West Windsor Township Climate Action Plan

West Windsor Township
Environmental Commission

July 2015

ACKNOWLEDGEMENTS

The initial draft of the Climate Action Plan was prepared for the West Windsor Environmental Commission by Spiezel Architectural Group and Terra Neutral Consulting. The plan was prepared under a grant from Sustainable Jersey, which the Commission gratefully acknowledges. The Commission has made a number of changes to the original draft document, and will continue to modify it based on stakeholder input.

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Executive Summary

The West Windsor Climate Action Plan:

- Summarizes the science of climate change and the risks climate change imposes on us.
- Provides an estimate of the quantity of greenhouse gas emissions (our carbon footprint) within the Township, due to both municipal government operations and the community sources at large.
- Establishes a greenhouse gas emission reduction goal equal to the State of New Jersey's Global Warming Response Act.
- Proposes a plan of action to achieve greenhouse reduction goals.
- Initiates a discussion on how we should plan for and adapt to climate change.

Climate Science

West Windsor is already beginning to experience a changing climate. The climate is changing principally due to an increasing concentration of GHGs in the atmosphere, particularly carbon dioxide (CO2). GHGs trap heat in the atmosphere, causing global warming. Combustion of fossil fuels for transportation, electricity generation, building heating and industrial processes is the principal sources of anthropogenic CO2. The CO2 concentration in the atmosphere has recently reached the 400 part per million (PPM) level, and is rising at a rate of two parts per million per year.

West Windsor can expect that heat waves, intense precipitation and flooding will pose a growing challenge. This will increase the vulnerability of the region's residents, especially its most disadvantaged populations. Infrastructure will be increasingly compromised.

Scientists agree that climate change is here, we're causing it, it's bad, and it's getting worse.

Our "Carbon Footprint" - Green House Gas (GHG) Emission Estimate

West Windsor Township emitted 340,000 metric ton of CO2 equivalents of greenhouse gas (GHG) emissions in 2012. Ninety nine percent (340,000 metric tons) of the Township's emissions were from the community at large. Only one percent (3,500 metric tons) results from municipal operations. Overall transportation represents the single largest category: 54% of total GHG emissions. Electricity use represents an additional 18.5% of emissions. Heating fuels account for 24.5% of emissions, and decomposition of waste represents the balance at 3%.

GHG Reduction Goal

The West Windsor GHG reduction goal is aligned with the State goal:

- Stabilization of greenhouse gas emissions at 1990 levels by 2020
- A further reduction of emissions to 80 percent below 2006 levels by 2050

GHG reductions by the Township are voluntary, not mandated. Overall, the Township would need to reduce GHG emissions by 96,000 metric ton between the present and 2020 to meet the state goal. Business as usual emissions reductions over this time period should total 50,000 metric ton. This leaves an additional 46,000 metric ton for which the Township must implement actions in order to achieve its 2020 goals.

Plan of Action

GHG reduction targets for municipal operations are more readily achievable due to the scale of effort and the ability of the Township to directly influence energy usage in building and fleet operations. Community emissions reductions require broader concerted effort by the Township. Direct actions by the municipal government to reduce GHG emissions are those which the municipality has the ability to implement in ways that control the outcome of such actions. For example, energy conservation measures yield direct quantifiable reductions in emissions. The Township recently commissioned an energy audit of municipal building which identified 17 energy conservation measures, including LED lighting, and HVAC equipment. The cost, payback and savings over time were estimated. Other proposed actions include: building retro-commissioning, improvements to building operations through education and purchasing, vehicle fleet replacement and waste reduction, establishing policies that promotes emissions reduction such as building energy efficiency standards and building benchmarking requirements, creating transportation policy and programs that promote reduction in transportation emissions and promote alternatives to single vehicle use, purchasing green electricity and implementing community education programs. GHG mitigation options should be considered based on cost effectiveness, implimentability and the ability to realize significant GHG reductions. Financing mechanisms are proposed, including an Energy Savings Improvement Plan (ESIP). The municipality's ability to influence indirect actions by the community at large is difficult to predict. Implementing a community education program will be a key component. Examples include community education is geared towards appliance efficiency and minimizing vehicle miles driven.

The CAP proposes a system to track progress over time.

Adaption

The CAP initiates a discussion on how we can become more resilient and adapt to a changing climate.

Next Steps

The West Windsor Environmental Commission seeks public input on this draft CAP, after which the CAP will be presented to the Township for official adoption and implementation. Adoption will constitute Township support for the overall intent and direction of the CAP. However, when specific actions are considered for implementation, the action would be subject to normal Township administration/council review processes. Adoption of the CAP is not intended to represent a financially binding commitment by the Township.

1.0 Introduction

This section provides an introduction to the Climate Action Plan (CAP), summarizes the scientific basis behind the concern about climate change, and provides an overview of the Township for context.

1.1 Climate Action Plan Overview

This Climate Action Plan:

- Describes where we stand today: The CAP provides an estimate of current Greenhouse Gas (GHG) emissions within the Township, due to municipal and community sources
- Establishes goals for emission reduction and preparation for climate change
- Identifies actions and policies to reduce emissions
- Identifies actions the township can perform to become more resilient to the effects of climate change
- Establishes a plan and schedule to achieve greenhouse reduction goals

The CAP was designed to include the requirements for a CAP specified by the Sustainable Jersey program, http://www.sustainablejersey.com/actions-certification/actions/#open/action/26, which West Windsor participates in.

The West Windsor Environmental Commission requested that the Rutgers Climate Institute (RCI) peer review the draft CAP. RCI arraigned for the CAP to be reviewed as an Earth Systems Science Class Report. The Rutgers' review and West Windsor's responses are attached as Appendix 1. Key findings of the review are summarized below.

- Rutgers affirmed that the CAP emission totals are accurate
- Rutgers offered several prospective GHG mitigation actions the CAP had not included. The CAP will now consider the actions.
- Rutgers felt that the "business as usual" annual trend with respect to GHG should be upward, not downward. West Windsor disagrees. The NJ GHG inventory for 2012 shows a slight downward trend, consistent with West Windsor.

The West Windsor Environmental Commission seeks public input on this draft CAP, after which the CAP will be presented to the Township for official adoption and implementation.

1.2 Climate Science: What's the Problem?

West Windsor is already beginning to experience a changing climate. The climate is changing principally due to an increasing concentration of GHGs in the atmosphere, particularly CO2. GHGs trap heat in the atmosphere, causing global warming. Combustion of fossil fuels for transportation, electricity generation, building heating and industrial processes is the principal sources of anthropogenic CO2. Anthropogenic CO2 emissions have

shifted the natural balance of the carbon cycle. The CO2 concentration in the atmosphere has recently reached the 400 part per million (PPM) level, and is rising at a rate of two PPM per year. A 400 PPM level of CO2 has not been experienced in over 800,000 years, as illustrated in Figure 1 below. Once released into the atmosphere, CO2 persists for decades to centuries, as shown by its increasing atmospheric concentration.

According to a 2014 report by the United Nations' Intergovernmental Panel on Climate Change (IPCC), which draws on contributions from thousands of scientists from around the world, "Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts."

According to NASA's former chief climate scientist Dr. James Hansen, "If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO2 will need to be reduced from [current levels] to at most 350 ppm."

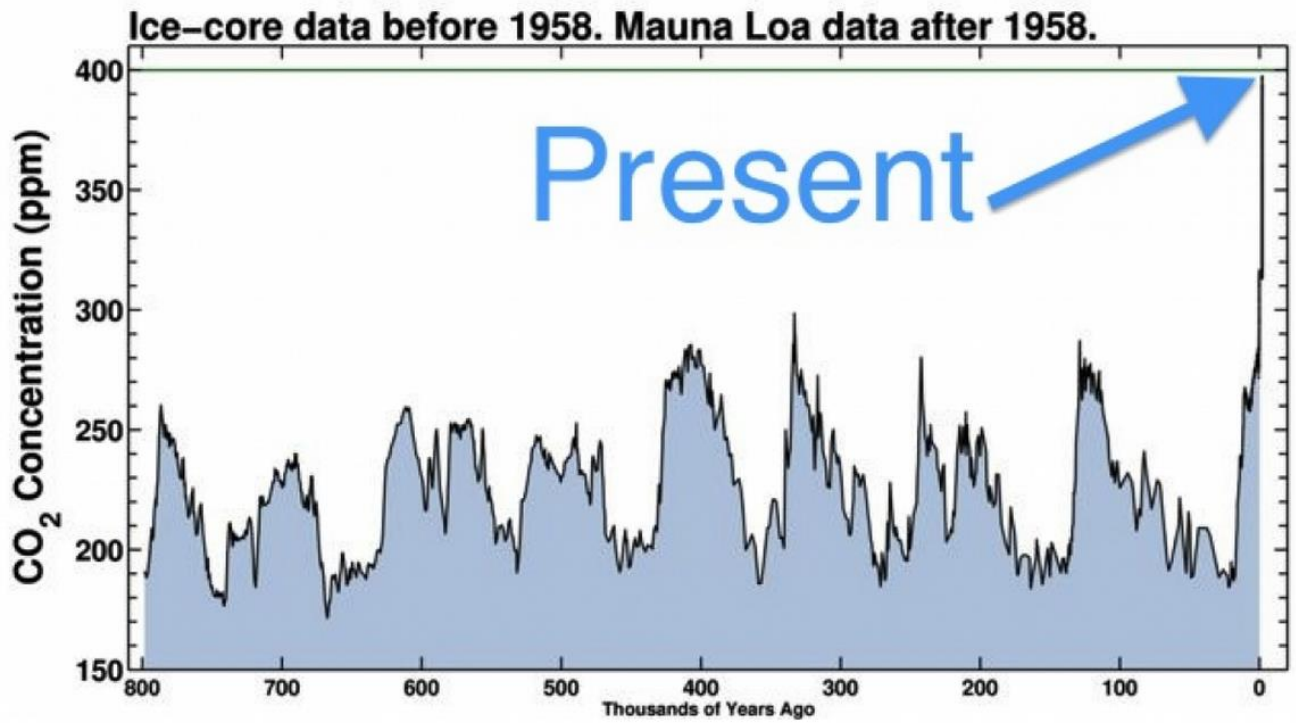

Figure 1. Atmospheric CO2 Concentration - Past 800,000 Years

Source: http://www.climatecentral.org/news/the-last-time-co2-was-this-high-humans-didnt-exist-15938

The most definitive available information on how climate change will affect the northeast United States comes from an October 2014 report entitled: Climate Change Impacts in the (Northeast) United States: The Third National Climate Assessment, prepared by the United States Global Change Research Program http://s3.amazonaws.com/nca2014/low/NCA3_Full_Report_16_Northeast_LowRes.pdf?download=1.

Key findings from the report:

1. Heat waves, coastal flooding, and river flooding will pose a growing challenge to the region's environmental, social, and economic systems. This will increase the vulnerability of the region's residents, especially its most disadvantaged populations.
2. Infrastructure will be increasingly compromised by climate-related hazards, including sea level rise, coastal flooding, and intense precipitation events.
3. Agriculture, fisheries, and ecosystems will be increasingly compromised over the next century by climate change impacts. Farmers can explore new crop options, but these adaptations are not cost- or risk-free. Moreover, adaptive capacity, which varies throughout the region, could be overwhelmed by a changing climate.
4. While a majority of states and a rapidly growing number of municipalities have begun to incorporate the risk of climate change into their planning activities, implementation of adaptation measures is still at early stages.

In summary, scientists agree that climate change is here, we're causing it, it's bad, and it's getting worse.

1.3 Township Overview

In order to provide context for the West Windsor CAP, a brief overview of the Township is provided here. West Windsor Township was established in 1797 and incorporated in 1798. The Township has a total land area of 26.27 square miles. The 2010 United States Census indicates that the community consists of 9,449 households supporting 7,606 families and a total of 27, 165 residents. This represents a 25% population increase from 2000 Census figures and is indicative of the growth of the community.

Land use consists of a significant proportion of suburban residential development (383.7 housing units per square mile) mixed with commercial and transportation corridors, working farmland and preserved open space.

Mercer County Community College and a portion of the Princeton University campus are located in West Windsor, both of which are excluded from greenhouse inventory calculations. West Windsor is part of a combined school district with Plainsboro Township. The West Windsor-Plainsboro Regional School District is similarly excluded from greenhouse gas inventory calculations.

The township is strategically located on major intercity transportation routes, which has driven its growth and development over time. Both US Route 1 and the Northeast Rail corridor bisect the Township providing strong transportation links for the community. The Township's close proximity to Interstates 195, 295, and the New Jersey Turnpike (Interstate 95) reinforce the significance of vehicle transportation emissions.

