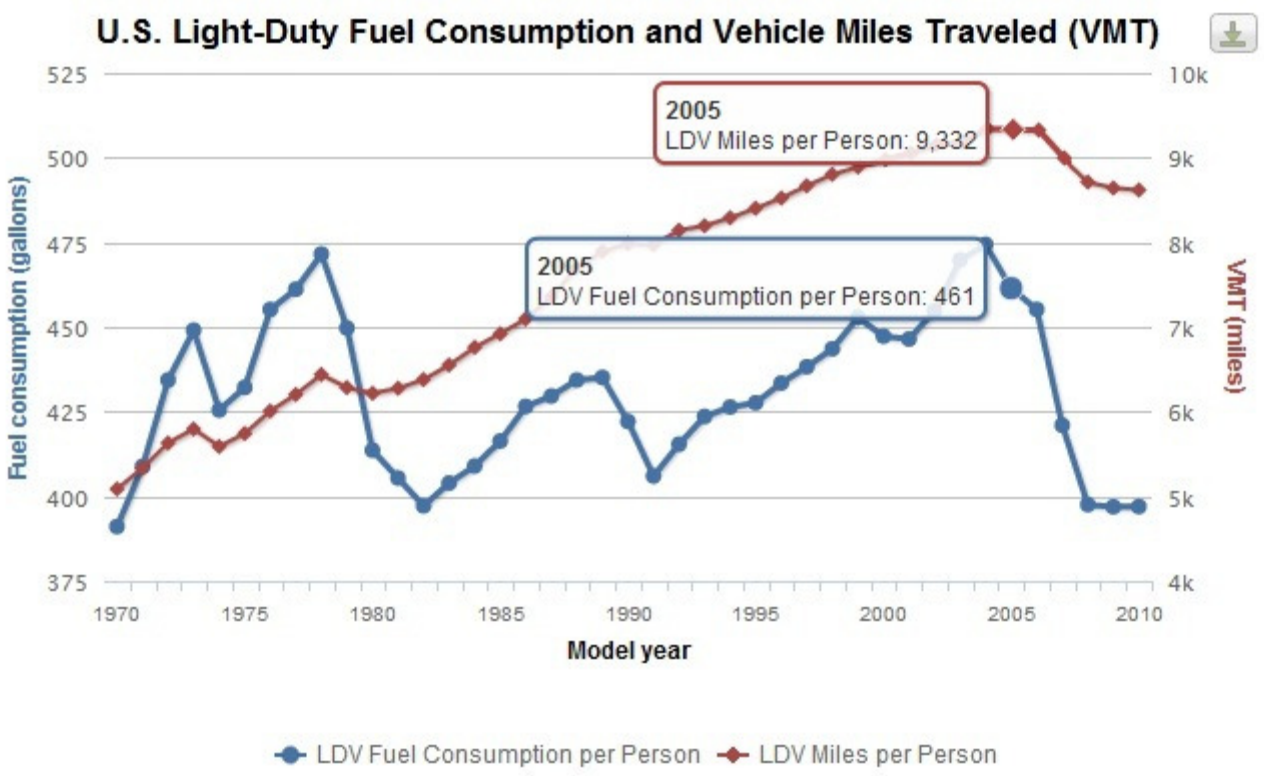
52,320 metric tons, or **57,672 tons.**

Gasoline consumption was estimated using Red Hook's calculated VMT per person per day and using data from the Alternative Fuel Data Center for 2005. The following graph shows that in 2005, Americans drove 9,332 miles per year (as opposed to Red Hook's 10,798 miles per person per year). It also shows that Americans per capita consumed an average of 461 gallons of gasoline in 2005, bringing that year's fuel efficiency to 20.2 miles per gallon. This number was used to calculate how much gasoline was consumed per capita by Red Hook residents in 2005.

(10,798 miles) (1 gallon / 20.2 miles) =

534.6 gallons per year / 365 days =

1.3 gallons per day.



Source: Bureau of Transportation Statistics (BTS) Table 4-11, 4-12, 1-32 (for VMT).

Notes: Data for 2007-2009 were calculated using new vehicle categories not consistent with previous years.

This chart shows annual per capita average vehicle miles traveled and per capita fuel use from 1970 through 2010 in light-duty vehicles (LDVs).

Graph from: http://www.afdc.energy.gov/data/tab/vehicles/data_set/10307

Calculations for Tons CO_2e Emitted per Fuel Source:

This author used the CACP software to calculate ICLEI's estimates on tons of CO_2e emissions per unit fuel source. This was done by isolating the usage rates for each fuel source and reading the resulting CACP software emissions results. Then, the tonnage output by the software was divided by the number of units of the fuel source being calculated.

This yielded the following results, which were listed earlier in this document:

Tons CO2e	per
0.000412	kWh electricity
0.0113	Gallon fuel oil
0.00006	Thousand Cubic Feet natural gas
2.48	Ton coal
0.0064	Gallon stationary LPG
0.00871	MMBtu wood
0.00892	Gallon gasoline

According to US EPA estimates, one kWh of electricity yields approximately 0.000760 tons of CO_2e, which is higher than the output calculated by ICLEI (0.000412 tons) but on the same order of magnitude. For the sake of consistency, the method described on the previous page was applied for all fuel types, and the outputs from CACP were used instead of those from the EPA. It is possible that the CACP software takes into account regional electricity sources to more accurately estimate a locality's emissions from electricity use. Since New York uses a high percentage of non-carbon-emitting hydropower, for example, it is possible that one kWh purchased in this state would have a lower carbon footprint than one purchased elsewhere.

Appendix B: Reductions Goals Calculation and Methodology

This ECAP did not specify reductions goals for each sector because it would be unrealistic to a) assume all sectors could reduce emissions by 20%, and b) make reductions goals assumptions without the proper information on feasibility for various reductions projects. Instead, a table of example projects or achievements and their resulting emissions reductions was drawn up for use as a reference before more general emissions reductions strategies were recommended.

Reductions in that table focused largely on building energy consumption and transportation, because those are two of the largest sources of emissions in Red Hook. As explained in that chapter, it is often most financially feasible to focus on larger emissions sectors because of greater accessibility to "low-hanging fruit" actions that can be accomplished with little financial input and can yield significant reductions.

The reductions actions that were quantified did not include certain measures that would likely be adopted because the effects were too difficult to accurately estimate.

Appendix C: Community Resources

State and County Community Resources:

NYSERDA: http://www.nyserda.ny.gov/

About:

"A public benefit corporation, NYSERDA offers objective information and analysis, innovative programs, technical expertise, and funding to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce their reliance on fossil fuels. NYSERDA professionals work to protect our environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York since 1975."

NYSERDA is one of the major providers of residential, commercial, and institutional energy audits and incentives for energy efficiency and renewable energy measures.

unwasteNY (formerly the Public Service Commission) http://www.unwasteny.org/

About:

"New Yorkers are spending more and more to power our homes and businesses every year, yet without realizing it, 25 percent of the energy we pay for, we waste. unwasteNY is a free public service that brings New Yorkers together to reduce our energy waste, so that we can all live more resourcefully. By illuminating energy use we can help homeowners and businesses eliminate energy waste."

Outreach coordinators are available especially to speak at community events about energy efficiency at home. They especially concentrate on low-income households and homeowners.

Cloud Institute for Sustainability Education http://www.cloudinstitute.org/

"Our mission is to ensure the viability of sustainable communities by leveraging changes in K-12 school systems to prepare young people for the shift toward a sustainable future."

The Cloud Institute could be an excellent resource for incorporating effective sustainability education into Red Hook school systems. Their methods aim to improve education and critical thinking all around, not just for the purpose of educating for sustainability.

Rural Ulster Preservation Company (RUPCO): http://www.rupco.org/

About:

"Our mission is to create homes, support people, and improve communities. Our vision is for strong vibrant communities with opportunity and a home for everyone."

In the context of this ECAP, RUPCO is an excellent resource as a temporary-to-permanent replacement of NYSERDA's Energy $mart Communities program in assisting the public in accessing NYSERDA's home and

commercial energy audit programs, including the EmPower program for low income households. RUPCO coordinators can perform the same duties as E$C coordinators insofar as speaking at events, co-hosting events, and assisting other organizations – like the CAC – with event planning. RUPCO coordinators are also able to follow through with customers and track their progress through the application and implementation processes of the NYSERDA programs.

Northern Dutchess Alliance http://www.northerndutchess.org/

About:

"Northern Dutchess Alliance aims to create a broad-based and inclusive institutional structure for regional cooperation and economic development throughout Northern Dutchess County with a public process that will lead to the implementation of the goals, ideas and policies established by the members of Northern Dutchess Alliance."

Dutchess County Community Action Partnership http://www.dutchesscap.org/

About:

"The mission of Community Action Partnership of Dutchess county is to serve low-income residents of Dutchess county by creating opportunities and advocacy for systemic changes that will support them in their journey to become self-sufficient."

Weatherization Assistance Program http://www.dutchesscap.org/weatherization/index.php

About:

"The Weatherization Assistance Program (WAP) lets income eligible families reduce their energy bills. Weatherization work is performed on your home to help you stay warmer in the winter and cooler in the summer. These services are offered at NO COST to eligible households.

We perform energy audits to determine which energy efficiency measures save you the most money! Weatherization crews also look for energy-related health and safety conditions and fix them."

Dutchess BOCES http://www.dcboces.org/

About:

"The Dutchess Board of Cooperative Educational Services provides educational leadership through service, solutions and savings. Dutchess BOCES is recognized for its premier educational and support services providing quality and cost-effective solutions for our community. We promote an organizational culture fostering collaboration, innovation, efficiency, excellence and leadership that is embraced by BOCES and its community."

BOCES administrators in surrounding counties have been interested in renewable energy technology training and in hosting events in coordination with NYSERDA. Dutchess BOCES could be helpful to the CAC

in hosting ECAP awareness events and/or planning renewable technology programs that enrich the Dutchess County community's access to 21st century job training.

Dutchess County Arts Council http://www.artsmidhudson.org/index.html

About:

"The mission of the Dutchess County Arts Council is to provide the leadership, funding, encouragement, and services necessary for the highest quality of art to thrive in our county and region, and for citizens to value the arts as an important part of daily life, economy, and social fabric of our communities."

The Arts Council could be instrumental in public outreach, or public events the incorporate art into ECAP awareness-building efforts.

Dutchess County Regional Chamber of Commerce http://www.dutchesscountyregionalchamber.org/

About:

The Dutches CoC could be a valuable networking resource within the business communities of Dutchess County. Could help with accessing the commercial sector to discuss energy efficiency measures and/or assistance with public awareness for the ECAP.

Dutchess County Economic Development Corporation http://www.thinkdutchess.com/dcedc/index.html

About:

"The formal mission statement of DCEDC is: To attract, retain, and expand for-profit and not-for profit businesses to Dutchess County."