There is approximately 7.3 million square feet of commercial space in the township, employing approximately 26,000 people. A majority of the commercial space consists of offices.

The Township manages 104,420 square feet of municipal buildings, with approximately 224 staff. It also maintains a fleet of 127 vehicles.

The Township generated 6,686 tons of municipal solid waste in 2012. It is not known how much commercial waste is generated from business activities on an annual basis.

2.0 Where We Stand Today: Estimate of Annual Greenhouse Gas (GHG) Emissions

This section provides an estimate of the recent level of GHG emissions in the Township. GHG emission levels may also be called a GHG inventory or a "carbon footprint".

Greenhouse gas inventories are based on quantifying direct and indirect emissions. Direct GHG emissions are those from sources that are owned or controlled by the reporting agency (the Township). In the case of West Windsor Township, this includes emissions from both community and municipal sources. Indirect emissions are those that are a consequence of activities of the Township, but occur at sources owned or controlled by another entity. When building the inventory, it was necessary to identify what are direct or indirect emissions, and what are totally outside the control of Township activities, and as such are excluded from the inventory.

Inventory emissions are further categorized into three broad scopes:

- Scope 1: Direct GHG emissions from fuel use (gasoline, diesel, natural gas, oil, propane, etc.)
- Scope 2: Indirect GHG emissions from the consumption of electricity, heat or steam
- Scope 3: Indirect emissions from outsourced activities such as waste disposal, etc.

Recommended actions to reduce GHG emissions are organized to address these scopes of emissions.

The baseline year for generating a GHG inventory is 2012, based on information available when the inventory was compiled. The complied inventory data reflects recent and past information about population and buildings within the Township, as well as municipal, residential, commercial, and transportation energy use. Data from previous years (1990, 2005, 2006 & 2009) was also evaluated to create a framework of information. Emission factors for electricity, fuel and waste are included and normalized to represent GHG emissions in units of equivalent metric tons of CO2 (eMTCO2). With this data the inventory generated a snapshot of baseline GHG emissions broken out by category; municipal, community, residential, commercial, transportation related, etc., and further broken down by fuel or energy source.

Using the baseline year 2012 required normalization of other data as follows:

- Community data was obtained from Delaware Valley Regional Planning Commission ("DVRPC") for calendar year 2005
- Municipal Fleet data was based on a 2009 inventory
- Population, household and employment data was based on the 2012 census.

The municipal greenhouse gas inventory was based on utility information obtained for calendar year 2012 as follows:

- From utility bills for the natural gas and electricity usage.
- From accounting records for the gasoline and diesel fleet usage
- From the solid waste contractor Waste Management for the municipal solid waste disposal tonnage

The community greenhouse gas inventory was based on information provided by the DVRPC. The allocation to West Windsor Township was based on 2005 data and has been adjusted to 2012 based on changes in population, households and employment. The allocation by DVRPC to the Township used the following methodology. Note that DVRPC uses Minor Civil Divisions ("MCD") to describe cities, townships and boroughs.

- Electricity and Natural Gas (and other heating fuels) data were compiled either at the Township level or at the Zip Code level. Where Zip Codes overlapped multiple MCDs, the allocation was based on census tract information.
- Mobile Highway Emissions were compiled by using a model based on the Highway Performance Monitoring System which is a federal program that monitors travel throughout the country. The model allocates total vehicle mileage to each MCD based on trips made to and from and each municipality.
- Mobile Transit Emissions were compiled at the regional level and allocated based on 2000 US Census data for the number of workers who made the trip to work using public transit.
- Landfill Waste Emissions were estimated on a per capita basis and did not account for local differences in landfill methane capture technologies.

To allow for date consistency with the 2012 data for the municipal greenhouse gas inventory, the community greenhouse gas data was estimated for a 2012 baseline based on the following.

- Residential Electricity and Natural Gas (and other heating fuels) data were adjusted based on increase in households and usage efficiency from 2005 to 2012
- Commercial Electricity and Natural Gas (and other heating fuels) data were adjusted based on increase in employment and usage efficiency from 2005 to 2012
- Mobile Highway Emissions were adjusted based on an increase in population, employment and usage efficiency from 2005 to 2012
- Mobile Transit Emissions were adjusted based on an increase in population, employment and usage efficiency from 2005 to 2012
- Landfill Waste Emissions were adjusted based on an increase in population, employment and usage efficiency from 2005 to 2012

Emission factors and global warming potential factors were based on industry standards with a primary source being the Intergovernmental Panel on Climate Change ("IPCC") 4th assessment report. The one major exception was the electricity emissions from PSEG. These were obtained from PSEG's 2012 annual report based on total emissions and total output. The forward looking emission factors for PSEG were further adjusted to reflect New Jersey's Renewable Portfolio Standard.

The inventory "back casts" to 1990 and for purposes of this report forward to 2020. We extrapolated forward to 2050, but the projections only indicate a potential order of magnitude change in GHG emissions and are not an accurate predictor for such a distance timeframe. The GHG inventory projects emissions to align with the Township's emissions reductions goals, which reference the years 1990, 2006, 2020, and 2050.

Combined Township emissions for 2012 were 342,463 eMTCO2, as detailed in Table 1 below.

Municipal operations contributed 3,488 metric ton to the Township total and community emissions contributed 338,974 metric ton. The largest source of emissions is attributable to transportation, followed by electricity, then heating fuels. Landfill waste is the smallest category of emissions.

Table 1: West Windsor GHG Inventory

Source	Local Gov't Quantity Used In Year	Community Quantity Used In Year	Total	Units	CO2 Emission Factor (eKG CO2/unit)*	Local Gov't GHG Emissions eMT CO2**	Community GHG Emissions eMT CO2**	Total GHG Emissions eMT CO2**
Scope 1 Emissions								
Heating Fuels								
Residential Heating Fuels								
Natural Gas	-	10,840,449	10,840,449	therms	5.2923	-	57,371	57,371
Heating Oil	-	599,748	599,748	therms	74.2138	-	4,451	4,451
Propane	-	16,209	16,209	gallons	61.4904	-	100	100
Subtotal Residential Heating Fuels						-	61,922	61,922
Commerical Heating Fuels								
Natural Gas	89,560	3,511,656	3,601,216	therms	5.2923	474	18,585	19,059
Heating Oil	-	232,560	232,560	therms	74.2138	-	1,726	1,726
Propane	-	97,618	97,618	gallons	61.4904	-	600	600
Subtotal Commerical Heating Fuels						474	20,911	21,385
Subtotal Heating Fuels						474	82,833	83,307
Fleet Fuel								
Gasoline	76,300	16,738,608	16,814,908	gallons	8.9321	682	149,510	150,192
Diesel	30,830	3,134,142	3,164,972	gallons	10.0778	311	31,585	31,896
Gas Transit	-	186,431	186,431	gallons	10.0778	-	1,879	1,879
Fleet Electricity	-	4,576,757	4,576,757	kWh	0.2863	-	1,310	1,310
Subtotal Fleet Fuels						992	184,284	185,276
Scope 1 Emissions Totals						**1,466**	**267,117**	**268,584**
Scope 2 Emissions								
Residential Electricity	-	103,707,931	103,707,931	kWh	0.2863	-	29,689	29,689
Commercial Electricity	2,985,877	113,599,070	116,584,947	kWh	0.2863	855	32,521	33,375
Scope 2 Emissions Totals						**855**	**62,210**	**63,064**
Scope 3 Emissions								
Landfill Waste	6,686	55,254	61,940	tons	174.6	1,167	9,647	10,815
Scope 3 Emissions Totals						**1,167**	**9,647**	**10,815**
Annual Totals						**3,488**	**338,974**	**342,463**

GHG inventories are complex undertakings which involve a host of factors and variables. The accuracy of most inventories, including this estimate is not absolute. The value of this inventory is its ability to illustrate the magnitude of emissions generated in the Township.

The magnitude of the West Windsor GHG inventory has been corroborated by a Rutgers University peer review and by comparing it to the 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory (http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file).

- West Windsor's estimated emissions were 342,000 eMTCO2
- New Jersey's estimated emissiions were 105,000,000 eMTCO2, as illustrated in Figure 2 below.

West Windsor contains approximately 0.3% of the State's population, and emits approximately 0.3% of the State's emissions.

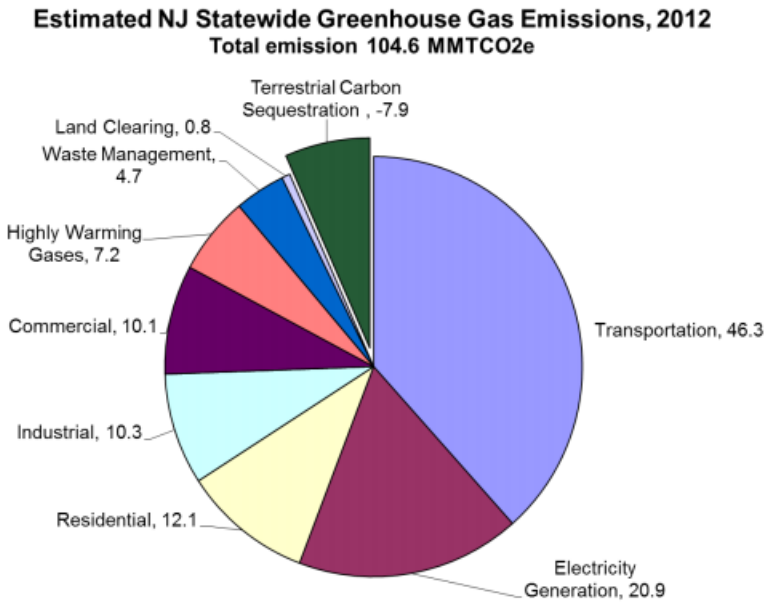

Figure 2: Estimated NJ Statewide Greenhouse Gas Emission, 2012

2.1 Baseline Trends

Township population increased 70% from 1990 to 2012, reflecting strong growth and development. Households recorded a similar 77% increase in residents. Commercial development square footage and employment both increased by 49%.

During this timeframe, GHG emissions from residential energy use increased 63%. Commercial energy use increased 35%, and municipal GHG emissions increased by an estimated 76%, Emissions from highway miles-driven increased 49%, which reflects increased population activity tempered by improvements to vehicle fuel efficiency. Public transportation emissions increased 41%, also reflecting increased population activity. Overall, residential energy use did not increase as fast as population, indicating improvements in housing and appliance energy efficiency. Energy efficiency gains in commercial buildings were largely offset by the growing energy demands of technology over the same period.

A number of these trends reflect the business as usual (BAU) assumptions built into GHG emissions patterns predicted through 2020. The BAU case assumes moderate population and household growth, increased efficiency of motor vehicles, and small incremental improvements in building and appliance efficiency. The inventory predictions do not account for any emissions reductions from energy sources that could be attributable to changes in the power generation fuel mix or the contribution of renewables at the utility level. In order for the Township to meet its GHG emissions goals, actions beyond the business as usual scenario must be implemented.

2.2 Business as Usual Trends

The business as Usual ("BAU") trends predict that greenhouse gas emissions will slowly decline even if no explicit conservation or GHG reduction actions are implemented. We expect population growth and increased building activity, but these increases will be mitigated by a number of factors including:

- Increased equipment efficiency and increased awareness efficient building operations
- Improved fuel efficiency across all vehicle types

- Decreased waste due to increase awareness of reusing and recycling.

A BAU case for municipal operations does not predict any significant increase in space utilization or municipal square footage, although it assumes a small increase in staff. The assumption is that the municipality will increase the efficiency of its buildings and its space usage in facilities it currently occupies.

The BAU trend for municipal GHG emissions suggests a reduction of 382 eMTCO2 (11%) from 2012 levels.

Municipal GHG BAU Emissions		*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Commercial										
Electricity	eMTCO2	855	847	825	788	781	782	748	732	680
Natural Gas	eMTCO2	474	474	465	465	465	456	456	434	434
Total Building Emissions		1,329	1,321	1,289	1,253	1,246	1,238	1,204	1,165	1,114
Fleet Vehicles										
Motor Gasoline	eMTCO2	682	682	675	664	650	637	620	606	587
Diesel Fuel	eMTCO2	311	311	310	308	305	303	299	296	292
Total Fleet Emissions		992	992	986	972	955	940	920	902	879
Waste										
Landfill Waste	eMTCO2	1,167	1,167	1,149	1,149	1,149	1,131	1,131	1,136	1,113
Total Emissions		**3,488**	**3,481**	**3,424**	**3,375**	**3,350**	**3,310**	**3,255**	**3,203**	**3,106**

Residential and commercial construction and renovation will favor the use of natural gas, electricity, and renewable energy over fuel oils, resulting in a relative decrease in greenhouse gas emissions in this sector. Although we expect both population and conditioned square footage to grow, we do not predict an increase in population per square foot of built area. We see this metric as staying relatively stable. Efficiency will outpace population and building growth to create a net reduction in emissions. (Redevelopment of the Howard Hughes tract may lead to an absolute increase in emissions).

Overall, BAU trends for community emissions suggest a decline of 49,241 eMTCO2 (14.8%) from 2012 levels.

GHG BAU Emissions		*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Residential*										
Electricity	eMT CO2	29,689	29,303	28,386	27,381	27,007	26,945	25,403	24,096	22,554
Natural Gas	eMT CO2	57,371	57,141	55,869	54,395	54,167	53,941	52,551	50,952	48,778
Fuel Oil	eMT CO2	4,451	4,433	4,334	4,220	4,202	4,185	4,077	3,953	3,784
LPG	eMT CO2	100	99	97	95	94	94	91	89	85
Total Residential	eMT CO2	91,611	90,976	88,687	86,091	85,471	85,164	82,122	79,089	75,201
Commercial*										
Electricity	eMT CO2	32,521	32,040	30,982	29,832	29,372	29,252	27,530	26,067	24,356
Natural Gas	eMT CO2	18,585	18,477	18,034	17,526	17,422	17,318	16,842	16,301	15,578
Fuel Oil	eMT CO2	1,726	1,716	1,675	1,628	1,618	1,608	1,564	1,514	1,447
Other	eMT CO2	600	597	582	566	563	559	544	526	503
Total Commercial	eMT CO2	53,432	52,830	51,273	49,552	48,975	48,738	46,480	44,408	41,883
Mobile Highway*										
Motor Gasoline	eMT CO2	149,510	149,647	148,779	146,925	144,433	142,343	139,395	136,763	133,445
Diesel Fuel	eMT CO2	31,585	31,614	31,431	31,039	30,512	30,071	29,448	28,892	28,191
Mobile Transit*										
Diesel Fuel	eMT CO2	1,879	1,881	1,870	1,846	1,815	1,789	1,752	1,719	1,677
Electricity	eMT CO2	1,310	1,300	1,289	1,278	1,267	1,271	1,231	1,205	1,179
Total Transportation	eMT CO2	184,284	184,441	183,368	181,089	178,027	175,473	171,825	168,579	164,492
Waste*										
Landfill Waste	eMT CO2	9,647	9,656	9,514	9,237	9,246	8,827	8,836	8,599	8,157
Total GHG Baseline Emissions		**338,974**	**337,903**	**332,842**	**325,969**	**321,718**	**318,202**	**309,263**	**300,675**	**289,733**

3.0 West Windsor Emission Reduction Goals

This CAP proposes to establish goals to reduce greenhouse gas emissions identical to the goals set forth in the New Jersey Global Warming Response Act (GWRA), http://www.nj.gov/dep/sage/docs/gw-responseact-07.pdf. The GWRA establishes statewide limits on greenhouse gas emissions. Specifically, the law mandates the statewide reduction of greenhouse gas emissions to:

- Stabilization of greenhouse gas emissions at 1990 levels by 2020
- A further reduction of emissions to 80 percent below 2006 levels by 2050

The state law does not flow down directly to municipalities – adoption of GWRA goals by the Township would be voluntary.

The GWRA is supported by identical goals in State of New Jersey Executive Order #54, http://www.state.nj.us/infobank/circular/eojsc54.htm.

The challenge, based on the Township's Greenhouse Gas Inventories and baseline trends, is to achieve a combined overall reduction in emissions of 28.1% by 2020 compared to 2012 emission levels, ramping up to 79% reduction in 2012 emissions by 2050. The 2020 goal is achievable with focused effort. The 2050 goal requires a fundamental rethinking of energy generation and use on a local and global level to achieve its aim. Daunting as it may seem, consistent and persistent efforts to reduce energy consumption are achievable over time.

Overall, the Township's goal is to reduce GHG emissions by 96,403 metric tons, to 246,060 eMTCO2, between present and 2020. Business as usual emissions reductions over this time period should total 49,623 metric ton. Therefore in order to achieve its 2020 goals, the Township must implement actions that reduce overall GHG emissions by an additional 46,779 metric tons, as illustrated in the table below.

2020 Municipal GHG Reduction Goals

Emissions Source	*Estimated 1990*	*2012 Emissions*	*2020 BAU*	*reduction*	*2020 Goal*	*reduction*
Community :	243,394	338,974	289,733	-14.5%	243,394	-28.2%
Municipal :	2,666	3,488	3,106	-11.0%	2,666	-23.6%
Total :	246,060	342,463	292,839	-14.5%	246,060	-28.1%

4.0 Actions and Policies to Reduce Greenhouse Gas Emissions

In order to achieve its 2020 goals, the Township will need to execute a series of actions that reduce GHG emissions. Additionally, the Township should put in place planning and policy initiatives that support reductions in building energy and transportation energy use. Finally, the Township must create a robust mechanism to track GHG emissions.

The Climate Action Plan recommendations are organized in categories: direct actions, indirect actions, and the additional recommendation to implement data management and reporting. Direct actions are those where the Township controls the action and can predict the outcome of those actions. Indirect actions are those where the Township can be the catalyst for action, but the outcome is controlled by others.

The GHG Inventory quantifies community and municipal GHG emissions. The Climate Action Plan sets similar goals for both aspects of Township emissions: to reduce GHG emissions to 1990 levels by 2020. It will be easier for the Township to achieve its municipal emissions reduction goal because the Township has direct control over its building and transportation energy use. Reductions of community related emissions will be more challenging due to the size of the reductions needed and due to the fact that most of the reduction strategies are indirect actions that require voluntary participation by the community.

As part of the evaluation process, the following key items are summarized for each greenhouse gas emission measure.

- Total greenhouse gas emission reductions from 2014 through 2020
- Total greenhouse gas emissions as a percentage of the overall municipal goal
- Total cost savings from 2014 through 2020
- Total implantation costs from 2014 through 2020
- Simple Payback or Internal Rate of Return ("IRR") with cash flows through 2020. Simple payback is used when there is one upfront cost and IRR is used when there are costs in multiple years and the payback calculation is not appropriate.

4.1 Direct Actions

Direct actions are those that the municipality can take to reduce GHG emissions. These actions focus on energy consumed and waste generated by municipal activities. Because these activities are within direct municipal control, actions to reduce GHG emissions can be readily measured and quantified.

Building Retro-Commissioning

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Cumulative cost savings through 2020*	*Cost of Implementing Through 2020*	*IRR through 2020 (multiple cash out)*
118	15.9% 0.12%	$164,027	$105,000	1.56

Retro-commissioning is used to restore a building either back to its original design operating conditions or to confirm that controls and systems are operating according to current desired operating conditions. Additional data collection devices would be added to provide detailed operating information that can be used to monitor operations on a regular basis. Retro-commissioning with data collection is recommended. Retro-commissioning can ensure that HVAC equipment and controls are operating per the facility requirements and at optimal efficiency. This can significantly reduce thermal and electrical loads.

In addition to retro-commissioning, there is re-commissioning and continuous commissioning. Re-commissioning is a periodic (typically one year or multiple years) commissioning of the building based on the original commissioning tests and procedures. Continuous commissioning is the use of current best technology practices to allow for re-commissioning "on demand" or on a shorter period schedule (for example, monthly) for the major equipment groups. Re- and Continuous Commissioning require the building automation/sub-metering system to allow for the "on demand" components of this process.

Typically, the retro-commissioning of a building is between $0.40 and $0.80 per square foot based on the complexity, size and types of systems to be commissioned and assuming that the installation of the building automation/sub-metering has occurred. Otherwise, this cost may be increased by the cost of installing temporary data collections system. Savings are estimated to be approximately 6 to 10% annually. For purposes of this exercise, we have budgeted $90,000 over 6 years; 50% to be spent on creating a comprehensive retro-commissioning program and for initial commissioning of Township buildings, and 50% in subsequent years for up to 2 more streamlined, re-commissioning exercises.

Action Steps

- Implement a plan to retro-commission all Municipal Buildings and Facilities
- Create a program that includes re-commissioning or continuous commissioning as part of a long-term facilities maintenance strategy.
- Further consider the recommendations in the Retro Commissioning section of the Energy Audit.

Incentives

Retro-commissioning is a recommendation from the Energy Audit that the Township has initiated. Depending on the results, the township may qualify for Energy Savings Improvement Plan financing or other incentives from the New Jersey Smart Start program.

Triple Bottom Line Value

Economic:	Predicted energy and operations savings; $164,000
Environmental:	CO2e reduction = 648 eMTCO2 avoided over seven years
	Electricity reduction = 1.44mWh conserved over seven years
	Fossil fuel consumed reduction = 49,000 therms conserved over seven years
Social:	Improved thermal comfort and IAQ for building occupants

Resources

Commissioning Process: http://www.peci.org/sites/default/files/epaguide_0.pdf
Retro-commissioning scope of work example:
http://www1.eere.energy.gov/femp/pdfs/11_3_exampleretrocommissioningsow.pdf
Retro-commissioning handbook: http://www.oregon.gov/ENERGY/CONS/BUS/comm/docs/retrocx.pdf
New Jersey Smart Start: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

Building operations – Occupant Education & Energy Star Purchasing

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Cumulative cost savings through 2020*	*Cost of Implementing Through 2020*	*IRR through 2020 (multiple cash out)*
37.5	7.5% 0.06%	$74,300	$45,000	37.8%

Educating and involving employees in energy conservation measures for building operations and informed purchasing is an effective low-cost strategy to improve building operations and reduce GHG emissions.

Employee participation extends from building maintenance staff to departmental employees who use facilities and purchase equipment on a regular basis. Each employee has an impact on building operations directly or indirectly.

Education programs are often done in concert with energy conservation initiatives or to raise awareness of sustainable policies and procedures. Examples include programs to train people to turn off lights and equipment when not in use, or to print double-sided copies, or to use re-usable containers for food. Employee and occupant participation programs are effective in changing habits and creating a sense of common mission and achievement. Incremental changes over time can create impressive results.

Additional benefit can be achieved if the Township implements policies that require purchasing computers, appliances, equipment and lighting that meet the requirements to be Energy Star Qualifying Products. Energy Star qualified products use 30%-75% less electricity than standard equipment. Where qualified products cost more than a conventional less-efficient counterpart, the cost premium can often be recovered through energy savings within a reasonable time period. Applicable categories of Energy Star qualified products include building products, Heating and Cooling equipment, lighting, computers and electronics, and commercial appliances.

Action Steps

- Identify current and proposed energy conservation measure and strategies that are affected by the actions of building occupants.
- Create appropriate protocols and policies to support and encourage these strategies
- Create materials and a plan to communicate the information to building occupants
- Incentivize when appropriate and use strategies to engage participation broadly and continually
- Use friendly competition as a way to encourage action
- Measure and communicate results continually
- Repeat education programs over time to reinforce habits and actions
- Create an inventory of equipment used for municipal business operations. Identify what existing equipment and appliances are currently Energy Star qualified.
- Identify a budget and schedule for planned replacement for equipment.
- Implement an Energy Efficient Purchasing Policy for municipal equipment, appliances and building products; including mechanical and electrical equipment.

Triple Bottom Line Value

Economic:	Predicted energy and operations savings; $74,300
Environmental:	CO2e reduction = 162 eMTCO2 avoided over seven years Electricity reduction = 417,000 kWh conserved over seven years Fossil fuel consumed reduction = 9,500 therms conserved over seven years
Social:	Targeted education will have positive impacts on employee actions and attitudes and can improve employee satisfaction and work performance by allowing them to “make a difference”. Modified attitudes can positively impact their actions in the community.