The DCEDC brought the first solar cell manufacturer, SpecterWatt, into NY State in 2009. It is an established supporter of green economic growth in Dutchess County. Would likely be supportive of Red Hook's efforts to implement the ECAP.

Cornell Cooperative Extension of Dutchess County http://ccedutchess.org/

About:

"CCEDC works to extend the educational resources of Cornell University and the New York State Colleges of Agriculture and Life Sciences, Human Ecology and Veterinary Medicine, the Land Grant university system and other educational institutions, to the people of Dutchess County to foster economic, social and environmental improvement of its individuals, families and communities."

Environment and Energy Program http://ccedutchess.org/environmentenergy/overview

About:

"Through education, research and partnerships, the Environment and Energy Program empowers individuals and municipal groups to expand their knowledge and actions to protect, restore and enhance the environment of Dutchess County for future generations."

Resources for CACs http://ccedutchess.org/environmentenergy/resources-for-cacs-and-the-emc

About:

"CCEDC Environment and Energy Program staff work with Conservation Advisory Councils (CACs) and the Dutchess County Environmental Management Council to provide them with educational and technical resources and organizational support. We maintain a directory and online community to inform municipal groups of upcoming environmental events and educational resources, and assist in their efforts to develop environmental ordinances, and adopt better site design principles in their municipal codes."

The CCEDC could be an excellent resource for events, information, and networking with other communities on conservation and climate. The CCEDC can also assist the Town Board/CAC in adopting resolutions/ordinances required to enforce green policies.

Dutchess County Industrial Development Agency http://www.dutchesscountyida.org/dcida_proto/

About:

"The Dutchess County Industrial Development Agency (DCIDA) is a public benefit corporation created by state law in 1976 to promote economic development and job creation in Dutchess County. The DCIDA induces companies to invest capital in projects that create jobs and increase the county's tax base, thereby improving the quality of life for Dutchess County residents."

The IDA could have possible future interest in support of ECAP to support the growth of the green jobs sector, in addition to helping the local economy weather the influx of possible climate refugees from nearby coastal areas.

Dutchess County School Board Association http://www.dcsba.org/

About:

"…A cooperative project of districts in the county to promote education and enhance the knowledge of serving school board members…The mission remains to provide leadership for and support services to our component school boards and their members….[and] to provide a permanent organization which will represent member school districts to various regulatory and legislative bodies at the local, state, and national levels."

The School Board Administration currently seems very focused on school taxes, but could be instrumental in future efforts to bring sustainability education into school curricula across the county.

Dutchess County Historical Society http://dutchesscountyhistoricalsociety.org/index.html

About:

"Dutchess County Historical Society collects, preserves and promotes the county's history to educate and engage both present and future generations. We look forward to serving your needs and interests through our collections and research library, our programs and events, our publications and member benefits, and our volunteer and school resource opportunities."

The historical society could have future interest in climate change mitigation and adaptation to protect the integrity of historic sites at risk of inundation or other damage due to extreme weather.

Dutchess County Environment/Land Preservation
http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/16138.htm

About:

Includes Dutchess County Natural Resource Inventory (NRI), Dutchess Goes Green, Environmental Impact Statements, Greenway - Centers and Greenspaces, Open Space and Farmland Protection sections.

Dutchess County Natural Resource Inventory
http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/16138.htm

About:

Includes Planning, Calendar of Events, Community Development & Housing, GIS & Mapping, Transportation Council, LOOP Bus, Census & Data, Publications & Forms, and Planning-Related Links sections

Dutchess Goes Green http://www.co.dutchess.ny.us/CountyGov/12563.htm :

About:

Includes County Executive's Message, Dutchess County's Green / Sustainability Plan, In the News, Current County Green Practices, Recycling in Dutchess County, Daily Green Tips, Ride Sharing Assistance, and Carbonrally sections.

Environmental Impact Statements http://www.co.dutchess.ny.us/CountyGov/10880.htm

About:

"A list of draft and final Environmental Impact Statements that have been submitted to the State DEC by departments of Dutchess County Government."

Greenway – Centers & Greenspaces
http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/17329.htm

About:

Like the Natural Resource Inventory Page, also provides links to planning, Calendar of Events, Community Development & Housing, GIS & Mapping, Transportation Council, LOOP Bus, Census & Data, Publications & Forms, and Planning-Related Links sections.

Open Space and Farmland Protection
http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/16882.htm

About:

"The PMG [Partnership for Manageable Growth] Open Space & Farmland Protection program was created in 1999 to assist the County and its municipalities in implementing the Dutchess County Agriculture and Farmland Protection Plan by protecting important agricultural and open space resources. The program provides a matching portion of fee simple, development rights, or the conservation easement purchase price up to 50% of the total project cost. Applicants work in partnership with the County and other public and private funding sources in order to secure full project funding. Since its inception, the program has helped protect over 2,363 acres of farmland and open space in Dutchess County."

Red Hook Farms protected by the PMG:
Linden Farms — 234-acre vegetable farm
Mead Orchards — 100 acres of fruit orchard/ vegetable farm
Mead Orchards II — 82 acres of orchard
Steiner Farm — 228-acre farm in the breadbasket of Red Hook
Wil-Hi Farm — 15-acre sheep farm

Like the Natural Resource Inventory Page, also provides links to planning, Calendar of Events, Community Development & Housing, GIS & Mapping, Transportation Council, LOOP Bus, Census & Data, Publications & Forms, and Planning-Related Links sections.

Also includes links to application materials and information on completed and pending projects.

Red Hook Area Community Resources

Sustainable Hudson Valley/10% Challenge: http://www.sustainhv.org/ / http://redhookchallenge.org/

About:

"Sustainable Hudson Valley's mission is to speed up the shift to a low-carbon economy with high quality of life for all, by bringing people together with knowledge and each other."

"The 10% Challenge is a call to reduce our town's energy use by ten percent over the next year and to get 10% of our co-workers, citizens, or social network involved."

Red Hook's 10% Challenge campaign was kicked off in October, 2010, and helped the town reduce its energy use by approximately 3% by the end of 2011. The campaign will continue and should work hand-in-hand with organizations such as NYSERDA, RUPCO, unwasteNY, and in the implementation of the ECAP.

Bard College

About:

Bard Center for Environmental Policy http://www.bard.edu/cep/ (Molly Williams, Admissions: cep@bard.edu, 845-758-7071)

Center for Civic Engagement http://www.bard.edu/civicengagement/ (Erin Cannan, Assoc. Director: cannan@bard.edu)

Sustainability Coordinator (Laurie Husted: husted@bard.edu, 845-464-8025)

Red Hook Public Library http://redhooklibrary.org/

About:

"The mission of the Red Hook Public Library is to provide services and materials for our community residents of all ages for their personal growth, enjoyment and educational needs."

The Red Hook Public Library, specifically librarian Erica Freudenberger, has expressed interest in and agreed to host energy efficiency events on behalf of Sustainable Hudson Valley. The Library would likely be interested in supporting the CAC and education about the ECAP.

Tivoli Free Library http://www.tivolilibrary.org/

About:

Like the Red Hook library, the Tivoli Free Library will likely be a good community gathering place for informational events for the ECAP.

Red Hook Area Chamber of Commerce http://www.redhookchamber.org/

About:

"The Chamber was organized for the purpose of advancing the trade, commercial, industrial and civic interests of the Red Hook Area."

[*Like the Dutchess county IDA, the Red Hook COC could have future interest in support of ECAP to support the growth of the green jobs sector, in addition to helping the local economy weather the influx of possible climate refugees from nearby coastal areas.*]

Red Hook Community Arts Network http://rhcan.blogspot.com/

About:

"The Red Hook Community Arts Network is dedicated to creating an environment that engages creativity, art, and culture as a catalyst for community transformation, sustainability, prosperity, and livability."

An opportunity to build community involvement and conversation around the ECAP and its implementation through creativity and teamwork. The RHCAN is a potential sponsor for community art projects to raise awareness of sustainability and the ECAP.

Montgomery Place (Historic Hudson Valley) (Annandale-on-Hudson) http://www.hudsonvalley.org/historic-sites/montgomery-place

About:

"Montgomery Place, a serene reflection of nearly 200 years of continuous family stewardship…But the totality of the estate - house, gardens, arboretum, woodlands, orchards, hamlet, and natural features - makes it a unique American treasure."

[*Possible future interest in climate change mitigation and adaptation to protect the integrity of this historic site at risk of inundation or other damage due to extreme weather, especially due to its location very close to the banks of the Hudson. Additionally, if the energy use at Montgomery Place has not yet been included in the emissions inventory, working closely with Historic Hudson Valley to obtain utility records for the property will assist the CAC in obtaining a more complete picture of the Red Hook community's total emissions. As an older property, weatherization projects could significantly improve its energy efficiency. Its beautiful location could provide a good location for future events planned around public outreach for ECAP related activities.]*

Red Hook Central Schools http://www.redhookcentralschools.org/redhookcentral/site/default.asp

About:

"The mission of the Red Hook Central School District shall be to develop in its students the knowledge, intellectual integrity, and social consciousness to prepare them to accept the obligations and opportunities found in a complex society. The District seeks to provide a challenging educational environment that fosters and rewards the values of respect, responsibility, honesty, integrity, and community service in all its members."

Superintendant Paul Finch: pfinch@rhcsd.org,

845-758-2241, Ext. 4720

Facilities Director Perry Sheldon: psheldon@rhcsd.org,

845-758-2241, Ext. 4705

Who Cares Club; Mary Pat Budd: mpbudd@rhcsd.org,

845-758-2241 ext. 3324

Environmental Conservation Club; Ken Erb: kerb@rhcsd.org,

845-758-2241 ext. 3228

The Red Hook Central School District has implemented a "Virtual Backpack" program to eliminate paper waste generated from send-home newsletters for students' families. This project was part of the school district's pledge to the 10% Challenge campaign. RHCS has also expressed interest in working to increase school bus riding to cut down on passenger car emissions related to school traffic, and to investigating the installation of solar panels to supplement the electricity consumed by some of the buildings. Red Hook High School hosts an annual career fair, and always invites local environmental organizations to represent green jobs. Because the district and schools have shown interest and activity in energy reduction and environmental awareness, in addition to the fairly large contributions to Red Hook's total GHG emissions, the school district likely would be a strong ally in the implementation of the ECAP.

Devereux School http://www.devereux.org/site/PageServer?pagename=ny_index

About:

"Devereux is a leading nonprofit behavioral health organization that supports many of the most underserved and vulnerable members of our communities."