Resources

Energy Awareness Programs:
http://www1.eere.energy.gov/femp/pdfs/yhtp_ceap_hndbk.pdf
http://members.questline.com/Article.aspx?articleID=3510
http://www.energylens.com/articles/energy-awareness

Environmentally preferable purchasing: http://www.epa.gov/opptintr/epp/
Energy Star Products: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.&s=mega
New Jersey Smart Start: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

Building Energy Upgrades

There are energy efficiency upgrade opportunities for all municipal buildings. Energy audits performed by CDM Smith (West Windsor Township Final Audit Report, February 2014) identified 17 energy conservation measures for 6 of the 9 audited buildings. They identified energy conservation measures that include improvements in the following categories:

- Interior lighting upgrades to 6 buildings
- Exterior lighting timers for 1 building
- HVAC equipment upgrades to 2 buildings
- Motor upgrades for the waterworks/pool facility
- New boilers for 1 building and the waterworks/pool facility
- Boiler system modifications to 1 building
- Controls upgrade to 2 buildings
- Retro-commissioning to 1 building

The total cost of the audit ECM recommendations is $709,915. It is unlikely the Township would implement all of the recommendations immediately. Select building energy upgrade recommendations have been culled from the audit report and summarized below.

Summary of Energy Efficiency Recommendations
____Audit – Recommended Building Upgrades

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
95.4	11.6% 0.09%	39,100	$423,500	10.8

Exterior Lighting Controls at Princeton Junction Firehouse

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
10.5	1.27% 0.009%	$3,519	$13,980	3.97

DDC Control Upgrades

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
31.9	3.88% 0.03%	8,840	$133,200	15

HVAC Incremental Efficiency Upgrades

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
6.0	0.73%	2,147	$13,730	6.39

	0.005%			

Boiler Upgrades

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
44.2	0.5.37% 0.04%	9,976	$93,640	9.38

Waterworks Heater and Motor Upgrades

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
10.4	1.26% 0.007%	3,760	$31,915	6.39

8.1.3 Combined Impact

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Annual Cost Savings*	*Total Cost*	*Simple Payback*
198.2	24.11% 0.18%	58,502	709,915	12.13

In many cases, implementation of energy efficiency upgrades can be performed when equipment has reached the end of its useful life or during a planned maintenance cycle. In these cases, the required cost of these improvements would be a part of the Township's capital budgets and can be implemented without significant incremental cost. Accelerating these upgrades and maximizing the cost savings and greenhouse gas reduction potential will potentially require additional investment from the Township. Alternative financing mechanisms exist through third party financing sources.

Action Steps

- Review audit results and recommendations
- Review capital improvement plans
- Review financing options

Triple Bottom Line Value

Economic: Predicted energy and operations savings; $385,000
Environmental: CO2e reduction = 724 eMTCO2 avoided over seven years
Electricity reduction = 2.04 mWh conserved over seven years
Fossil fuel consumed reduction = 75,600 therms conserved over seven years
Social: Improved thermal comfort and IAQ for building occupants

Incentives
NJ Smart Start: http://www.njcleanenergy.com/commercial-industrial/programs/local-government-energy-audit/local-government-energy-audit

Resources
NJ Smart Start: http://www.njcleanenergy.com/commercial-industrial/programs/local-government-energy-audit/local-government-energy-audit

Energy Audits: https://www.ashrae.org/resources--publications/bookstore/procedures-for-commercial-building-energy-audits

Vehicle Fleet Replacement

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Cumulative cost savings through 2020*	*Cost of Implementing Through 2020*	*IRR through 2020 (multiple cash out)*
19.1	2.54% 0.01%	$20,300	$17,500	14.7%

Fleet replacement offers an opportunity to reduce GHG emissions. Replacement can occur as needed, or can be part of a planned vehicle management program. Vehicle fuel efficiency standards are continually improving with each model year. This gradual improvement in fuel efficiency is the basis for business as usual emissions reductions. A more focused replacement program can incorporate hybrid and alternative fuel vehicles which will accelerate GHG emissions reductions.

The cost of more fuel efficient vehicles is typically higher. Cost benefit analysis calculations are provided for the following passenger vehicle scenarios; hybrid versus gasoline, plug-in hybrid versus gasoline, and natural gas versus gasoline. The calculations reflect published pricing and mileage ratings for similarly equipped vehicles. These parameters change for each vehicle purchased; however, the methodology is the same.

To achieve the greenhouse gas emission savings as noted above, it is estimated that 33% of new passenger vehicles purchases by 2020 would be hybrids and that the hybrids have a cost premium of $2,500. The rate of purchase of the hybrid vehicles is estimated to be 1 vehicle per year.

For one vehicle conversion travelling 15,000 miles per year with an average fuel efficiency of 24 mpg, the cost benefit analysis was calculated for the hybrid, plug-in hybrid and natural gas alternatives versus a traditional gasoline vehicle.

The simple payback per vehicle for each scenario is:

- 2.22 years simple payback - Hybrid versus gasoline with 2.7 emit CO2 reduction per vehicle
- 4.36 years simple payback - Plug In Hybrid versus gasoline with 3.0 eMTCO2 reduction per vehicle
- 3.89 years simple payback - Natural Gas versus gasoline with 1.4 emit CO2 reduction per vehicle

Hybrid vs Gasoline	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Totals*
Purchase Premium	**2,500**	-	-	-	-	-	-	**2,500**
City Miles Travelled	11,250	11,250	11,250	11,250	11,250	11,250	11,250	
Highway Miles Travelled	3,750	3,750	3,750	3,750	3,750	3,750	3,750	
Total Mileage	15,000	15,000	15,000	15,000	15,000	15,000	15,000	105,000
Gasoline Usage Baseline (Gallons)	625	625	625	625	625	625	625	4,375
Hybrid Gasoline Usage (Gallons)	319	319	319	319	319	319	319	2,234
Cost of Gasoline (3% annual increase)	3.61	3.72	3.83	3.94	4.06	4.18	4.31	
Gasoline Cost Reduction	**1,104**	**1,137**	**1,171**	**1,207**	**1,243**	**1,280**	**1,318**	**8,460**
eMT CO2 Reduction	**2.7**	**2.7**	**2.7**	**2.7**	**2.7**	**2.7**	**2.7**	**19.1**
Maintenance Premium	-	-	-	-	-	-	-	-
Cash Flows	**(1,396)**	**1,137**	**1,171**	**1,207**	**1,243**	**1,280**	**1,318**	**5,960**
Simple Payback	**2.22**							

Plug In Hybrid vs Gasoline	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Totals*
Purchase Premium	**6,150**	-	-	-	-	-	-	**6,150**
City Miles Travelled	11,250	11,250	11,250	11,250	11,250	11,250	11,250	
Highway Miles Travelled	3,750	3,750	3,750	3,750	3,750	3,750	3,750	
Total Mileage	15,000	15,000	15,000	15,000	15,000	15,000	15,000	105,000
Gasoline Usage Baseline (Gallons)	625	625	625	625	625	625	625	4,375
Hybrid Mileage City	2,813	2,813	2,813	2,813	2,813	2,813	2,813	19,688
Hybrid Mileage Hwy	3,750	3,750	3,750	3,750	3,750	3,750	3,750	26,250
Electric Mileage City	8,438	8,438	8,438	8,438	8,438	8,438	8,438	59,063
Hybrid Gasoline Usage (Gallons)	140	140	140	140	140	140	140	977
Electrical Usage (kWh)	2,751	2,751	2,751	2,751	2,751	2,751	2,751	19,260
Cost of Gasoline (3% annual increase)	3.61	3.72	3.83	3.94	4.06	4.18	4.31	
Cost of Electricity (3% annual increase)	0.15	0.15	0.16	0.16	0.17	0.17	0.18	
Gasoline Cost Reduction	**1,339**	**1,380**	**1,421**	**1,464**	**1,508**	**1,553**	**1,599**	**10,264**
eMT CO2 Reduction	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**21.1**
Maintenance Premium	-	-	-	-	-	-	-	-
Cash Flows	**(4,811)**	**1,380**	**1,421**	**1,464**	**1,508**	**1,553**	**1,599**	**4,114**
Simple Payback	**4.36**	** federal tax credit available						
Natural Gas vs Gasoline	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Totals*
Purchase Premium	**2,500**	-	-	-	-	-	-	**2,500**
City Miles Travelled	11,250	11,250	11,250	11,250	11,250	11,250	11,250	
Highway Miles Travelled	3,750	3,750	3,750	3,750	3,750	3,750	3,750	
Total Mileage	15,000	15,000	15,000	15,000	15,000	15,000	15,000	105,000
Gasoline Usage Baseline (Gallons)	625	625	625	625	625	625	625	4,375
Natural Gas Usage (therms)	781	781	781	781	781	781	781	5,469
Cost of Gasoline (3% annual increase)	3.61	3.72	3.83	3.94	4.06	4.18	4.31	
Cost of Nat. Gas (3% annual increase)	2.10	2.16	2.23	2.29	2.36	2.43	2.51	
Fuel Cost Reduction	**616**	**634**	**653**	**673**	**693**	**714**	**735**	**4,717**
eMT CO2 Reduction	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**10.1**
Maintenance Premium	-	-	-	-	-	-	-	-
Cash Flows	**(1,884)**	**634**	**653**	**673**	**693**	**714**	**735**	**2,217**
Simple Payback	**3.89**							

Action Steps

- Identify current fleet inventory condition and prioritize vehicle replacement needs
- Identify appropriate vehicle options (conventional gas, diesel, hybrid, electric, alternative fuels)
- Identify any associated infrastructure required for non-conventional fuel options
- Determine cost premium ROI for hybrid, electric, or alternative fuel vehicles over vehicle useful life
- Determine if an accelerated vehicle replacement program is beneficial or desired
- Formalize a green fleet policy based on the preferred vehicle replacement program

Triple Bottom Line Value *(for hybrid vehicle option)*

Economic: Predicted gasoline cost savings: $34,841
Environmental: CO2e reduction = 76.5eMT through 2020;
Reduced gasoline usage = 8,564 gallons
Social: reduced vehicle emissions and ground level ozone contributes to better community health

Incentives

NJ Incentives: http://www.afdc.energy.gov/laws/laws/NJ/tech/3270

Resources
Green vehicle Guide:
http://www.epa.gov/greenvehicles/Index.do;jsessionid=xzLtSJwfSXyLtBFJ3c72PywNrM2yByb4XP1C0zMdZPTNTc7wJ6kS!-929384884
NJ Resources: http://www.nj.gov/dep/cleanvehicles/

Vehicle Fleet Fuel Switching

eMTCO2 reduction through 2020	*% of Municipal Goal* *% of Overall Goal*	*Cumulative cost savings through 2020*	*Cost of Implementing Through 2020*	*IRR through 2020 (multiple cash out)*
1.2	0.15% 0.0%	($16,250)	0	NA

The two options for Vehicle Fleet Fuel Switching are from gasoline to natural gas and from diesel to biodiesel. Some of the service vehicles may be able to be converted to natural gas from gasoline and the cost benefit analysis will be similar to the above section based on a similar conversion price. Switching to biodiesel as a portion of diesel fuel consumed will have a greenhouse gas reduction benefit but comes with a corresponding increase in operating costs. Many diesel vehicles can run B20 biodiesel without any modifications. B20 biodiesel is a blend of 80% diesel and 20% biodiesel. Converting to B100 biodiesel (100% biodiesel) will require modifications and the cost will be dependent on the vehicle.

For one vehicle conversion travelling 15,000 miles per year with an average fuel efficiency of 10 mpg, the cost benefit analysis is as follows.

B20 Biodiesel vs Diesel	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Totals*
Purchase Premium	-	-	-	-	-	-	-	-
Total Mileage	15,000	15,000	15,000	15,000	15,000	15,000	15,000	105,000
Diesel Usage (gallons)	1,500	1,500	1,500	1,500	1,500	1,500	1,500	10,500
BioDiesel (B20) Usage	1,531	1,531	1,531	1,531	1,531	1,531	1,531	10,714
Cost of Diesel (3% annual increase)	3.97	4.09	4.21	4.34	4.47	4.60	4.74	
Cost of BioDiesel (3% annual increase)	4.14	4.26	4.39	4.52	4.66	4.80	4.94	
Fuel Cost Increase	**382**	**393**	**405**	**417**	**430**	**443**	**456**	**2,925**
eMT CO2 Reduction	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**8.7**
Maintenance Premium	-	-	-	-	-	-	-	-
Cash Flows	**(382)**	**(393)**	**(405)**	**(417)**	**(430)**	**(443)**	**(456)**	**(2,925)**
Simple Payback	-	** no investment but increase in annual operating costs						

Action Steps

- Evaluate availability of alternative fuels and suppliers
- Determine what existing or planned vehicles are suitable for fuel switching
- Determine what modifications may be needed to vehicles, vehicle maintenance or support infrastructure
- Evaluate the installation of plug-in electric vehicle charging stations

Triple Bottom Line Value

Economic: net increase cost for biodiesel = $2,925 per vehicle over seven years
Environmental: CO2e reduction = 179 eMTCO2 avoided by fleet over seven years
Reduced waste (agricultural or used cooking oil)

Social: improved regional air quality

Incentives
NJ Incentives: http://www.afdc.energy.gov/laws/laws/NJ/tech/3270

Resources
Natural Gas fueled vehicles: http://www.ngvi.com/faq.html
Electric vehicle comparison:
http://www.epa.gov/greenvehicles/Index.do;jsessionid=xzLtSJwfSXyLtBFJ3c72PywNrM2yByb4XP1C0zMdZPTNTc7wJ6kS!-929384884
NJ Resources: http://www.nj.gov/dep/cleanvehicles/

Municipal Waste Stream Reduction

eMTCO2 reduction in 2020	*% of Municipal Goal* *% of Overall Goal*	*Cumulative cost savings through 2020*	*Cost of Implementing Through 2020*	*IRR through 2020 (multiple cash out)*
133.6	18% 0.14%	$86,033	$35,000	3.23%

The municipal waste stream represents 20% of the annual municipal GHG emissions. A two-pronged approach of reducing the amount of waste generated by municipal operations and increasing the amount of waste material that is recycled or otherwise diverted from landfill can have a significant effect on municipal emissions.

The savings above are based on a $30 per ton landfill charge and the costs are based on an increased education and recycling program.

Waste Education	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Totals*
Cost of Education/Audit	**15,000**	-	**10,000**	-	**10,000**	-	-	**35,000**
Waste Reduced %	0%	3%	3%	6%	6%	9%	12%	0
Total Tons Reduced	-	197	197	389	389	586	765	2,523
Cost of Landfill (3% annual increase)	30.00	30.90	31.83	32.78	33.77	34.78	35.82	
Annual cost savings	-	**6,101**	**6,284**	**12,743**	**13,125**	**20,368**	**27,413**	**86,033**
eMT CO2 Reduction	-	**34.5**	**34.5**	**67.9**	**67.9**	**102.3**	**133.6**	**440.6**
Maintenance Premium	-	-	-	-	-	-	-	-
Cash Flows	**(15,000)**	**6,101**	**(3,716)**	**12,743**	**3,125**	**20,368**	**27,413**	**51,033**
	(15,000)	**6,101**	**(3,716)**	**12,743**	**3,125**	**20,368**	**27,413**	
		2	**3**	**4**	**5**	**6**	**7**	
	-	**1.71**	-	**3.23**	-	-	-	
IRR	**40.8%**							
Simple Payback	**3.23**							

Reducing the amount of waste generated can be achieved through employee training and education as well as by better monitoring and management of waste streams. Policies such as double-sided printing and the preferred use of electronic documents reduce the use of paper, ink and their associated packaging. Purchasing programs that allow departments to recycle toner and ink cartridges through suppliers helps remove these items from the waste stream. Waste reduction strategies compliment environmentally preferred purchasing strategies that put a similar emphasis on reduced packaging and reduced environmental impact.

Programs should be considered to salvage or reuse durable goods first before considering recycling or disposing of them. Work with your contracted waste hauler to analyze existing waste streams and ask them to recommend modifications to waste infrastructure and scheduling that will increase recycling.

Action Steps

Wind Purchase Calculation Scenarios			
Incremental Cost of Wind ($ /kWh)	**$ 0.005**	**$ 0.002**	**$ 0.001**
Electricity Emission Factor	0.2863	0.2863	0.2863
kWh required to produce 1 eMT CO2	3,493	3,493	3,493
Cost to avoid 1 eMT CO2	**$ 17.47**	**$ 6.99**	**$ 3.49**

- Conduct a facilities-wide waste audit that quantifies the type and amounts of waste being generated by facility or department
- Document current recycling activities and identify additional recycling opportunities
- Work with waste hauler to implement additional recycling opportunities
- Develop and implement an employee education program that reduces overall waste generated and increases reuse and recycling of waste materials
- Evaluate curbside composting programs that Lawrence and Princeton have implemented. Consider a Pay as You Throw" program (Rutgers recommendation)

Triple Bottom Line Value

Economic: Predicted operations savings; $86,033
Environmental: CO2e reduction = 34.5 eMTCO2 year 1 to 133.6 eMTCO2 year 7
Reduction in landfilled materials = how many tons of waste
Social: Enhanced quality of life for community; reduced odor from landfill waste,

Resources
New Jersey DEP: http://www.nj.gov/dep/dshw/recycling/source_red.htm
Environmentally preferable purchasing: http://www.epa.gov/opptintr/epp/
Zero Waste Initiatives: http://www.grrn.org/page/zero-waste-community

Purchasing Wind Energy

Purchasing RECs generated from wind energy (also known as green power) is a way to offset emissions from electricity generated at the local level. Similar to investing in carbon offsets, wind energy investment is considered an offset not a reduction. Wind energy credits can be procured from third-party providers through annual or multi-year contracts, in any amount desired. Obviously, the larger the block purchased the better the price-per-unit will be. Wind energy credits can also be purchased through Utility providers and appear as an on-bill premium. In either scenario, the renewable energy credit is transferred to the municipality to be retired as an offset towards the municipality's carbon emissions. Wind generated RECs are currently the most cost effective offsets for electricity-generated carbon emissions. Solar Renewable Energy Credits (SRECs) trade at much higher premiums.

Energy Aggregation

One option to consider would be to create a community-wide purchasing co-op in conjunction with a third-party provider that could aggregate purchases by the municipality and residents. The collective offsets purchased could then be easily documented and attributed to community actions to reduce Township emissions. Some balance of increased Class I Renewable content and /or savings can be realized through aggregation. The municipality has entered into an aggregation agreement for municipal purchases as a demonstration project for residents. The municipality has contracted for an aggregation package containing

20% Class I renewable energy content. Future purchases should consider increasing the renewable energy percentage.

Purchasing Carbon Offsets

Purchasing offsets; either in the form of Renewable Energy Credits (RECs) that count towards Scope 2 emissions or purchasing carbon offsets that count towards Scope 1 & 3 emissions, is a strategy that can be used to reduce the community's carbon footprint. Many corporations use this strategy to meet their environmental reporting commitments. The cost to the community to meet its carbon reduction goals in the year 2020, based on assumed BAU reductions could range from $199,000 to $998,000 based on the mix of offsets purchased. This strategy becomes an annual reoccurring cost which has less value than investing in energy conservation.

Investing in carbon offsets takes the form of either purchasing carbon offset certificates or investing in specific carbon offset projects where the benefit of the project's actions can be attributed to the Township's carbon emissions. Since the cumulative Township goal is to achieve a fixed reduction of eMTCO2, investing in carbon offsets can be done at any point between now and 2020. Offsets are a one-time event and are subject to reoccurring costs to maintain their reduction value.

There are a number of different types of carbon offset certificates currently available in the market. Each is based on an accepted standard. Generally, the difference in certificate cost is based on the stringency of the standard. The following are the most common standards.

- The Clean Development Mechanism (CDM)
- The Climate Action Reserve (CAR)
- The Voluntary Carbon Standard (VCS)
- The American Carbon Registry (ACR)
- Reducing Emissions from Deforestation and Forest Degradation (REDD) projects
- In addition, pricing will be dependent on the type of project and the location where that the carbon offsets are being produced.

Typical carbon offset projects include:

1. Coal Mine Methane Capture: This method quantifies the emissions reductions generated by capturing and destroying methane from abandoned/decommissioned coal mines. The capture and destruction of methane prevents the GHG from being emitted into the atmosphere once a coal mine is abandoned. The methodology quantifies GHG emission reductions by providing an approach to determine the quantity of methane that would be released without the project.

2. Landfill Gas Capture: The capture of methane from landfills using wells, pipes, blowers and other technology. This methane is destroyed by burning it in a flare, used to generate renewable electricity, or purified into gas that is sent to industrial end-users for process heat. If these projects did not capture the methane, it would have been released into the atmosphere, methane has a global warming potential 21 times greater than Carbon Dioxide.

3. Agricultural Methane Capture: The Livestock Project Protocol provides guidance to calculate, report, and verify GHG emission reductions associated with installing a manure biogas control system for livestock operations, such as dairy cattle and swine farms.

4. Reforestation Programs: Planting of forest tracks that will mature and be maintained over time, based on accepted standards of carbon sequestration for various species of trees.

Resources
Carbon Offsets: http://science.howstuffworks.com/environmental/green-science/carbon-offset3.htm
Carbon Fund: http://www.carbonfund.org/

Benchmarking Commercial Energy Use

Accurate data is the most important tool for any community that wants to reduce GHG emissions. A growing number of municipalities around the country now require large commercial buildings to benchmark and report their energy use. The net effect of such benchmarking efforts creates awareness of energy use in its various forms and awareness of the corresponding GHG emissions impact on the region. It also becomes a management tool for building owners to improve building energy use and operations. Although building owner initially balk at such requirements, most comply over time and find the effort beneficial. Most municipalities require buildings of a certain size, often 50,000sf. or larger to report energy use annually.

There are approximately 65 commercial buildings (out of 240+) each larger than 50,000 square feet in the township. They represent over 80% of the commercial square footage. Working with these property owners to benchmark energy use, and incentivizing them to improve energy efficiency and reduce GHG emissions can help the Township achieve its 2020 carbon reduction goals. The EPA's Energy Star Portfolio Manager Tool is an easy and accessible tool to benchmark energy performance for a wide range of building types, and is the basis for most energy benchmarking regulations.

Resources
Benchmarking and Disclosure: http://www.imt.org/resources/detail/building-energy-transparency-a-framework-for-implementing...energy-rating-d
EPA Benchmarking:
http://www.energystar.gov/ia/business/downloads/datatrends/DataTrends_Savings_20121002.pdf?3d9b-91a5
City of Philadelphia Benchmarking Ordinance:
http://s146206.gridserver.com/media/files/Philadelphia_energy_benchmarking_bill.pdf
Data Access for Building Benchmarking: http://s146206.gridserver.com/media/files/IMT_Report_-_Utilities_Guide_-_March_2013.pdf

Energy Efficiency Standards for New Construction

Energy efficiency standards for commercial and residential buildings are a way to ensure that the GHG emissions of future development and construction are comparatively less than those of existing buildings. Putting these standards in place is politically challenging. Relying on improvements to State energy codes will not achieve enough meaningful GHG emissions in the desired timeframe to meet the Township's goals. Higher expectations for energy efficiency and lowered energy use intensity would be required. It is laudable for the Township to broadly embrace green building requirements for all community construction and renovation, but for the purposes of GHG emissions reductions the focus needs to be on energy efficiency.

Energy efficiency standards that are more stringent than required by code (code being business as usual) generally reference programs such as Energy Star. Energy Star has widely accepted standards for both residential and commercial construction, as well as for products and equipment. It is reasonable that the Township could require all new homes to be Energy Star rated; most production home builders are capable of building to that standard. Commercial construction can be required to also meet Energy Star Rated performance, which is a score of 75 or better.

Higher energy efficiency standards carry the perception that added cost inhibits development. In many cases this is unfounded, and in a Community such as West Windsor Township, there is already a competitive

environment where residential and commercial builders are offering better quality products to attract buyers. In an environment such as this, it is easier to make the argument for higher energy efficiency standards. The New Jersey Clean Energy Program supports Energy Star Homes with rebates and incentives for residents.

Resources
Residential Energy Efficiency Policy: http://www.epa.gov/statelocalclimate/local/topics/residential.html
Residential and Commercial Energy Efficiency Trends: http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/bt_stateindustry.pdf
Energy Star Buildings: http://www.energystar.gov/index.cfm
New Jersey Clean Energy Program: http://www.njcleanenergy.com/residential/home/home

GHG Analysis Requirements for Commercial Building New Construction Permits

In addition to energy efficiency requirements for new construction, The Township can require a statement of projected GHG emissions as a condition for issuing a building permit for all new commercial construction. This provides the municipality with an opportunity to predict what impact new construction will have on the Township's carbon reduction goals. It also allows reviewers and planners to engage developers in a conversation about energy efficiency. Energy Star provides a simple and quick analysis tool called Target Finder which is designed for use in the project design phase. Target finder summarizes building details such as size, hours of operation, number of building occupants, computers, energy sources and predicted energy use. It also will tabulate a projected comparative score based on the building type and predict GHG emissions.