[*Because the Devereux School is a large complex, and has not yet been incorporated into the Red Hook GHG inventory, working with the School will be important to future drafts of the ECAP in order to accurately represent energy consumption and emissions rates. The CAC will need to work with the Devereux School to obtain reports from Central Hudson on its utility use from 2005 moving forward. The School's involvement in ECAP implementation could begin with energy efficiency upgrades and lead to investigation of renewable installation. The School could also sponsor and/or host future CAC/ECAP events. Involvement in ECAP events could foster enhanced interaction between the school and the community.*]

Unification Theological Seminary (Barrytown hamlet) http://www.barrytowncollege.org/home.html

About:

"Unification Theological Seminary educates people of faith for ministry and professional life by engaging them in personal spiritual formation, equipping them with resources for sound theological and intercultural understanding, and empowering them to serve communities of the Christian and diverse faiths, to the glory of God and benefit of humanity."

Because UTS is a large complex, and has not yet been incorporated into the Red Hook GHG inventory, working with the Seminary will be important to future drafts of the ECAP in order to accurately represent energy consumption and emissions rates. The CAC will need to work with UTS to obtain reports from Central Hudson on its utility use from 2005 moving forward. Furthermore, conversations should be

started about how environmental stewardship is incorporated into the curricula at the Seminary. The Seminary's involvement in ECAP implementation could begin with energy efficiency upgrades and lead to investigation of renewable installation. The Seminary could also sponsor and/or host future CAC/ECAP events. Involvement in ECAP events could foster enhanced interaction between the school and the community. Henry Christopher is the contact for this group and is the publisher of the Barrytown Gazette.

Red Hook Golf Club http://www.redhookgolfclub.com/

About:

"Red Hook Golf Club is a semi-private club…easily accessible from the Taconic Parkway and Route 9, which has enabled the club to attract many members from the New York City area."

Because the golf club is a facility used by a large number of residents of the greater Red Hook area and beyond, its support and involvement in the ECAP implementation process could provide a valuable conduit between the CAC and the general public. Additionally, since the maintenance of golf course grounds is so landscape and lawn intensive, land use policies to optimize the facility's relationship with the environment could have a significant impact on Red Hook's total emissions. Increasing use of organic fertilizers, organic pest control, the incorporation of native plants into landscaping, and landscaping to maximize natural rainwater reticence and use in watering are only a few ways the Red Hook Golf Club could show its support of the ECAP in the future.

Red Hook Farmers' Market

About:

Farmers' Markets provide excellent public outreach opportunities. The CAC could plan to host a table weekly to represent the ECAP and provide information to the public about energy audits, weatherization projects, and future town/village events focused on energy and environment. It could also be an opportunity to find volunteers for further implementation projects. Providing a public face for the ECAP document will help the public to feel the plan is more accessible, "real," and an active presence in the community.

Other Community Organizations, Groups, and Contacts

Town of Red Hook Tree Commission (Nancy Guski, Chair: nmg@frontiernet.net, 845-757-5121)

Town of Red Hook Senior Services (Senior Services - Andy Kehr, Chair: kehr@frontiernet.net, 845-464-5067)

Agriculture and Open Space (Pete Hubbell, Norm Greig, Co-chairs: pete@rphubb.com, ngreig@hvc.rr.com)

Red Hook Trails Committee (Howie Callies, Chair: hoca@mycelery.com, 845-758-4410)

Village of Red Hook Green Tree Committee (Brenda Cagle, Officer: brendacagle@yahoo.com, 845-758-0504)

Village of Tivoli Green Committee (Village Trustee, Green Committee Contact -Joel Griffith: jrobertgriffith@yahoo.com, 845-757-2021)

Veterans of Foreign Wars Post 7765 http://www.vfw7765.org/

St. Christopher School http://www.stchrisredhook.org/ReligiousEducation.html

United Methodist Church of Red Hook and Rowe http://redhookumc.org/

Northern Dutchess Bible Church http://www.ndbiblechurch.org/

St. John's Reformed Church http://www.stjohnsreformed.org/

St. John's Episcopal Church (Barrytown) http://stjohnsbarrytown.dioceseny.org/hisotry_of_stjs.htm

St. Paul's Church (Tivoli) http://stpaulstivoli.org/

Red Hook Rhinebeck Elks http://www.elklodge.org

Hendrick Hudson Lodge No. 875 http://redhookmasons.org

Friends of Elmendorph Inn http://elmendorph.org/

Egbert Benson Historical Society of Red Hook http://www.redhookhistory.com/

Monumental Masonic Lodge (Tivoli) 845-757-3532

Harris-Smith American Legion, **Post 524** (Tivoli) 845-757-4489

Red Hook Rotary Club http://www.redhookrotaryclub.org/

Red Hook Seniors 845-876-2428

Old Dutch Village Garden Club 845-758-5653

PANDA Public Access TV for the Northern Dutchess Area http://pandatv23.org/

Boy Scouts rpope1@hvc.rr.com, 845 758-9478

Girl Scouts jen@potluck.com

Farms

Migliorelli Farms (produce) http://migliorelli.com/
"Migliorelli Farm is committed in working toward a future of less fossil fuel dependency by studying various options to implement a biomass digester system combined with farm labor housing and greenhouse production."

Panorama Farm (horse farm and equestrian facility) http://www.panoramafarm.com/

Northwind Farm (poultry, pork, goat, lamb, foul, beef with CSA service) (This farm also has a solar installation – more information needs to be gathered about the installation's size and generating capacity.) http://www.northwindfarmsallnatural.com/www.northwindfarmsallnatural.com/Home.html

Blue Ribbon Farm and Academy (horse farm and equestrian facility) http://blueribbonacademy.com/

Werner Farms (518) 537-4008

Blue Star Farms, Inc. (horse farm and equestrian facility) http://www.bluestarfarmsltd.com/

Jantzen Farm (845) 756-2386

Viking Farms, Inc. (845) 758-3017

Hardeman Orchards (845) 758-5154

Paisley Farm (Upstate Farms) (produce, also provides CSA service to Hudson Valley and NYC) http://upstatefarmsny.com/paisleyfarm.html

Nannick Farms (845) 756-5350

Alison Wines and Vineyards http://www.alisonwines.com/index.asp

Greig Farm (produce, plant nursery, goats) http://www.greigfarm.com/
"We do not use systemic chemicals and chose [sic] natural predators over the chemical solution whenever possible."

Fraleigh's Rose Hill Farm (produce and orchard fruits) http://www.pickrosehillfarm.com/

Sawkill Farm (Robertson Farms LLC) (organic vegetables, pasture/humanely raised beef, pork, poultry) http://www.localharvest.org/sawkill-farm-M42806

Kalina Farms (845) 758-1711

F W Battenfeld & Son (Christmas trees) http://christmastreefarm.us/

Pistil Farm (flowers) http://www.pistilfarm.com/

Shoving Leopard Farm (vegetables and flowers) (Barrytown)
http://www.superiorconcept.org/shovingleopard/
Small 2-acre farm that uses no synthetic pesticides or fertilizers. Also provides CSA.

Hearty Roots Community Farm (produce and CSA in Hudson Valley and NYC)
http://www.heartyroots.com/

Linden Farms (234 acre vegetable farm) (845) 758-6184

Mead Orchards (100 acres produce farm and fruit orchard) http://www.meadorchards.com/

Mead Orchards II (82 acres of orchard adjacent to the original farm)

Steiner Farm (228-acre farm)

Wil-Hi Farm (15-acre sheep farm – wool and meat) http://wil-hifarm.com/index.html

Newspapers or Other Publications

Poughkeepsie Journal
Red Hook Observer
Barrytown Gazette
The Daily Freeman

Appendix D: Introduction Letter and Certificate of Support to be Sent to Community Stakeholders

Introduction Letter

___ Date

I would like to introduce a project commissioned by Red Hook's Conservation Advisory Council (CAC) on a project called the Energy and Climate Action Plan (ECAP). The ECAP's goal is to help the Red Hook community reduce its impact on the environment by focusing on reducing energy use. Reducing energy use also has the important benefits of saving money on utility bills and maintaining our community's clean air and water. The ECAP is available for public viewing should you wish to read the document.

I would like to invite you, an important community stakeholder, to be involved in the support of the ECAP. The CAC is only asking for your commitment to show support for the ECAP. This could mean supporting the CAC at public outreach events, for instance, or setting an example in the community by reducing energy use within your own organization. Attached to this letter is a "Certificate of Support" further explaining how you can support the ECAP and asking for your signature.

If you are willing to participate, your involvement will be very meaningful to the success of the ECAP. Plus, you will join a dynamic group of organizations and businesses in the area who are setting the stage for a project that will improve our community's environment, economy, and health. Please return signed Certificates to Laurie Husted, Chair of the CAC, and feel free to contact her with any questions or concerns.

husted@bard.edu
Bard College
PO Box 5000
Annandale-on-Hudson, NY 12504
Office: 845-758-7180

Mailed or emailed copies are both welcome. We look forward to your reply and thank you warmly for your support.

Best regards,

_____

Certificate of Support for the Red Hook Energy and Climate Action Plan

To the Red Hook Conservation Advisory Council (CAC):

I, as a representative of _____, have been informed of the purpose of the Energy and Climate Action Plan (ECAP) developed by the CAC. I understand its goals and potential positive impacts on the environment, economy, and health of the communities of Red Hook and Tivoli.

I also understand the important role Red Hook's and Tivolie's businesses and organizations will play in the public outreach and education efforts that will make this plan successful in our community.

My business or organization will be influential in providing this support through a willingness to:

- Attend/exhibit at outreach events planned by the CAC, **and/or**
- Host outreach events, **and/or**
- Provide information to the public about the ECAP at my place of business and on my website, and at community events where I am exhibiting, **and/or**
- Set an example to fellow community members by reducing energy use in my own building/home using recommendation provided by the ECAP.

By signing this letter of intent my business or organization lends its support to the Red Hook CAC to carry out the goals of the Energy and Climate Action Plan in the Town and Villages of Red Hook, Tivoli, and their surrounding hamlets.

_____ _____

Signature Date

_____

Printed Name

_____

Name of Organization

_____ _____

CAC Member Signature Date

Please return to Laurie Husted at husted@bard.edu, or
Bard College, P.O. Box 5000, Annandale-on-Hudson, NY 12504

Appendix E:

This appendix is an extension of the various renewable energy technologies that are available for adoption by the Red Hook area municipalities, businesses, and private residents overviewed in Chapter 3. It provides explanations of how each technology works, the benefits of adopting them, cost estimates and detailed lists of available state incentives, and recommendations for site feasibility, installation, and provider selection.

Geothermal Heat Pumps [87]

Geothermal heat pumps (also called GeoExchange, earth-coupled, ground-source, or water-source heat pumps) are not a brand new technology; in fact, geothermal heat pumps have been used since the late 1940s.

These heat pumps use underground or underwater temperatures – which remain constant throughout the year – to heat buildings in winter and cool them in the summer, and can also be used to heat water. Because underground temperatures are more consistent than those of outside air, geothermal systems reach higher efficiencies (300 – 600 percent) on even the coldest winter nights, compared to the efficiency (175 – 250 percent) of air-source heat pumps on milder cool days.

Approximately 50,000 geothermal heat pumps are installed in the United States every year.

Benefits of Geothermal Heat Pumps:

Because they use the renewable resource of the temperatures underground or underwater, their most significant benefit is that:

- **typical annual energy savings range from 30% to 60%.**

Additional Benefits:

- will reduce the amount of air pollution and greenhouse gases emitted from burning fossil fuels to heat a building.
- greater humidity control by maintaining about 50% relative indoor humidity, which is helpful for the prevention of mold growth but also is an improvement on the dry air generated by central heating systems in winter.

[87] Information on geothermal technology from the U.S. Department of Energy: http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

- the ability to be installed in both new and existing buildings.
- smaller size than traditional HVAC equipment saves space.
- the ability to provide excellent “zone” space conditioning, allowing for individual room temperatures to be controlled by building occupants.
- few moving parts and indoor installation makes systems durable and reliable with little maintenance required, and improved accessibility for routine upkeep.
- many systems come with warranties on underground piping components for 25-50 years.
- systems last about 25 years for the inside components, and over 50 years for the outdoor ground loop (estimates by the US Department of Energy).
- compared to traditional air conditioning units, geothermal heat pumps generate no noise.
- efficacy and cost operation not affected by temperature of outside air.
- most systems will be automatically covered under homeowner's insurance policies with proper notification to the provider that the system has been installed.

Costs:

The installation price of a geothermal system can be several times that of an air-source system or gas-fired furnace of the same heating and cooling capacity, however:

- depending on site characteristics (climate, soil conditions, and the system features chosen) and available financing and incentives, **initial investments may be returned in two to ten years through lower utility bills**.
- **energy bill savings are visible every month**.
- for extra savings, units equipped with a device called a "desuperheater" can **heat the household water**; in warm months, the heat that is taken from the house is used to heat water for free, and in cool months, a geothermal heat pump will reduce water heating costs by about half.
- banks and mortgage companies may offer an "**energy-efficient mortgage**" covering the purchase of a geothermal system plus other energy-saving retrofits to the home.
- when included in a mortgage, a geothermal heat pump can have a **positive cash flow right away**. For example, if the cost of the system were an extra $3,500 and were to add $30 per month to each mortgage payment, one year’s energy cost savings would easily exceed that added mortgage amount.
- other **special financing options and incentives** from state and federal governments may be available to help offset the cost of adding a geothermal system. See below for in-depth information about cash-back incentives and tax rebates, and *consult these sources before moving forward with purchase and installation to ensure compliance with requirements for receiving incentives and rebates*.

Some of New York State's incentives: [88]

**There currently are no NYSERDA programs to specifically incentivize geothermal heat pumps, but they may be considered an eligible home performance measure within the Home Performance with ENERGY STAR® and Assisted Home Performance with ENERGY STAR® programs[89]. In these programs, participants can receive up to 10 percent or 50 percent off the total cost of efficiency measures, respectively. If a heat pump is installed as part of this work, the cost of the heat pump will be included in the total cost of the efficiency measures. However, the AHPwES 50 percent rebate is capped at $5,000 for single family homes.*

- PACE Financing loans up to 10% of total property value for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors
- Energy Conservation Improvements Property Tax Exemption of 100% of the value added to residence
- financing through Home Performance with ENERGY STAR®[90] program

How Geothermal Heat Pumps Work:

Geothermal heat pumps use the constant temperature of the earth to regulate indoor air temperature instead of using electricity, gas, or oil to condition air that comes from outside, potentially at extremely hot or cold temperatures depending on the weather.

Although outside air temperature can fluctuate dramatically, the temperature just a few feet below the earth's surface remains fairly constant, anywhere from 45°F to 75°F depending on location. This ground temperature is warmer than air temperature during the winter and cooler in the summer. A geothermal heat pump's **ground heat exchanger** uses these constant underground temperatures to heat or cool buildings.

When referring to these systems, a **ground loop** is the system of pipes containing water or other temperature regulating fluids that actually draws the heat from the ground to be transferred to the building through the heat exchanger.

Site Feasibility:

Geothermal heat pumps can be used almost anywhere in the US, but certain site characteristics will help determine which kind of system is best. Those characteristics include the geology, hydrology, and land space of the site.

- **Geology:**
  - the composition of soil and soil-to-rock ratio can affect heat transfer rates for ground loops, determining the size of the ground loop required.

[88] Refer to this webpage for more information on rebates and incentives for renewable energy and energy efficiency: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=0&state=NY

[89] http://www.nyserda.ny.gov/en/Page-Sections/Renewables/Geothermal-Heat-Pumps.aspx

[90] http://www.nyserda.ny.gov/en/Page-Sections/Residential/Programs/Existing-Home-Renovations.aspx

- amount of soil available contributes to system design, determining whether a vertical or horizontal ground loop is best (hard rock or shallow soil vs. deep, less rocky soil, respectively)

- **Hydrology:**
  - ground or surface water availability also helps determine what type of ground loop to use.
  - Ensure the system supplier/installer fully explores the site's hydrology in order to avoid problems such as aquifer depletion and groundwater contamination (although antifreeze fluids circulated through closed-loop systems generally pose little to no environmental hazard).

- **Land Availability:**
  - amount and layout of land, landscaping, and the location of underground utilities or sprinkler systems also affect system design.

Types of heat pumps:

1. **Heat sources:**

Pure Geothermal Systems:

- no components for pumping air to supplement geothermal energy, and use only one geothermal resource.
- type of system discussed throughout the entirety of this part of the ECAP.

Dual-source Systems:

- combines an air-source heat pump with a geothermal heat pump.
- have higher efficiency ratings than air-source units, but lower efficiency than pure geothermal units.
- cost much less to install than a single geothermal unit, and work nearly as well.

Hybrid Systems:

- use several different geothermal resources, or a combination of a geothermal resources with outdoor air
- most effective where cooling needs are much greater than heating needs.

2. **Closed vs. Open Ground Loop Systems:** Choice depends on climate, soil conditions, land availability, and local installation costs; all appropriate for both residential and commercial applications.

Closed-loop systems: A heat exchanger transfers heat between refrigerant in the heat pump and antifreeze solution in the closed loop, usually composed of plastic tubing. The loop can be in a horizontal, vertical, or pond/lake configuration (discussed below).

However, in a **direct exchange** system, there is no heat exchanger. Refrigerant is pumped directly through copper tubing in a horizontal or vertical underground configuration. These systems require a larger compressor and moist soils, which can necessitate adding an irrigation system. *Because these systems circulate refrigerant through the ground, local environmental regulations may prohibit their use in some locations. Not suitable for site with corrosive soils.*

- **Horizontal**:
  - most cost-effective for residential installations,
  - good for new construction where sufficient land is available.
  - land area required prohibitive for larger facilities such as commercial buildings or schools.
- **Vertical:**
  - good for large facilities such as commercial buildings and schools
  - can be used in shallower soils
  - minimize the disturbance to existing landscaping

- **Pond/Lake:**
  - may be the lowest cost option for a site with and adequate body of water (meets minimum volume, depth, and quality requirements).

Open-loop systems: Well or surface body water is used as the heat exchange fluid that circulates directly through the system. Water returns to the ground through the well, a recharge well, or by surface discharge. Open-loop systems can only be used on sites with enough water that is sufficiently clean. Also, all local codes and regulations regarding groundwater discharge must be met.

Selecting and Installing a Geothermal Heat Pump System

Selection:

- heating efficiency of ground-source and water-source heat pump indicated by the coefficient of performance (COP), the ratio of heat provided in Btu per Btu of energy input.
- cooling efficiency indicated by the Energy Efficiency Ratio (EER), the ratio of the heat removed (in Btu per hour) to the electricity required (in watts) to run the unit.
- an ENERGY STAR® label indicates a heating COP of 2.8 or greater and an EER of 13 or greater. If no label is evident on a unit, ask for efficiency ratings of at least 2.8 COP or 13 EER.
- special financing incentives may be available for ENERGY STAR® qualified units.

Installation:

- not a do-it-yourself project: find a qualified installer through NYSERDA[91], Central Hudson[92], the International Ground Source Heat Pump Association[93], or the Geothermal Exchange Organization[94].
- ask the installer for references.

Solar Thermal (Active Solar Heating)[95]

Solar Thermal (also called Active Solar Heating) technology uses energy from the sun's rays (solar radiation) to heat building interiors and to heat water.

Benefits of Solar Thermal Systems:

Heating a building with solar thermal can significantly cut down on "dirty" energy consumption.

Other benefits include:

- significant reduction in utility bills in the winter.
- reduction in the amount of air pollution and greenhouse gases emitted from burning fossil fuels to heat a building.
- most solar water heaters are automatically covered under homeowners' insurance policies.

Costs:

The cost of a solar thermal system (or "collector") will vary depending on system size, frequency of use throughout the year, available state and federal incentives and rebates, and total supplementation of a building's heat supply.

- the larger the system, the lower the cost per unit of collector area.
- systems range from $30 to $80 per square foot of collector area, installed.
- systems often come with warranties of 10 years or more.
- systems very often last for decades.
- optimize the cost/benefit ratio by using the system to heat water in the summer, when it would otherwise not be in use.
- unless used year-round (for heat in winter and hot water in summer), solar thermal systems are most cost-effective in sunnier, colder climates (i.e. in places with long cool seasons).
- more economical when displacing expensive heat sources like electricity, propane, and oil heat.
- most cost-effective systems provide 40%–80% of a home's heating needs.

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[91] NYSERDA: http://www.nyserda.ny.gov/en/Page-Sections/Renewables/Geothermal-Heat-Pumps.aspx,
[92] Central Hudson: http://www.centralhudson.com/products_services/geothermal_heat_pumps.html
[93] International Ground Source Heat Pump Association: http://www.igshpa.okstate.edu/
[94] Geothermal Exchange Organization: http://www.geoexchange.org/
[95] US Department of Energy's page on solar thermal:
http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12490

- well designed and/or insulated homes require smaller systems and may need to use little other heat from sources than the solar thermal system.