Resources
Energy Star Target Finder: https://www.energystar.gov/buildings/service-providers/design/step-step-process/evaluate-target/epa's-target-finder-calculator

Energy Audit Requirements for Renovation Permits

As a condition for issuing a permit for major building renovations, the municipality can require that applicants conduct a facilities energy audit. The energy audit at a minimum should comply with ASHRAE Level I audit requirements. An ASHRAE level I audit consists of a visual walkthrough of the facility to identify no-cost and low-cost improvements that could be made to improve energy efficiency. There is a clearly defined format for conducting an audit and presenting the findings and recommendations. An ASHRAE Level II audit would provide a more detailed analysis of the cost benefit of energy efficiency measures, but may be too burdensome for smaller renovation projects. Pay for Performance, through New Jersey Smart Start Program has incentives to support conducting energy audits and implementing recommendations for existing buildings.

Resources
Pay for Performance: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance

Community Education

Actions that reduce GHG emissions will be influenced by changes in behavior by the community at large. Influencing community behavior outside of regulation is best achieved through a comprehensive and extended community education campaign. There are a number of ways the Township can influence behavior; opportunities to learn can occur in many ways and in many venues. Accessibility to information is important, as is a consistent message delivered in a variety of ways. Community education can be fun, engaging, and be geared to a varied, multi-generational audience. You can leverage a sense of community pride and friendly competition to achieve meaningful emissions reductions.

A community education program needs to be comprehensive in scope and executed consistently over time. To achieve the Township's GHG reduction goals, a multi-year education program should run through 2020, with specific goals to educate and provide assistance to community members. There are many facets to a community education program and if well designed and executed, the program will yield positive results.

Effective community programs are partnerships that reach across the community and beyond. Many organizations can be recruited to deliver the message and provide program support. Leveraging the energy and resources of community partners will help achieve the desired program results.

Community Partnership Programs – BPU and PSE&G

The New Jersey Board of Public Utilities and PSE&G have a number of programs that support energy conservation. Residential and commercial participation in these programs will reduce the Township's carbon footprint. Participation should be encouraged and actively promoted. The perennial challenge for utility sponsored energy conservation programs is getting broad participation from their customer base. The most effect means of engaging the public is often through positive word-of-mouth at the local level. This is where the Township can be an effective partner with utilities to conserve energy and reduce GHG emissions.

Community partnerships can leverage existing programs though education and awareness, targeting specific sectors of the community. The partnership can provide both outreach and assistance to residents and business owners who express interest in participating in energy conservation programs. The partnership can also work with the utilities to track energy savings and credit these actions towards the Township's emissions reductions goals. Community partnerships can creatively leverage available utility funding to help the community reduce GHG emissions. Energy use is responsible for 51% of the community's GHG emissions load. Community partnerships focused on energy conservation will contribute to achieving the Township's 2020 carbon reduction goals.

Resources

New Jersey Board of Public Utilities Clean Energy Program: http://www.njcleanenergy.com/main/board-public-utilities/board-public-utilities-0
PSE&G: http://www.pseg.com/family/pseandg/energyefficiency/index.jsp

Community Partnership with Local Schools

Kids get it, and can influence the actions of their parents and households. Community education about energy efficiency, climate change and GHG emission reductions is effective when it happens in and around public schools. The school district can and should be a vital partner in achieving the Townships emissions reduction goals. Opportunities to educate the community exist throughout the year, both inside and outside the classroom. Local schools can act as a clearinghouse for information and an important communication channel at the neighborhood level.

Sustainable Jersey has recently launched a Sustainable Jersey program for Schools program, http://www.sustainablejersey.com/about/sustainable-jersey-for-schools/. Although the schools are not counted within West Windsor's GHG inventory, the District should be further encouraged to participate in this worthy program.

Resources

EPA: http://www.epa.gov/climatechange/wycd/school.html
Resources for Educators: http://hdgc.epp.cmu.edu/teachersguide/teachersguide.htm

The Role of Local Governments and Community Organizations: http://aceee.org/files/pdf/white-paper/Local-EE-Implementation.pdf

Community Partnership with Faith-Based Organizations

Many faith-based organizations share the view that we are stewards of this planet and have a moral obligation to protect the environment. As local partners, they have the ability to educate and communicate with community members. An effective partnership can be forged with local faith-based organizations that align the Township's climate action goals with those of the local religious community. Such partnerships can yield positive results at the local level.

Resources

President's Advisory Council on Faith-based and Neighborhood Partnerships: http://www.whitehouse.gov/sites/default/files/partnerships-environment-climate-change.pdf
New Jersey Faith-based Initiatives: http://www.nj.gov/state/programs/dos_program_faith_based.html
New Jersey Interfaith Coalitions: http://greenfaith.org/about

Community Education – State & Federal Incentive Programs

Energy efficiency and energy conservation measures are supported at the State and Federal level through a number of tax credit, loan and incentive programs. Many residential and commercial property owners are not aware of these programs which help make building upgrades and energy efficient technology more affordable. At the Federal level, energy efficient commercial buildings tax credits, accelerated depreciation credits, and energy investment tax credits are available. Corporate tax credits are available for builders of energy efficient homes, and personal exemptions are available for energy efficient and renewable energy technologies. At the State level there are solar loan programs through PSE&G, sales tax exemptions for solar, and grants for small scale combined heat and power for commercial buildings. For residential construction there are State loan programs for Energy Star construction, and rebate programs for a wide array energy efficiency measures.

As part of a comprehensive community education program, the municipality can provide education about available Federal and State programs, and provide assistance in accessing programs that can make building upgrades and energy efficiency measures more affordable.

Resources

Database of Federal and State Incentives:
http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=1&state=NJ
State Incentives: http://www.njcleanenergy.com/main/board-public-utilities/board-public-utilities-0

Community Education – Appliance Efficiency

Electronics and appliances increasingly dominate the energy loads of residential and commercial buildings. Even when not in operation, electronics and appliances can consume up to 40% of household energy. Educating the public about the environmental and cost benefits of energy efficient electronics and appliances will help reduce GHG emissions.

Resources

Energy Star Products: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.&s=mega
Efficient Appliances: http://energy.gov/energysaver/articles/energy-efficient-home-appliances-can-save-you-money
Energy Efficient Appliances: http://aceee.org/consumer

Community Driver Education

Driving habits and vehicle maintenance play a big part in reducing GHG emissions. Although most people consider themselves good drivers, many do not realize that small changes to how they drive can have a big impact on emissions. Proper maintenance of vehicles improves performance, mileage and reduces emissions.

There are a number of education programs available geared to helping the public driver smarter and reduce their carbon footprint.

Resources
EPA recommendations for reducing air pollution: http://www.epa.gov/airquality/peg_caa/reduce.html
Fuel Economy and climate change: http://www.fueleconomy.gov/feg/climate.shtml
Fuel Efficient Driving Practices: http://www.epa.gov/region9/climatechange/transportation/driving.html

GHG Mitigation Project Prioritization

GHG mitigation options should be considered based on cost effectiveness, implimentability and the ability to realize significant GHG reductions. Measures to prioritize selection of alternatives include:

- The West Windsor Energy Audit prioritizes actions based on cost effectiveness
- The McKinsey GHG Abatement Cost Curve, shown below, provides an illustration of relative cost effectiveness of a wide array of projects. The Cost Curve can help to prioritize projects.

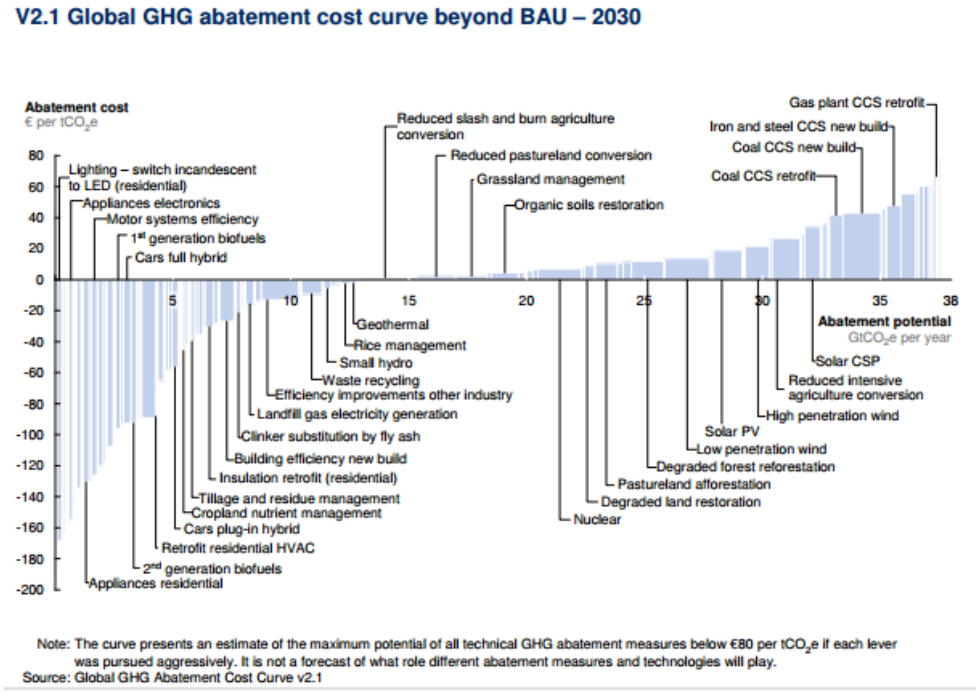

Figure 3: GHG Abatement Cost Curve

Source: www.mckinsey.com

4.2 indirect actions

It is difficult to predict the impact of indirect actions, so specific target reduction goals and predicted reductions in eCO2 emissions and costs are not included. These recommendations all contribute to reducing

Township emissions to a lesser or greater degree depending upon individual participation. The inability to measure the impact of a specific indirect action does not lesson their importance; rather it emphasizes the importance of updating the Township's GHG inventory annually to see the aggregate effect of indirect actions.

Green Building Requirements for Municipal Construction and Renovations

The municipality has the ability to set performance requirements for the buildings it constructs, renovate and operate. Requiring energy efficiency and reduced environmental impact (energy, water, resource use and waste generation) in municipal operations codifies the Township's commitment to reducing its GHG emissions and its carbon footprint.

Reliance on improvements to State energy codes will not achieve enough meaningful GHG emissions in the desired timeframe to meet the Township's goals. Higher expectations for energy efficiency and lowered energy use intensity would be required. There are a number of ways that this can be achieved, depending upon the scope and extent of desired performance. Green building rating systems such as LEED are appropriate for benchmarking performance across a number of environmental indicators. Energy Star Portfolio Manager is appropriate for specifically benchmarking energy use and GHG emissions. West Windsor has established an Energy Star Portfolio Manager account.

The perception that higher levels of building performance require higher cost is unfounded. Operational savings consistently outweigh first costs over time, and the positive impact on GHG emissions is cumulative. Higher levels of building performance can be achieved using an integrated approach to building design and operations, by staff or consultants experienced with high performance design processes. The Township should establish criteria for higher performing facilities with the expectation that better quality services can be achieved in building operations and delivered by consultants, all for reasonable cost. In many cases additional first costs for high performing buildings are associated with the investment in better quality systems that have reasonable return on investment. State and Utility-based incentive programs exist to support energy conservation and to help offset the cost of high performing building systems and components.

Action Steps

- Determine what metrics or programs adequately measure and benchmark desired performance criteria (energy, water, resource use, waste, etc.)
- Determine the beneficial impact of higher levels of building performance in terms of GHG emissions reductions and operational cost savings over time
- Establish reasonable cost expectations for achieving higher levels of building performance (no added cost, investment with short ROI, increased first costs to yield long term benefit, etc.)
- Create departmental policy that directs staff to implement programs that result in higher levels of building performance

Resources

Federal & State Incentives: http://www.dsireusa.org/incentives/index.cfm?re=0&ee=0&srp=1&state=NJ
Energy Star Buildings: http://www.energystar.gov/index.cfm
US Green Building Council Programs: http://www.usgbc.org/
State Green building Resources: http://www.usgbcnj.org/

Traffic Control

Overall community GHG emissions can be influenced by municipal actions that reduce transportation emissions. Although it is difficult to track the outcome of specific actions, the net effect is to reduce engine "run time". Two actions that the municipality can take are to implement and enforce an anti-idling ordinance and to synchronize traffic signals to reduce idling at intersections. Anti-idling ordinances restrict the amount of time vehicles, especially trucks or busses, are allowed to sit with their motors running. Many municipalities have enacted anti-idling policies for their communities. The State of New Jersey has anti-idling regulations that limit idling to 3 minutes before a driver is required to turn off the vehicle engine. As part of a Township policy, these regulations should be publicized and enforced. A public anti-idling awareness campaign focusing on schools is an excellent way to raise awareness and educate the community about anti-idling regulations. Similarly, an awareness campaign aimed at retailers and commercial deliveries can be effective in reducing transportation emissions. The West Windsor Police Department has established an anti-idling campaign.