Some of New York State's incentives[96]:

- cash back incentive from NYSERDA of up to $4,000 per residential site and up to $25,000 per commercial site (15-20 percent of total cost)[97]
- a Residential Solar Tax Credit up to $5,000
- an Energy Conservation Improvements Property Tax Exemption of 100% of value added to property through addition of system (solar water heating only)
- residential State and Local Sales Tax exemptions of 100 percent of sales taxes
- commercial, industrial, residential, and agricultural sector Solar, Wind, and Biomass Energy Systems Exemptions of 100 percent exemption for 15 years.
- PACE Financing loans up to 10% of total property value for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors
- financing through Home Performance with ENERGY STAR® program
- *Investigate the requirements for receiving rebates and incentives before moving forward with the purchase and installation of a solar thermal system to ensure compliance and that rebates/incentives will be received.*

How Solar Thermal Systems Work:

There are two types of solar thermal systems: solar air and solar liquid systems. Heat generated from solar radiation is either sent directly to heat an interior space or to a storage system that distributes the heat. Liquid systems usually have included storage systems and are better to use with radiant heating systems, boilers with hot water radiators, and absorption heat pumps and coolers. Both air and liquid systems can be used to supplement forced air heating/cooling systems.

Site Feasibility:

Local climate, the type and efficiency of the collector(s), and space availability for the collector determine how much heat a solar heating system can provide. The building's orientation to the sun and shade cover can also determine how suitable a site will be for a solar collector system.

Local Codes and Regulations: Before installing any solar energy system,

- investigate local building codes, zoning ordinances, and subdivision covenants, as well as any special regulations pertaining to the site.
- obtain a building permit to install a solar energy system on existing buildings.

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[96] Refer to this webpage for more information on rebates and incentives for renewable technologies and energy efficiency: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=0&state=NY

[97] Scroll to the bottom of this webpage for information on NYSERDA's Solar Thermal program: http://www.nyserda.ny.gov/Page-Sections/Renewables/Solar-Technologies.aspx

- comply with existing building and permit procedures in the neighborhood or subdivision. Some have homeowners' regulations that do not allow residential renewable energy installations.
- avoid installation in flood plains
- there are no Town or Village ordinances barring installation of solar energy systems.
- common problems homeowners can have with building codes include:
    - exceeding roof load,
    - unacceptable heat exchangers,
    - improper wiring,
    - unlawful tampering with potable water supplies.
- zoning issues can include:
    - obstructing side yards,
    - erecting unlawful protrusions on roofs,
    - siting the system too close to streets or lot boundaries.
- contact Red Hook or Tivoli's zoning and building enforcement divisions and any appropriate homeowner's, subdivision, neighborhood, and/or community association(s) about ordinances, codes, and regulations.

Selecting and Installing a Solar Thermal System

Selecting the appropriate solar energy system depends on factors such as the site, design, and heating needs of your house. Local covenants may restrict your options; for example homeowner associations may not allow you to install solar collectors on certain parts of your house (although many homeowners have been successful in challenging such covenants).

Things to consider:

- heating needs of building and supplemental heat source (systems supplying 100 percent of heating needs are not usually cost-effective)
- suitability of site (exposure to solar radiation)
- optimal system design and installation
- quality and durability of components
- experience level of contractor
- building codes and neighborhood regulations
- new, different controls for thermostat
- systems with a room air collector can remain operational in the event of utility power outage
- periodic visual inspection and proper maintenance required to optimize performance and avoid breakdowns (DOE recommends 8-16 hours of maintenance per year).
- damage to solar hot water heaters from freezing usually not covered under homeowners' insurance policies.

Passive Solar Heating[98]

Passive solar heating technology is employed directly in the construction of a building. A building constructed with significant southern exposure with lots of south-facing windows and built with heat absorbent materials can convert sunlight to heat without special electronic components or other technology. Those materials collect heat during the day and slowly radiate it at night in a process called direct gain.

Features involved in the actual architecture of a building that can passively harness the power of the sun's heat are sunspaces and trombe walls. These features collect sunlight and heat from sunlight and allow it to be vented throughout the building or slowly released throughout the day, respectively. In addition, a building may be designed to employ daylighting, or using open floor plans and strategically placed windows to allow all rooms of the house to receive light and heat from the sun's rays.

During the summer months when the building does not need extra heat from sunlight, overhangs built into the structure can shade windows, and sunspaces can be closed off from the rest of the building.

This renewable technology is most feasible for new construction. NYSERDA offers a few programs for green building and ENERGY STAR® building for new construction. Consult these programs before designing and constructing a new building to ensure compliance if certification is desired.

Residential New Construction Program: http://www.nyserda.ny.gov/en/Page-Sections/Residential/Programs/New-Construction.aspx

Commercial/Not-for-Profit/Institutional New Construction Program: http://www.nyserda.ny.gov/en/Page-Sections/Commercial-and-Industrial/Programs/New-Construction-Program.aspx

Solar Electric (or Photo-Voltaic)[99]

Solar electric technology (also called photo-voltaic technology, or PV) employs the sun's rays (solar radiation) to create electricity for a building. New York State has plenty of sunshine to make solar electric installations effective electricity generators for homes, businesses, and larger facilities.

[98] Information on passive solar heating from the National Renewable Energy Laboratories http://www.nrel.gov/learning/re_passive_solar.html

[99] Information on solar electric technology from the U.S. Department of Energy http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10710

Benefits:

- much of the greenhouse gas emissions generally associated with energy generation are offset because the sun renewable, clean energy (however, the manufacture of the panels themselves emits GHGs – consult the solar installer for a life cycle analysis of their panels' carbon footprint)
- solar leases and the incentives and rebates available in the state of New York for purchasing solar electric systems can make solar electricity price competitive with (or even less expensive than) purchasing electricity from Central Hudson
- generating solar electricity can help avoid the price fluctuations of conventional electricity

Costs:

Solar electric systems are becoming more affordable as manufacturing processes become more efficient and as the growing market drives down prices.

- **capital costs** (associated with the design and installation of the system) can be minimized by first ensuring the building operates as energy efficiently as possible. Consult state programs such as NYSERDA's Home Performance with ENERGY STAR® (residential) or FlexTech[100] (commercial/not-for-profit) to obtain free/reduced-cost energy audits and energy efficiency work with incentives.
- other costs associated with solar electric systems are the **operating costs** (associated with maintaining and operating the PV system over its lifetime).
- factors that affect both capital and operating costs include system components, system size, and amount of solar energy available onsite.
- cost of electricity per kilowatt-hour (kWh) declines as the installed system becomes larger
- state and federal incentives and rebates can bring down the cost of a purchased solar electric system by 40 to 70 percent (see incentives listed on the following page).
- PV installers can give quotes for the total cost of the system and the estimated pay-back period, and will often provide free initial site visits to determine site feasibility and estimated system cost.
- when providing a quote, an installer might provide a price range of 20 percent or so. Quotes also should include: cost of hardware, installation, connection to the grid, permitting, sales tax, and warranty.

Some of New York State's Incentives[101]:

- cash back incentive from NYSERDA of $1.50 per watt ($1,500 per kW-generating capacity of system), capped at 7kW for residential, 25kW for not-for-profit, and 50kW for commercial sites. Total rebate capped at 40% percent of total cost[102].

[100] http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Programs/FlexTech-Program.aspx
[101] For more information about incentives and rebates for solar electric: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=0&state=NY
[102] NYSERDA's Solar Electric program: http://www.nyserda.ny.gov/Page-Sections/Renewables/Solar-Technologies.aspx

    - For example, if a home in New York state will need a 4 – 5 kW system to supply most or all of its electricity needs, this NYSERDA program will reduce the total system cost by $6000 - $7,500, or 40% of the total cost of the system, whichever is less.
- a Residential Solar Tax Credit up to $5,000
- residential State and Local Sales Tax exemptions of 100 percent of sales taxes
- commercial, industrial, residential, and agricultural sector Solar, Wind, and Biomass Energy Systems Exemptions of 100 percent exemption for 15 years.
- PACE Financing loans up to 10% of total property value for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors

How Solar Electric Works

Solar electric systems, or PV systems, convert sunlight into electricity. A **solar array** is the total system once installed onsite, but an array is composed of **modules**, which are in turn composed of individual **solar cells** (producing 10 to 300 watts apiece). Solar cells are made of **semiconductor** materials that convert energy from sunlight into electricity. Light is composed of photons, which "excite" electrons in the atoms in the conductor material in a process called the **photoelectric effect**. The solar cell sends these electrons through a circuit to create an electric current.

More information:

- PV systems can still produce electricity on cloudy days, but not as much as on a sunny day.
- PV arrays can be mounted at a fixed angle facing south, or they can be mounted on a tracking device that follows the sun, allowing them to capture the maximum amount of available sunlight over the course of a day.
- PV systems can be designed to be as large or small as the customer needs.
- systems can be "stand-alone" (not connected to the power grid) or grid-connected. Most solar installers recommend connecting a PV system to the grid to ensure a) electricity connection in the event of system breakdown, inclement weather, and at nighttime, and b) *the customer can access the state incentives and rebates which require connection to the grid with net metering*.

Selecting and Installing:

Site Feasibility: In general, New York state has plenty of sunlight to power solar electric systems. However, particular site characteristics can make a site suitable or not suitable for an installation. These characteristics include:

- geographic orientation of the site – is there southern facing exposure either on a rooftop or on the ground?
- amount of shade – does the site have too much tree cover, and is tree removal an option?

Small Solar Electric System Permits and Covenants: Before purchasing a solar electric system, check local permit and neighborhood covenant requirements.

- obtain permits from town or county building department, including a building permit, an electrical permit, or both. Often, the installer will take care of this, rolling the price of the permits into the overall system price. Consult installers on permitting practices.
- consult installer on local electric code requirements and ensure installer is prepared to design and install system in compliance.
- local homeowners associations (HOA) may need to approve a solar electric system plans before installation begins.

Systems Options:

- discuss with the installer the generating capacity desired for the site, and how much generating capacity is available per cost.
- *obtain more than one bid for the installation of a PV system to compare prices and services included*. Ensure all competing bids are for systems comparable in size and design. Different bids might include varying grades of panels – ensure the installer chosen will maximize the efficiency-to-cost ratio.
- for new buildings, work with both the builder and solar installer to best incorporate the PV system into a whole-building system design, which will maximize the energy efficiency of the building.

Maintenance:

- discuss routine and periodic maintenance practices with installers.

Solar Leasing and Power Purchase Agreements (see Case Study on following page):

Over the past years and months, companies have begun to offer large and small-scale leases and Power Purchase Agreements (PPAs) to residential, commercial, and institutional customers.

General Facts on How a Lease or PPA Works:

- the installer owns the system and performs all necessary maintenance.
- the lessee signs an agreement for a number of years (often around 20) for which the equipment will produce electricity onsite
- lessee can often choose what percentage of total lease to pay up front – remaining balance will be paid in monthly installments
- at end of lease term, lessee often has option to buy system
- if property is sold before the end of the lease term, the equipment and lease stays with the property, and lease is transferred to new owner (or originally lessee can terminate lease early, usually with penalties)

Benefits:

- Lessee avoids high upfront costs associated with purchasing solar electric systems

- Often, total lease cost is less than the upfront cost of purchase, enabling lessee to pay 100% of the lease cost upfront resulting in no monthly payments to lessor, only the monthly connection charge from Central Hudson

Small Wind[103]

Wind turbines use the renewable energy source of moving air to generate electricity. If a site is suitable for a wind turbine, many benefits can be gained. "Small wind" refers to systems that power residential or small business/institutional sites as opposed to large wind farms that supplement regional power providers.

Benefits:

- reduce GHG emissions associated with conventional electricity generation (however, manufacture of turbines still emits GHGs)
- lower electricity bills significantly
- can also be used for other applications, such as water pumping on farms.

Cost: Cost will depend on size of the system and its generating capacity.

- the Department of Energy recommends that systems are most economical when normal electric bills are at least $150 per month
- before considering incentives and rebates, for a 10kW system, a user who normally pays the utility provider 14 cents per kWh for electricity and whose site receives a 12 mph average wind speed could expect to a payback period of 25 years; with a 14 mph average wind speed, the payback period would be about 16 years[104].
- obtain quotes from a few installers to receive a price competitive bid that includes all desired maintenance and warranties.

Some of New York State's Incentives:

- NYSERDA Small Wind program[105] offers the following incentive levels based on **Annual Energy Output** (**AEO**):
  - If the AEO is 10,000 kWh or less, than the NYSERDA incentive is **$3.50 per kWh**. For example: for a turbine with an AEO of 7,400 kWh, the incentive is $25,900 (7,400 kWh x $3.50/kWh).

  - If the AEO is greater than 10,000 kWh, but not greater than 125,000 kWh, the incentive is **$35,000 plus $1.00 per kWh for every kWh greater than 10,000 kWh**. For example: for a

[103] Information on Small Wind Technology from the U.S. Department of Energy: http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10880
[104] http://www.nyserda.ny.gov/Page-Sections/Renewables/Small-Wind/Financial-Benefits.aspx
[105] NYSERDA's Small Wind program: http://www.nyserda.ny.gov/Page-Sections/Renewables/Small-Wind.aspx

turbine with an AEO of 32,500 kWh, the incentive is $57,500 {$35,000 + [(32,500 kWh – 10,000 kWh) x $1.00/kWh]}.

- If the AEO is greater than 125,000 kWh, the incentive is **$150,000 plus $.30 per kWh for every kWh greater than 125,000 kWh**. For example: for a turbine with an AEO of 200,000 kWh, the NYSERDA incentive is $172,500 {$150,000 + [(200,000 kWh – 125,000 kWh) x $.30/kWh]}.

- PACE Financing for Commercial, Industrial, Residential, Nonprofit, Multi-Family Residential, Agricultural, and Institutional sectors – loans up to 10% of the appraised real property value or cost of system.
- Energy Conservation Improvements Property Tax Exemption of 100% the value added to the property by addition of wind system for residential sector
- Local Option Solar, Wind & Biomass Energy Systems Exemption for 15 years from property tax of 100% the value added to the property by addition of wind system for Commercial, Industrial, Residential, and Agricultural sectors

How a Wind Electric System Works:

Winds are masses of air the move because of air pressure differences that are created the sun heating spots on Earth's. When one area becomes warmer than another, air pressure differences cause air to begin to flow, creating wind. Wind turbines take the energy in this air movement (kinetic energy) and change it into electric energy.

- when wind blows and moves the blades of a wind turbine, a rotor begins to turn inside the turbine and drives a generator.
- the generator creates an electric current.

The manufacturer can provide information on the maximum wind speed at which the turbine is designed to operate safely. Most turbines have automatic overspeed-governing systems to keep the rotor from spinning out of control in very high winds.

Installing and Maintaining a Small Electric Wind System:

Feasibility[106]:

- NYSERDA recommends a site provide at least a 10 mile per hour sustained wind speed to power a wind turbine efficiently. Check out a location's wind speed by visiting http://nyswe.awstruepower.com/.
- at least an acre of land is usually recommended with sufficient distance from trees, buildings, and property lines.
- additionally, a site's wind direction, vegetation, and topography can affect wind quality.
- a 10kW turbine at a site with an average annual wind speed of 10 miles per hour produces about 7,200 kWh per year, approximately the annual electric needs of a small house.

[106] http://www.nyserda.ny.gov/Page-Sections/Renewables/Small-Wind/Wind-Energy-Wisdom.aspx

- speak with local officials to determine any building permits, electrical permits, approvals, and certifications that are needed prior to installing a wind system. The wind installer and local utility can help with compliance with all rules and regulations and will assist in obtaining all necessary approvals before the system is up and running. *Consult all desired incentives before choosing an installer and designing the system to ensure compliance with those requirements.*

Anaerobic Digestion (Methane Recovery)[107]

Appliances called biodigesters recover methane from animal manure or landfill material through a process called anaerobic digestion. The gas recovered from this process produces heat.

Methane and Anaerobic Bacteria

Methane (CH_4) is a greenhouse gas discussed earlier in this document. The methane produced in anaerobic digestion comes from **anaerobic bacteria** breaking down organic matter.

"Anaerobic" means these bacteria do not "breathe" oxygen. This is why, unlike humans and other animals who breathe oxygen, their gas by-product is methane (CH_4 – only carbon and hydrogen) instead of carbon dioxide (CO_2 – carbon and oxygen). In other words, anaerobic bacteria "digest" organic material without using oxygen, as opposed to the bacteria at work in composting, which requires lots of oxygen and produces CO_2 and heat. The CH_4 produced by anaerobic bacteria is sometimes called "**biogas**."

Anaerobic decomposition occurs naturally in swamps, water-logged soils, deep bodies of water, and in the guts of large animals. However, these anaerobic processes can be intentionally contained in a "digester" (an airtight tank), which is primarily used for waste treatment, nutrient cycling, and odor control. The useful biogas by-product is an additional side-benefit.

Sludge or effluent, the solid or liquid material drawn from the digester is rich in nutrients (ammonia, phosphorus, potassium, and more than a dozen trace elements) and is an excellent soil conditioner. It can also be used as a livestock feed additive when dried. It is important to test the effluent for toxic compounds from pesticides and fertilizers before using it on a large scale.

Cost:

- the trade-offs in maintaining optimum digester temperatures to maximize gas production while minimizing expenses are somewhat complex and should be taken into consideration when designing a system.
- a digester usually requires manure from at least 150 large animals to generate electricity cost effectively.
- anaerobic digestion and biogas production can also reduce overall operating costs where costs are high for sewage, agricultural, or animal waste disposal, and where the effluent has economic value.

[107] Information on anaerobic digestion from the U.S. Department of Energy:
http://www.energysavers.gov/your_workplace/farms_ranches/index.cfm/mytopic=30003

- Most anaerobic digesters are currently used only for biogas production because of the relatively inexpensive cost of fossil fuels for generating electricity.

Summary of How an Anaerobic Digester Works:

- biogas produced in anaerobic digesters consists of mostly of methane (50%–80%) and carbon dioxide (20%–50%), the amounts depending on the feed of the livestock and the management practices of the waste.
- one cubic foot (0.028 cubic meters) of biogas yields about 10 Btu (2.52 kcal) of heat energy per percentage of methane composition when burned. The higher the methane content, the greater the heating potential.
- depending on the species of bacteria, communities temperatures of about (mesophilic) or 130°F (thermophilic). Temperatures between those two preferred zones result in significantly lower bacteria activity, and below 98°F, activity drops off as temperatures falls.
- to optimize the digestion process, the biodigester must be kept at a consistent temperature, as rapid changes will upset bacterial activity.
- digesters usually require some level of insulation and/or heating which can affect cost/benefit ratio.

Appendix F: Detailed Energy Savings Actions for Home and Work:

Besides purchasing/leasing and installing renewable energy systems, such as solar panels, significant amounts of energy can be saved in buildings by maximizing energy efficiency for appliances and for the building structure itself in already existing buildings.

Approximately 35 percent of the homes in Red Hook and Tivoli were built more than 73 years ago. Older homes are typically less energy efficient than new homes, both because of the advancement of building materials over time and because of the wearing out of shell features such as window and door seals and insulation in walls and ceilings. Residents living in older homes would especially benefit from even the most superficial energy efficiency actions, and would likely notice significant increases in comfort and decreases in utility bills after taking advantage of whole-house energy efficiency upgrades possible through NYSERDA's energy efficiency programs. Many measures are considered eligible for deep rebates through these programs.

The list below describes both residential and commercial energy efficiency programs offered by NYSERDA, and links to the webpages with the necessary information for accessing those programs are provided in footnotes.

Residential:

Home Performance with ENERGY STAR®[108]: This program offers homeowners a comprehensive, whole-house approach to improving energy efficiency and home comfort while saving money. Free or reduced-cost energy assessments (also called "Energy Audits"), and efficiency upgrades are conducted by a participating Home Performance Contractor accredited by the Building Performance Institute (BPI). Homeowners in whose annual household income is below 200% of the area median income may be eligible for 10% cash back incentives from NYSERDA for qualified energy efficiency work.

Assisted Home Performance with ENERGY STAR®[109]: This program is the same as HPwES, but it offers income eligible participants[110] up to a 50% cash back incentive up to $5,000 per household or up to $10,000 for a 2- to 4- family home for qualified energy efficiency work.

EmPower[111]: Homeowners or residents who make below 60% of the Dutchess County area median income, or are HEAP eligible qualify[112] for this program that provides completely free energy assessments and energy efficiency work.

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[108] Home Performance with ENERGY STAR® program overview http://www.nyserda.ny.gov/Page-Sections/Residential/Programs/Existing-Home-Renovations/Comprehensive-Home-Assessments.aspx

[109] Assisted Home Performance with ENERGY STAR® program overview: http://www.nyserda.ny.gov/Page-Sections/Residential/Programs/Existing-Home-Renovations/Assisted-Home-Performance-with-ENERGY-STAR.aspx

[110] To determine household eligibility for Assisted Home Performance with ENERGY STAR®, visit this page and click on Dutchess County on the map: http://www.nyserda.ny.gov/Page-Sections/Residential/Programs/Existing-Home-Renovations/Assisted-Home-Performance-Income-Guidelines.aspx

[111] EmPower program overview: http://www.nyserda.ny.gov/Page-Sections/Residential/Programs/Low-Income-Assistance/EmPower-Overview.aspx

[112] To determine household eligibility for EmPower, visit: http://www.nyserda.ny.gov/Page-Sections/Residential/Programs/Low-Income-Assistance/EmPower-for-Residents/Eligibility-Guidelines.aspx

Commercial/Municipal/Not-for-Profit:

FlexTech[113]: This program's goal is to "increase productivity and economic competitiveness of participating facilities by identifying and encouraging the implementation of cost-effective energy efficiency, technical evaluations, process improvement analysis, energy master plans, retro-commissioning, and development of peak load curtailment plans (PLCPs) as well as combined heat & power (CHP) projects." Cost-sharing incentives are available to eligible participants for certain types of studies.