There are mixed opinions about the benefits of synchronizing traffic signals. Many people believe that the reduced time in stopped traffic has an aggregate positive impact on GHG emissions and air quality. Conversely, there are those who argue that improved traffic flow simply encourages more driving. For many of the Township's major routes, a combination of improving traffic flow and reducing speed can help reduce GHG emissions. Both the Department of Energy and Environmental Protection Agency have conducted research on the implementation of Intelligent Traffic Strategies (ITS).

Resources
Anti-idling policy: http://www.icleiusa.org/action-center/learn-from-others/2.1%20Anti-Idling%20Ordinance%20Guidance.pdf
Anti-idling regulations: http://www.atri-online.org/research/idling/Idling%20Regulations%20Compendium%20Dec%200611.pdf
New Jersey Air Quality Management regulations: http://www.state.nj.us/dep/aqm/
Department of Energy Anti-idling info: http://www.afdc.energy.gov/uploads/publication/light_duty_fs_6-2013_.pdf
EPA research on ITS: http://www.epa.gov/otaq/stateresources/policy/transp/its/fuelimpt.pdf

Increase Public Transportation Access and Use

Increasing public transportation access in the community is necessarily a regional strategy for reducing GHG emissions from vehicle use. The Township should advocate for better and increased public transportation options for its community and work with surrounding municipalities and New Jersey Transit to provide better access to public transportation. The largest sources of transportation related GHG emissions come from passenger cars and light-duty trucks. Based on average a passenger car that gets 25 mpg that drives 15,000 miles per year, using public transportation 1 day per week can eliminate .75 eMTCO2 per year. For every resident able to use public transportation to travel to work in lieu of driving, their impact is -3.75 eMTCO2 annually. Providing increased opportunity for public transportation use is one of the most effective ways to reduce community GHG emissions.

There are eight legacy electric vehicle charging stations located within a New Jersey Transit parking lot at the Princeton Junction train station. The municipality should encourage New Jersey Transit to retrofit the stations with new equipment. Since wiring and underground electric conduit has already been installed, approximately two thirds of the project cost has already been made.

Rutgers recommendations: Improved GPS enabled public transit system for busses and shuttles. Build a parking deck and more bike racks at the train station. Make Car2Go/Zipcar rental cars and bike rentals more available.

Resources
Public Transportation Advocacy: http://www.publictransportation.org/Pages/default.aspx
Carbon Calculator: http://www.publictransportation.org/tools/carbonsavings/Pages/default.aspx

Increase Active Transportation Networks

Providing alternative transportation options and networks can reduce trips and their related GHG emissions. Active transportation; walking and biking, promote community health, recreation, and reduce air pollution. Infrastructure such as sidewalks, bike paths and bike lanes encourages non-vehicle transportation for everyday needs. Accessibility and safety needs to be considered, but good comprehensive planning and development policies can support the creation and maintenance of this infrastructure. Alternative transportation networks are particularly effective in reducing short haul trips, and in connecting residential neighborhoods with schools, business districts and transportation nodes.

Resources
Safe Routes to School: http://www.saferoutespartnership.org/sites/default/files/pdf/Air_Source_Guide_web.pdf
Benefits of Bike Lanes: http://www.michigantrails.org/blog/wp-content/uploads/advantages_to_bike_lanes1-05.pdf

Increase Tree Canopy

Increasing the tree canopy provides a number of benefits for the community. Increased tree canopy coverage improves air quality and local water quality, reduces localized ambient temperatures which affects building energy use, sequesters carbon, enhances property values and improves beneficial wildlife habitat. Overall it is an important strategy for improving the quality and sustainability of the community. The focus of this strategy in reducing GHG emissions is its ability to reduce building energy demand and secondarily the ability of mature trees to capture and store carbon.

Building energy use is directly related to ambient temperatures surrounding the building. The cooler the immediate environment is around a building, the less energy is required to cool and condition the building interior. Ambient temperature increases caused by absorptive materials (roadways, pavement, roof surfaces, etc.) is commonly referred to as heat island effect. Reducing heat island effect reduces energy demand. Extensive tree canopy can provide shade for heat-attracting surfaces and has an aggregate effect on building energy use over time. The Township can encourage expanding its tree canopy by adopting policies to protect existing tree canopy and to increase tree canopy requirements in new development.

Resources
Tree Canopy Analysis: http://gep.frec.vt.edu/va_utc.html
Tree Canopy Benefits: http://www.canopy.org/pages/about-trees/the-benefits-of-trees.php
US Council of Mayors: http://www.usmayors.org/trees/treefinalreport2008.pdf

A timeline for emission reductions to achieve GHG reduction goals is shown below:

Municipal Climate Action Plan		2014	2015	2016	2017	2018	2019	2020
Business As Usual Case								
Electricity	eMTCO2	-	788	781	782	748	732	680
Natural Gas	eMTCO2	18	465	465	456	456	434	434
Motor Gasoline	eMTCO2	-	664	650	637	620	606	587
Diesel Fuel	eMTCO2	-	308	305	303	299	296	292
Landfill Waste	eMTCO2	-	1,149	1,149	1,131	1,131	1,136	1,113
Total Emissions		**18**	**3,375**	**3,350**	**3,310**	**3,255**	**3,203**	**3,106**
Total Emissions 2020 Goal		-	-	-	-	-	-	**2,666**
								(440)
Emission Reductions								
Energy Upgrades	eMTCO2	-	198	198	198	198	198	198
Energy Education	eMTCO2	11	8	8	35	34	33	38
Fleet Replacement	eMTCO2	-	5	8	11	14	16	19
Fleet Fuel Switching	eMTCO2	-	9	17	26	34	43	51
Waste Education	eMTCO2	-	34	34	68	68	102	134
Total Emission Reductions		**11**	**254**	**265**	**338**	**348**	**392**	**439**
Total Emissions per CAP		**7**	**3,120**	**3,084**	**2,972**	**2,908**	**2,812**	**2,667**

100% of Target Goal

5.0 Climate Change Preparedness and Resilience

According to John Paul Holdren, Director of the White House Office of Science and Technology Policy, the climate issue is what the mix going forward is going to be among mitigation, adaptation, and suffering. If our aim is to minimize climate change related suffering, as it should be, as it must be, we're going to have to maximize both mitigation and adaptation. The previous sections dealt with reducing (mitigating) carbon emissions. This section focuses on adaption, preparedness and resilience.

Prospective Actions:

- Consider effect of flooding, heat waves, drought and power outages on most vulnerable citizens, such as senior citizens
- Consider implementation of the flood mitigation measures identified in the Little Bear Brook Flood Hazard Assessment Study
- Plan for an increased use of the municipal services that were utilized during Hurricane Irene and Superstorm Sandy and budget accordingly
- Consider effects on public health, transportation, utilities, water resources, emergency services and insurance policies. Anticipate increased heat waves, droughts, flooding and power outages
- Raise awareness among residents about the need for preparation and self-reliance
- Review the information provided by the New Jersey Climate Adaption Alliance http://njadapt.rutgers.edu/ will be summarized. (The Honorary Chairpersons of the Alliance are Honorable James J. Florio and Honorable Thomas H. Kean)

6.0 Data Management & Reporting

Greenhouse Gas Inventory Management Plan

This plan recommends that a Greenhouse Gas Inventory Management Plan ("IMP") be prepared by the Township to ensure that the GHG Inventory accurately reflects the Township's GHG emissions, and rigorously adheres to the five GHG accounting principles: relevance, completeness, consistency, transparency, and accuracy. The IMP documents institutional, managerial, and technical procedures that need to be followed for the collection of data, calculation of greenhouse gas emissions, and for the evaluation of GHG Inventory data quality. The IMP should be prepared in accordance with the provisions of the *Greenhouse Gas Protocol* as well as the *Climate Leaders Greenhouse Gas Inventory Protocol Design Principles* published by the Environmental Protection Agency.

The following sections and subsections should be included in any management plan.

1. INTRODUCTION
   1.1. Organizational, Legal and Contact Information
2. ORGANIZATIONAL BOUNDARY CONDITIONS
   2.1. Organizational Boundaries
   2.2. Facilities List
3. OPERATIONAL BOUNDARY CONDITIONS 5
4. EMISSIONS QUANTIFICATION
   4.1. Methodology for Quantifying Emissions
   4.2. Emissions Factors
   4.3. Global Warming Potentials
5. DATA MANAGEMENT
   5.1. Data Location
   5.2. Data Collection
   5.3. Normalization Factors
   5.4. Quality Assurance
   5.5. Data Security
   5.6. Responsible Parties
6. BASE YEAR
   6.1. Adjustments Based Upon Structural Changes
   6.2. Adjustments Based Upon Methodology Changes
7. MANAGEMENT TOOLS
   7.1. Roles and Responsibilities
   7.2. Training
   7.3. Documentation Retention and Control
8. AUDITING
   8.1. Internal Auditing
   8.2. External Auditing
   8.3. Management Review
   8.4. Corrective Action

Resources

Greenhouse Gas Protocol: http://www.ghgprotocol.org/
EPA Greenhouse Gas Inventory Protocol: http://www.epa.gov/statelocalclimate/local/activities/ghg-inventory.html

7.0 FINANCING ALTERNATIVES

Both standard and creative financing options are required to fund the recommendations of this climate action plan. There are some opportunities to fund emissions reductions using other people's money, but much of the funding will come from within municipal operating budgets. A commitment to take action to reduce GHG emissions must translate into a commitment to strategically fund emissions reduction initiatives over time. Investing in energy efficiency and in infrastructure that reduces GHG emissions is a responsible use of Municipal funds.

Capital Budget Planning

Within each annual budget cycle, and within each department, preference should be given to allocating capital improvement and business operational expenses that demonstrate the ability to reduce greenhouse gas emissions. This requires that each department identify what actions they can take to save energy and reduce emissions. It also requires the municipality to have in place a method to evaluate decisions in terms of energy saved or emissions avoided. This methodology relies on having an updated greenhouse gas inventory and inventory management plan.

Within every budget cycle, priority should be given to any energy efficient strategy or upgrade with a favorable savings to investment ratio. Budgeting for the additional costs of energy efficiency upgrades over time will be equalized by realized cost savings.

Special Projects Financing

In addition to Capital Budget Planning, additional budget funds may be required for specific GHG reduction projects. As the Township continues to benchmark and update their Greenhouse Gas Inventory against their stated 2020 goals, it may become necessary to add Special Project funds to ensure that the 2020 greenhouse gas emission goals are met. In this context, special projects are those that would not fall within current operations and maintenance practices of the Township. This may include a number of the indirect action items noted, or projects that accelerate energy efficiency measures.

Grants, Rebates and Incentives

Incentives from local utilities, the state of New Jersey and the Federal government are continually evolving in the sustainability industry. A review of currently available incentives needs to be made during the planning stages of the project for every action contemplated. Each incentive has its own requirements and timeframe that may impact project implementation. A significant portion of Federal incentives are either tax credits or tax deductions. As the Township is not taxable, these incentives would require a third party financing entity to structure the project in such a way that they could pass on the benefit from the tax incentives in some way to the Township.

An exception to this is the EPACT program that allows tax deductions for local government building energy improvements to be passed to the designer. This program is set to expire at the end of 2013. If this program is extended (the bill is currently back in committee), it should be evaluated for new projects.

Third Party Financing

Third party financing takes various forms. Typical options include:

- Lease financing – this includes both operational and capital leasing structures where the key component is retained ownership of the asset for the duration of the lease term and ownership of any incentive benefit.
- Loans – typically used for low interest financing based on the Township's borrowing power. A variation on this option is an ESIP, which is discussed below.
- ESCO financing – An Energy Services Company ("ESCO") either finances the project based on the cost savings or provides a guarantee of energy savings. In the first case, the Township is obligated to pay a percentage of the cost savings to the ESCO over a designated period of time, which allows the ESCO to recapture capital costs and profit. In the second case, the ESCO is paid in full by the Township and guarantees that the Township will obtain the cost savings required to allow the Township to finance the capital costs.
- Power Purchase Agreements (PPAs) – these are generally used for power plant projects which produce either electric or thermal power. For these projects, the owner of the project secures a long term agreement to be supplied with power at a set price per energy unit, which allows the project owner to recapture the capital costs. This arrangement has been used extensively in the solar energy sector in New Jersey.