Existing Facilities[114]: This program offers a portfolio of incentive opportunities to offset the cost of energy improvements in existing commercial facilities. It offers up to $30,000 in incentives for pre-qualified improvements, and up to $5 million in incentives for larger, performance-based custom improvements.

Commercial Lighting Program from Central Hudson[115]: As of July 2012, Central Hudson offers funding for businesses, retail stores and not-for-profits to upgrade to brighter and more energy-efficient lighting for qualified projects. The process begins with a no-cost energy audit. Central Hudson's partner in this initiative, Lime Energy, installs the new lighting and completes all paperwork required. *This program is offered on a limited time basis.*

In the future, if the municipality of Red Hook adopts measures to instate local PACE financing, home and business owners in New York State will have the opportunity to access the PACE financing system. PACE stands for Property Assessed Clean Energy[116]. In this system, the Red Hook municipal government would act as a lender for energy efficiency and renewable energy projects to home and business owners, using funds from investors. Property owners pay back the loan over a fixed term through annual property taxes. This plan recommends to Red Hook planners to initiate a PACE financing measure.

[113] NYSERDA's FlexTech program overview: http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Programs/FlexTech-Program.aspx
[114] Existing Facilities Program overview: http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Programs/Existing-Facilities-Program.aspx
[115] Central Hudson's Commercial Lighting program overview: http://www.centralhudson.com/savemoney/
[116] PACE Financing: http://pacenow.org/blog/

The following list offers detailed room-by-room recommendations for achieving maximum building energy efficiency[117].

Home Appliances:

Living room/Office:

Use the power-saving features on computers, laptops, and monitors. Avoid using a screen saver, which wastes energy.

Use a DVD player to watch DVDs, not a game console, which consumes more energy.

Lower the brightness on your television and computer.

Replace old computers with ENERGY STAR® models.

Purchase an ENERGY STAR® qualified television, which saves energy without sacrificing design or features.

Always turn off TVs and computers when no one is using them.

Cost for using your television:

Large Screen TV	6 hrs./day	$9.40/mo.	• Turn the TV off when you are not watching it
Standard Size TV	6 hrs./day	$6.80/mo.	

Cost for using your computer:

Personal computer (with monitor and printer)	5 hrs./day	$8.00/mo.	• If you are not using your computer, turn it off, including the monitor and printer

Plug electronics into an advanced power strip which will allow turning off multiple appliances at one time, completely, so that they are not drawing power even when they themselves are switched "off."

Unplug phone chargers and other adapters when not in use.

When away from home for more than a day, unplug the cable box.

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[117] Cost breakdown for individual appliances from the former Public Service Commission's pamphlet entitled, "Household Electricity Use and Energy Savings Tips."

Cost incurred from your cable box:

Cable box	24 hrs./day	$4.80/mo.	• Consider unplugging extra cable boxes that are not in use so they do not draw power • Ask your cable provider for an ENERGY STAR device

Two cable boxes use the same amount of energy as one refrigerator.

Kitchen:

Purchase an ENERGY STAR® qualified refrigerator/freezer.

Savings potential for replacing your refrigerator with an ENERGY STAR model:

500 Refrigerators Replaced with ENERGY STAR models	
$0.17	Price of Electricity ($ per kWh)
464 kWh	Annual Energy Savings of one ENERGY STAR Refrigerator
$30	Incremental Cost to Purchase an ENERGY STAR Refrigerator
78	Annual Cost Savings per Household
0.38	Simple Payback (years)

[118]

ENERGY STAR qualified refrigerators and freezers more efficient than standard models, use one third the electricity, and come with more advanced features and settings.

Clean refrigerator coils located behind or beneath the refrigerator, as they can become covered with dust and pet hair.

Check refrigerators' seals and replace any that are loose.

Always fill refrigerators and freezers because these appliances work most efficiency when full. Make sure never to cover inner vents, though.

Spare refrigerators used only occasionally (like for parties) should be replaced with coolers.

Replace dishwashers made before 1994 with ENERGY STAR® models.

Cost for using your dishwasher:

[118] Calculations from ICLEI's CAPPA software.

Dishwasher (washing and drying cycles	1 load a day	$5.70/mo.	• Run dishwasher only when full • Use air dry (instead of heat dry) to use one-half the amount of electricity

ENERGY STAR dishwashers can save up to $100 annually.

Always unplug small kitchen appliances such as blenders, toasters, and coffeemakers when not in use. These items still use electricity when plugged into the wall even if they are themselves switched "off."

Use microwaves and toaster ovens for cooking, which require less energy to operate than standard ovens and stoves.

Costs for using your oven, stove, and microwave:

Oven	30 min./day	$20.10/mo.	• Consider using a toaster or microwave oven, which use about one-tenth the amount of electricity of a conventional oven
Stove top burner (large burner)	30 min./day	$7.30/mo.	• Smaller burners use one half the amount of electricity • Cook with lids on your pans
Microwave (1,400 watts)	30 min./day	$4.00/mo.	• Use a microwave oven for cooking when possible • Microwaves use about one-tenth the amount of electricity as an oven

Laundry:

Hang clothes to dry whenever possible instead of using the clothes dryer.

Purchase ENERGY STAR® qualified clothes washers and dryers.

Costs for using your clothes washer and dryer:

Clothes dryer	1 load/day	$17.80/mo.	• Use a clothesline when possible
Clothes washer	1 load/day	$5.90/mo.	• Use cold water when you can

An ENERGY STAR® qualified washing machine is 30% more efficiency than standard models and can save up to 11,000 gallons of water annually.

Only wash full loads of laundry.

Use cold water to wash laundry – cold water cleans clothes just as well as warm or hot water and uses far less energy over time.

Remove lint from the dryer's lint trap after every use to maximize efficiency and prevent risk of fire.

Heating, Cooling, and Ventilation:

Contact a Building Performance Institute (BPI) Home Performance with ENERGY STAR® Contractor who will perform a comprehensive home energy assessment to measure your home's overall energy performance. Learn more at www.nyserda.gov/residential .

Costs incurred by your furnace:

Furnace	24 hrs./day	50-60% of winter energy costs	• Insulate your attic • Insulate heating ducts and save 10-20% of heating costs • Seal cracks around windows and doors • Lower your thermostat at night and when you are not home • Install a programmable thermostat

The chart below shows the estimated average efficiency of various types of home heating appliances. It is a good reference for individuals interested in replacing old heating appliances with more efficient systems.

Table 2: Estimated Average Fuel Conversion Efficiency of Common Heating Appliances	
Fuel Type - Heating Equipment	**Efficiency (%)**
Coal (bituminous)	
Central heating, hand-fired	45.0
Central heating, stoker-fired	60.0
Water heating, pot stove (50 gal.)	14.5
Oil	
High efficiency central heating	89.0
Typical central heating	80.0
Water heater (50 gal.)	59.5
Gas	
High efficiency central furnace	97.0
Typical central boiler	85.0
Minimum efficiency central furnace	78.0
Room heater, unvented	99.0
Room heater, vented	65.0
Water heater (50 gal.)	62.0
Electricity	
Baseboard, resistance	99.0
Central heating, forced air	97.0
Central heating, heat pump	200+
Ground source heat pump	300+
Water heaters (50 gal.)	97.0
Wood & Pellets	
Franklin stoves	30.0 - 40.0
Stoves with circulating fans	40.0 - 70.0
Catalytic stoves	65.0 - 75.0
Pellet stoves and boilers	85.0 - 90.0

[119] Chart referenced below.

[119] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12330

Heating, Cooling, and Ventilation, continued:

To improve airflow, make sure heating return vents and registers are clear of furniture, rugs, or other items.

Ensure the connections at heating vents and registers are well sealed where they meet the floors and walls.

Seal and insulate heating ducts.

Improve efficiency of heating systems by up to 20%.

Install a programmable thermostat.

Set the thermostat to 68 degrees in winter to save money and maintain comfort. Set it to 78 degrees in summer.

Each degree above 78 will save 3 percent of the energy used to cool the home.

Wear a sweater instead of turning up the heat.

Space heaters and electric blankets are expensive to use and consume a lot of electricity – use only when necessary.

Cost of using supplemental heaters:

Portable Heater (1,500 watts)	8 hrs./day	$68.40/mo.	• Only use when necessary and in occupied rooms
Electric blanket (King size bed)	8 hrs./day	$7.70/mo.	• Consider using the electric blanket only to warm up the bed • Turn it off when you settle in

Use ceiling fans to maximize the efficiency of heating systems: Operate at low speed clockwise to push warm air back down into the living space – then lower the thermostat.

Check heating systems' filters once a month and change if they appear dirty. At minimum, change the filter once every 3 months.

Purchase an ENERGY STAR® qualified ventilation fan and have a BPI Accredited Home Performance with ENERGY STAR® Contractor Install it. These fans are quieter than standard models and still protect against mold and mildew.

Replace old air conditioner units with ENERGY STAR® models. Recycle the old unit.

Costs of using various cooling appliances:

Room air conditioner (12,000 BTU) **Central air conditioner**	6 hrs./day	$41.00/mo. $123.10/mo.	• Use only when necessary • Turn it down or off when you are not home • Use a programmable thermostat • Keep windows shut • Use a fan to circulate the air better
Circulating fan	6 hrs./day	$2.90/mo.	• Use fans to help move the air around and bring in cooler air at night • Fans use much less energy than air conditioners

ENERGY STAR cooling systems can save up to 20% on energy bills.

During the hottest part of the day, close shades, drapes, and curtains to keep the sun out of the house, reducing the amount of air conditioning needed.

Use ENERGY STAR® qualified dehumidifiers – save money and effectively prevent mold and mildew from accumulating in indoor spaces.

Cost of using a dehumidifier:

Dehumidifier	8 hrs./day	$22.80/mo.	• Try to identify and eliminate sources of moisture in your home in order to reduce use of the dehumidifier • Run with windows closed

Have BPI Accredited Home Performance with ENERGY STAR® contractors tune up heating and cooling equipment.

Lighting:

Replace standard light bulbs with ENERGY STAR® qualified compact fluorescent lights (CFLs) come in all shapes and sizes these days, including vanity, globe, and chandelier bulbs. They are also made for recessed, under-cabinet, and cove lighting applications, like might be used in kitchens.

Savings potential for replacing regular light bulbs with CFLs:

Replace 10 Lightbulbs with CFLs	
$0.17	Price of Electricity ($ per kWh)
44 kWh	Annual Energy Savings of one CFL (kWh)
$3	Cost of CFL
440 kWh	Total Annual Energy Savings (kWh)
$74.80	Annual Cost Savings
$0.34	Simple Payback (years)

ENERGY STAR CFLs can also last 10 times longer than standard incandescent bulbs.

Install occupancy sensors in each room.

Savings potential for using occupancy sensors to automatically turn off lights in unoccupied rooms:

Occupancy Sensors Installed in 2000 square foot Home	
$0.17	Price of Electricity ($ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
$35	Percent Savings With Occupancy Sensors
0	Cost of Sensors ($ per square foot)
4,795 kWh	Total Annual Electricity Savings per Household
$815.00	Annual Cost Savings per Household
0.14	Simple Payback (years)

For outdoor lighting, purchase ENERGY STAR® qualified. There are LEDs and CFLs designed to work outdoors, and they will last much longer than standard incandescent bulbs.

Put outdoor lighting on timers and use motion sensors, which saves energy and adds security and convenience.

Purchase ENERGY STAR® qualified LED holiday lights.

ENERGY STAR LED holiday lights use 70% less energy and can last up to 10 times longer than standard holiday lights.

Use timers for all holiday lights.

Water:

Costs incurred by an electric water heater:

Water heater electric (52 gallons)	24 hrs./day	$77.00/mo.	• Insulate hot water heater and hot water pipes • Lower water temperature to 120° (140° if you have a dishwasher) • Install faucet aerators and low-flow showerheads

Hot water conservation tips[120]:

Reduce hot water use:

Fix leaks - A leak of one drip per second can cost $1 per month.

Install low-flow fixtures – a fixture costs $10 to $20 and achieves water savings of 25%–60%.

Purchase energy efficient dishwashers and clothes washers - dishwashers with booster heaters can cost more, but they pay for themselves with energy savings in about 1 year if combined with lowering the water heater's temperature

Lower your water heating temperature.

Each 10ºF reduction in water temperature saves 3%–5% in energy costs.

Insulate your water heater tank.

Save 4%–9% in water heating costs.

Insulate hot water pipes - reduces heat loss and can maintain water temperature 2 – 4 degrees hotter than uninsulated pipes, allowing for further lowering of water heater temperature

Install heat traps on a water heater tank – best if installed with new water heater unless homeowner has skill in soldering, but the traps themselves are only $30/pair, which would be paid off on one to two heating bills.

Heat traps can save $15–$30 on one water heating bill.

Install a timer – save utility costs by only heating water during the day when it is in demand (DIY friendly).

[120] http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13030

Install a drain-water heat recovery system – recapture the heat from wastewater sent down kitchen, bathroom, and utility room drains. Prices range from $300 to $500 and systems require a qualified plumbing and heating contractor for installation. Installation usually less expensive in new home construction.

Payback period between 2.5 to 7 years, depending on frequency of use.

Access programs to help pay for a new, efficient water heater (http://www.savingscentral.com/hotwater/)

Install a high-efficiency showerhead.

High efficiency showerheads can save up to $125 annually on energy bills.

Repair leaky faucets.

Leaky faucets can cost up to $100 annually.

Install high efficiency toilets.

Windows, Doors, Walls, and Ceilings (Building Shell):

Purchase ENERGY STAR® qualified doors and windows and make sure they are installed correctly.

Ensure attics are properly insulated and that their vents are not blocked.

Replace screens with storm windows in fall to provide an extra barrier against cold air for the winter.

Remove window-unit ACs if possible.

Caulk and weather-strip around windows and door frames.

Re-shingle or repaint roofs in light colors to reflect light.

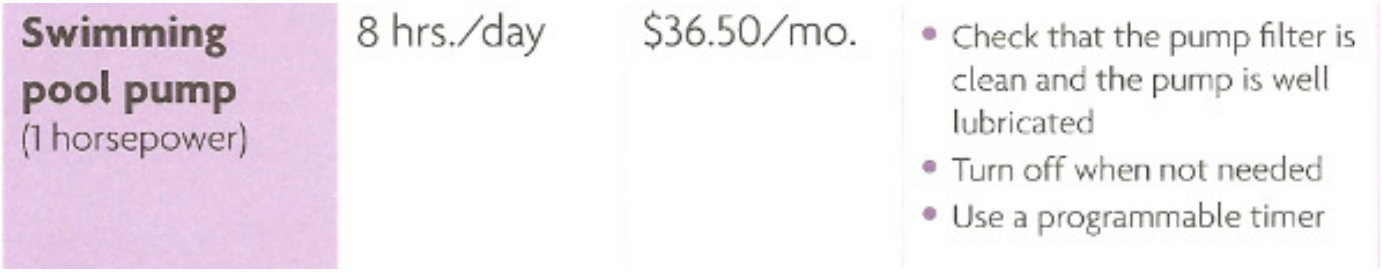
Outdoors:

Plant trees for shade – this can lower air conditioning costs.

Use timers on pool pumps so they run only when necessary.

Purchase a dual-speed or variable-speed pool pump.

Cost incurred by a swimming pool pump:



Whole Building:

Access NYSERDA's energy efficiency programs[121].

Purchase energy monitors and in-home control devices to monitor the home's energy use, lighting, HVAC system, and outlets.

Installing whole-house fans[122].

Waste:

Buy items that use minimal packaging. (For example, food items – like yogurt – packaged in single serving sizes use far more packaging materials than those packaged in bulk. Transfer these items to reusable containers for portability, or into dishes that can be washed and reused.)

Compost organic waste.

Recycle as much as possible.

Only use re-usable, washable grocery bags and avoid taking restaurant food to-go to minimize packaging waste.

Transportation:

Replace older vehicles with highly fuel efficient, hybrid, or electric models.

Keep vehicle tires properly inflated to optimize gas mileage.

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[121] Residential programs include Home Performance with ENERGY STAR®, Assisted Home Performance with ENERGY STAR®, EmPower, New York ENERGY STAR® Homes, and Green Homes. Commercial/Municipal/Not-for-profit/Institutional programs include FlexTech and Existing Facilities.

[122] Whole-house fans use cool air in the evening to cool the entire house and push hot air out of the attic area

Avoid idling by adjusting commuting times to avoid traffic and walking into restaurants instead of using the drive-thrus.

Limit highway driving to 55 mph if possible.

Avoid rapid acceleration and braking, as these are detrimental to fuel efficiency.

Walk and bike whenever possible.

Work from home more often.

Consolidate trips for errands – make as many stops as possible in one trip to minimize miles driven.

Avoid storing unnecessary items in the car.

Carpool with friends and neighbors and build ride-sharing networks.

Use school buses instead of private vehicles for travel to schools.

Measures Specifically for Larger Properties (Commercial, Municipal, Institutional, etc.):

While many of the actions listed above should be performed by owners/occupants of larger, non-residential properties, there are some actions that only apply to those kinds of buildings/properties. That list is below.

Install occupancy sensors in offices/rooms for lighting.

Access Central Hudson's Commercial Lighting Program.

Access NYSERDA's commercial energy audit and retrofitting programs[123].

Expand bike parking.

Encourage employees to work from home.

Encouraging teleconferencing to minimize long-distance travel.

Reduce use of disposable bags and disposable to-go containers; use only recyclable to-go containers when they are necessary.

Encourage more casual business dress in warm months to reduce reliance on AC units.

Installing occupancy/motion sensors for parking lot lighting.

[123] FlexTech and Existing Facilities programs

Rid Your House of Vampires!

"Vampires" are electronics that continue to consume electricity even when switched off. Many people are surprised to learn that significant portions of their utility costs are incurred by electronics when they are supposedly off and not being used.

This problem can be avoided by using power strips. For example, plug a power strip into a kitchen counter outlet, and use it to power counter-top appliances such as coffee makers, toasters, blenders, microwaves, etc. When the leaving the kitchen, turn the entire power strip off – it will block these appliances from pulling electricity from the outlet.

Additionally, replacing appliances and electronics with ENERGY STAR® models can minimize the effect of vampires[124]. These products are designed to consume as little power as possible while in stand-by mode.

Always unplug chargers for cell phones, computers, or batteries when not in use. Although they look small, they still use electricity even when not connected to the item they are meant to charge.

[124] http://www.energystar.gov/index.cfm?c=about.vampires

Appendix G: Sustaining the CAC

With the right plan for future sustenance, the Red Hook CAC could build a funding base that will allow it to continue its influential energy reduction projects in the future. While there is always the option of forming a not-for-profit that builds funds through traditional fund raising, there are also other models employed by similar groups in the region that provide larger resources and eliminate the task of constantly finding, connecting with, and eliciting donations from community members.

The Energy Improvement Corporation

One of these groups to whom the Red Hook CAC could refer is called the Energy Improvement Corporation[125], which is a community-based energy efficiency program funded through grants from the Department of Energy (DOE) and New York State Energy Research and Development Authority (NYSERDA). The organization is classified as a New York State Not-for-Profit Local Development Corporation. It's mission is as follows:

"The overarching goal of the Energy Improvement Corp is to save money and energy, and reduce greenhouse gas emissions in northern Westchester, and perhaps beyond, by enabling energy related improvements that meet or exceed state standards through innovative community based outreach and marketing efforts.

In addition, it will be a purpose of the Corporation to facilitate and finance qualified energy efficiency improvement projects and renewable energy system projects for residents, organizations, institutions and businesses in participating municipalities in New York while operating in a financially self-sufficient manner."

It was founded in early 2011 and funded via efforts by key stakeholder representatives who developed and submitted the grant proposal as a joint effort of NWEAC and the Town of Bedford.

The financing of energy efficiency and renewable energy system projects takes place through the Property Assessed Clean Energy[126] (PACE) financing system. The Energy Improvement Corporation sustains itself, in part, through interest collected on PACE loans. Red Hook might investigate how to become a qualified lender through PACE. Another benefit will be adding yet one more incentive to home and business owners to initiate energy efficiency or renewable energy projects.

This plan recommends the Red Hook CAC contact the organizers of the Energy Improvement Corporation for a better understanding of that groups current and upcoming financing mechanisms.

Community Foundations of the Hudson Valley

Red Hook also has an opportunity to look to the Community Foundations of the Hudson Valley[127] for funding for ECAP projects or to generally maintain the CAC.

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[125] Energy Improvement Corporation: http://energizeny.org/eic
[126] PACE Financing http://pacenow.org/blog/
[127] Community Foundations of the Hudson Valley: http://www.cfdcny.org/

“To strengthen our communities by offering donors the means to establish charitable legacies, by making grants, and by providing leadership to address community needs in a manner that is responsible, responsive and lasting.

To accomplish this we:

- Help donors with their charitable giving
- Assist attorneys and financial advisors to explore giving options to benefit their clients
- Establish endowment funds for nonprofits and other charitable causes
- Provide grants and resources to community organizations, and
- Work with government, private foundations, and local leaders to address current and emerging needs.