Energy Savings Improvement Program (ESIP)

The Energy Savings Improvement Program (ESIP) was specifically created to serve as an alternative financing mechanism for public agencies in New Jersey to fund energy conservation measures. The Legislature authorized such programs in 2009 and the ESIP process was further defined by the State in 2012. The law specifically allows boards of education, counties, municipalities, housing authorities and public authorities to enter into contracts for up to 15 years to finance building energy upgrades in a manner that ensures that annual payments are lower than the savings projected from the energy conservation measures.

In essence ESIPs are a type of "performance contract". ESIPs are based on the municipality's ability to demonstrate that the savings from the financed ECMs are greater than the financing terms, putting the municipality in a cash-positive position. The ESIP law allows municipalities, or other approved entities to use Energy Savings Obligations as the financing method to pay for the costs (capital as well as soft costs) of energy conservation measures.

Energy Savings Obligations is a financing tool that primarily uses debt or lease-purchase instruments. The law specifically authorizes municipalities, school districts, counties, and fire districts to issue refunding bonds as a general obligation, backed with full faith and credit of the local unit to finance the ESIP. Because an ESIP does not effectively authorize new costs or taxpayer obligations, the refunding bond is appropriate and proper, as it does not affect debt limits, or in the case of a board of education, voter approval. A municipality can also enter into a lease-purchase agreement to implement an ESIP with a single investor lease or certificates of participation. The agreement can be entered into directly by a municipality, with an ESCO, other private financing party, or through a county improvement authority or the New Jersey Economic Development Authority. When a municipality enters into a lease with a private party that is not a governmental entity, or with the ESCO it has selected through competitive contracting, it must be done in accordance with a competitive process as required under the municipality's procurement law.

An ESIP allows municipalities to use Energy Savings Obligations to pay for the capital costs of energy improvements to their facilities and pay for annual costs of the obligations with savings from reduced energy

costs. Energy savings obligations are not considered "new general obligation debt" and do not count against debt limits and do not require voter approval. In addition to energy savings, there are additional funding opportunities available through state and federal sources that can be layered into the financial package to offset the repayment of the obligations.

The creation of an ESIP is based on an Energy Savings Plan (ESP). There are three primary ways an ESP is developed:

1. Through the use of an "energy services company," commonly known as an "ESCO."
2. Through the use of independent engineers and other specialists, or using the municipality's own staff to provide and manage the individual functions that make up an ESP.
3. Through a "hybrid" model, where an ESCO may be hired for some purposes (i.e., the development of the ESP) and the local unit's engineer may prepare bid specifications.

The Law requires that all contractors performing ESIP work must be listed or qualified by the State Division of Property Management and Construction (DPMC).

An Energy Savings Plan is the outcome of an energy audit, which identifies current energy use of a facility or group of facilities, and identifies energy conservation measures that can be implemented to realize and maximize energy savings and energy efficiency. The law defines energy savings as:

> *"a measured reduction in fuel, energy operating or maintenance costs resulting from the implementation of one or more energy conservation measures when compared with an established baseline of previous fuel, energy, operating or maintenance costs, including, but not limited to, future capital replacement expenditures avoided as a result of equipment installed or services performed as part of an energy savings plan."*

The statutory definition of an energy conservation measure is:

> *"an improvement that results in reduced energy use, including, but not limited to, installation of energy efficient equipment; demand response equipment; combined heat and power systems; facilities for the production of renewable energy; water conservation measures fixtures or facilities; building envelope improvements that are part of an energy savings improvement program; and related control systems for each of the foregoing. "*

There are several types of industry-standard energy audits which are defined by ASHRAE Standard RP-669, "Procedures for Commercial Building Energy Audits". Under NJ-BPU requirements, an ASHRAE Level III audit is required for lighting efficiency improvements and a Level II audit is required for other energy conservation measures. The quality of the audit will greatly affect the success of an ESIP, so it is important that the audit process and audit report be properly executed and accurate.

An Energy Savings Plan consists of the following elements:

- the results of the energy audit;
- a description of the energy conservation measures that will comprise the program;
- an estimate of greenhouse gas reductions resulting from those energy savings;
- identification of all design and compliance issues and identification of who will provide these services;
- an assessment of risks involved in the successful implementation of the plan;

- identify the eligibility for, and costs and revenues associated for demand response and curtailable service activities;
- schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings;
- maintenance requirements necessary to ensure continued energy savings, and describe how they will be provided; and
- If developed by an ESCO, a description of, and cost estimates of a proposed energy savings guarantee.

Additionally, the calculation of energy savings must be made in accordance with protocols adopted by the BPU. An independent third party must review the plan and certify that the plan savings have been properly calculated in accordance with BPU standards and that all required elements of the ESP have been included.

The municipality must formally adopt the plan, and then submit it to the BPU where it will be posted on their website. The BPU does not have to approve the plan.

Once the ESP has been approved by the municipality and filed with the BPU, it becomes a routine public works project. Construction plans and specifications are prepared and the project proceeds using a public bidding process, with all the attendant requirements applicable to a standard public works contract. The energy improvements require commissioning, which is the process of inspecting during installation, starting, testing and adjusting of work to ensure that the ECMs perform in accordance with their design intent and will deliver the projected energy savings on which the ESIP financing is based. Commissioning is performed by an independent service provider known as a commissioning agent (CxA). Additionally, local staff must be trained in the use of new systems and equipment, and taught how to perform routine maintenance of all installed ECMs, unless a service contract for extended maintenance is included in the ESIP. The Law requires that an independent third party review the project once commissioning is completed to make sure all the requirements of the ESIP are met. If this process is successfully completed, the municipality can be assured that with proper maintenance, the system will perform as planned and energy savings goals will be realized.

The upside to an ESIP is that it provides a financing mechanism to implement energy conservation measures that will yield cost savings and efficiencies for the municipality without having to take on new general obligation debt. The downside of ESIPs is that they are time consuming to execute properly and generally require a 15-year repayment commitment. Eligible measures are often limited to those that on average have a payback of less than 10 years. Not every energy conservation measure identified in an audit will qualify for an energy savings program.

Revolving Loan Funds

Forward thinking institutions and municipalities have committed funds to create a revolving loan fund (RLF) dedicated to energy efficiency and GHG reduction initiatives. RLFs are financing instruments that allow for the ongoing investment of a pool of funds to be used for a defined set of projects. The interest and principal payments from these loans allows the operator of the funds to continue investment to new projects. For the Township, an example would be to create a RLF for energy audits or retro-commissioning of the community's commercial buildings. The funds that would be allocated out of the Township's budget would and be distributed in the form of low-interest loans to commercial building owners; repaid with interest over a set time period. As these loans are repaid, additional loans could be made and the cycle continues.

Creative Financing

Partnerships with aligned organizations, institutions and governmental entities can provide financing opportunities not readily available through traditional methods. Such creative funding opportunities requires exploration, collaboration, and in no small part creativity. In many instances institutions have missions that overlap with the Township's climate action goals. These institutions may also have a funding mechanism which allows both parties to achieve their goals. Such partnerships should be explored and nurtured over time.

8.0 imitations and Future Actions

This section summarizes known report limitations and provides recommendations for future actions. The recognized limitations do not fundamentally alter findings, conclusions or the need for action.

Future Actions

The following future actions are contemplated for this draft CAP by the Environmental Commission:

- Reach out to stakeholders: residents, Mayor and Council, administrative departments, transportation agencies, local business representatives, builders, housing associations, local nonprofits, and other community groups, such as senior citizens groups.
- Assemble task forces to work on the CAP and make revisions based on stakeholder input.
- Seek Township adoption of the CAP.
- Implementation.
- Establish quarterly objectives.
- Update the CAP annually.
- Incorporate more data visualization such as graphs and charts.

The CAP will require periodic updates, including the following items:

- GHG Inventory: Community data was obtained from Delaware Valley Regional Planning Commission ("DVRPC") for calendar year 2005, and adjusted to 2012. The inventory should be updated based on more recent data the DVRPC now has available.
- Emission factors and global warming potential factors were based on industry standards including the Intergovernmental Panel on Climate Change ("IPCC") 4th assessment report. The 5th assessment report has been released and should be reviewed for updates.
- Emission factors were taken from PSEG's 2012 annual report. The most recent PSEG annual report should be used.
- The municipal fleet inventory was collected in 2009. An updated inventory should be collected.
- The effect of municipal energy aggregation should be considered. (In 2015, West Windsor entered into an agreement to purchase 20% "green" (derived from renewable energy resources) electricity.
- Extract additional information from the NJ Climate Adaption website.
- Consider the use of the Greenhouse Gas Protocol (GHG Protocol) http://www.ghgprotocol.org/, as suggested by Rutgers.

Limitations

Emissions from public schools or the county college are not included from the GHG inventory.

The actions proposed in this CAP are illustrative and directional. The Environmental Commission will seek municipal adoption of this CAP. Adoption will constitute Township support for the overall intent and direction of the CAP. However, when specific actions are considered for implementation, the action would be subject to normal Township administration/council review processes. Adoption of the CAP is not intended to represent a financially binding commitment by the Township.

Appendix

Summary of Rutgers

Earth Systems Science Class Report on West Windsor Climate Action Plan
April 21, 2015
(Summary prepared by M. Hornsby)

Rutgers Comment	WW Response
Section 1. Evaluation of the Greenhouse Gas Inventory in the West Windsor Climate Action Plan	
- Rutgers emphasizes the importance of the Greenhouse Gas Protocol (GHG Protocol) http://www.ghgprotocol.org/.	• Will be reviewed and evaluated
- Third party review and certification.	-Rutgers was used for that purpose)
- Recommendations	
1. CAP should be updated annually. 2. Business as Usual (BAU) trend should be thoroughly reanalyzed and more consistent with what is being projected by other Climate Action Plans. 3. Identify task forces to implement the CAP. 4. Set quarterly objectives. 5. Implement most urgent and cost effective tasks first 6. Use more data visualization such as graphs and charts.	1. Agreed. (See Future Actions). 2. Rutgers utilized California based CAPs that were prepared prior to 2007. Subsequent to 2007, GHG emissions exhibited a downward trend, as shown in the 2012 Rutgers GHG inventory. The reason for the downward trend was due in large part to the economic downturn and fuel switching by electric generating companies from coal to gas. The BAU trend in the CAP is correct. 3. Agreed. (See Future Actions). 4. Agreed. (See Future Actions). 5. Agreed. (See GHG Mitigation Project Prioritization) 6. Agreed

Conclusion • CAP emission totals are accurate. • Reanalyze BAU projections.	• West Windsor appreciates the review. • See #2 above.
Section 2: Municipal Buildings and Fleet Favor LEED buildings, implement audit finding, retro commissioning for buildings, apply more renewables and solar. Education for public and employees. Increase tree canopy. Increase recycling and composting.	Agree to consider.
Section 3: Waste Stream Analysis Curbside and backyard composting. Make waste management a priority. Consider Pay As You Throw. Provide all homeowners with a magnet they can put on their refrigerator. Promote efforts at school assemblies.	Agree to consider.
Section 4: Transportation Improved GPS enabled public transit system for busses and shuttles. Build a parking deck at the train station. Make Car2Go/Zipcar rental cars and bike rentals more available.	Agree to consider. Zipcar rentals are already available at the train station.
Section 5: Trees, Forests, and Carbon Offsets • Increase tree canopy. • Purchase Carbon Offsets.	• Already in CAP • The municipality has recently agreed to purchase 20% green energy. It is more likely that the Township would increase the percentage of green content in electricity purchases, rather than purchase offsets.
Section 6: Education	Agree to consider.

Teach effective methods for reducing energy use and emissions to municipal workers and local businesses, the residential community, and school programs. Engage residents. Education programs should be focused on saving money, reducing carbon footprint, and reducing the adverse health effects. Working with schools emphasized. References: Foster City, California CAP; NASA's NICE (NASA Innovations in Climate Education) programs; the U.S. Global Change Research Program A formal meeting with the Mayor and council members should be a first step. Expand bike racks at the train station. Finally, the most significant sector of society is the one through which the township's future of environmental success will be made possible: the youth.	
Section 7: Financing Seek grants, rebates, and incentives. Implement an Energy Savings Improvement Program (ESIP).	Agreed. Already proposed in the CAP
APPENDIX. Inventory Calculation Analysis Rutgers: slight downward BAU trend is inaccurate – it should be upward. Compare to Woodbridge CAP.	Disagree. Downward trend is consistent with the NJ GHG Inventory