MULTI-MUNICIPAL GREENHOUSE GAS EMISSIONS INVENTORY & CLIMATE CHANGE ACTION PLAN

VOLUME 2: CLIMATE CHANGE ACTION PLAN

March 2011

A Report Prepared for:
Falls, **Lower Makefield**, **Lower Southampton,** and **Middletown** Townships, and **Penndel** Borough (Bucks County, Pennsylvania)
by the
Center for Sustainable Communities, Temple University, Ambler PA

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Volume 2:Climate Change Action Plan

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Introduction

In 2009 and 2010, the five communities of Falls, Lower Makefield, Lower Southampton, and Middletown Townships, and Penndel Borough collaborated with Temple University's Center for Sustainable Communities to prepare a Greenhouse Gas Emissions (GHG) Inventory and a Climate Change Action Plan (CCAP). The GHG inventory was documented in Volume 1 of this report and the CCAP is described in this volume.

The purpose of these efforts has been to document the level of emissions the residents, business owners and municipal governments of the five communities are responsible for; to set emissions reduction targets; and to identify actions that can help achieve those targets. This volume of the report builds on the analysis conducted in the GHG emissions inventory, presenting targets for emissions reductions set by the township managers of the municipalities and a series of recommended steps to take to meet those targets.

The Challenges Presented by Climate Change

The economy of the United States of America, like all industrialized economies in the world, is based upon the availability of inexpensive energy for construction, communications, transportation, building operations, agriculture, industry, and commerce. Most of the energy consumed in the United States comes from non-renewable fossil fuels: petroleum refined into gasoline, diesel, jet fuel, kerosene, heating oil, and other fuels; coal; and natural gas. As fossil fuels are combusted to provide energy, gases are emitted, including carbon dioxide (CO_2), nitrogen oxides (NO_x), and methane (CH_4). These and other gases are commonly referred to as "greenhouse gases" for their heat-retaining quality that contributes to global climate change.

While some uncertainty exists in the scientific community about the severity and timing of the impacts of climate change, there is no uncertainty that concentrations of greenhouse gases in the atmosphere are rising, global temperatures are warming, and human activities contribute to the climate change that is expected to have serious impacts on the natural environment as well as national and local economies. These activities include not only the combustion of fossil fuels, but also agricultural production, the use of chemicals for building and vehicle cooling, the decomposition of solid and liquid wastes, and land use changes as forests are converted to other uses.[1]

Changing global and regional climates due to the emissions of GHGs pose significant environmental challenges now and in coming years. These changes could have serious impacts on the economy of Pennsylvania and the quality of life for all of its residents. Some of the

[1] Anderegg, W. R. L., Prall, J. W., Harold, J., & Schneider, S. H. (2010). Expert credibility in climate change. *Proceedings of the National Academy of Sciences, 107*(27), 12107-12109.

significant changes expected include increases in the number of summer days over 90 degrees, deteriorating air quality, declines in cows' milk production, decreases in the yields of many crops, a shortening or cessation of snowmobiling and skiing seasons, and deteriorating conditions for prized hardwood trees.[2]

Reducing greenhouse gas emissions—by municipalities and other public institutions, businesses, and non-profit organizations, and individuals—can be achieved through greater efficiency in the use of energy sources, including the most widely used: electricity, natural gas, motor fuels (gasoline and diesel), and fuel oil. Behavioral changes too can be effective in reducing GHG emissions and could include heating and cooling buildings more selectively, using shared and non-motorized forms of transportation for local travel, and eating a diet that includes more local and regionally sourced foods.

There are many reasons to use resources more sustainably and to reduce or mitigate the negative impacts of economic activities on the natural environment. More efficient use of resources reduces pollution emissions into the air and water, and contributes fewer greenhouse gases to the atmosphere. Just as importantly, more sustainable use of resources can result in significant financial savings on energy, water, and waste-related costs, and contribute to greater stability and predictability in energy markets.

Accurately assessing the success of energy and GHG emissions reduction efforts requires precise measurements in a base year (or years). The GHG emissions inventory report (Volume 1) provided the baselines needed by residents, business owners, and municipal leaders in Falls, Lower Makefield, Lower Southampton, and Middletown Townships, and Penndel Borough to implement effective responses to climate change. This Climate Change Action Plan provides some specific actions and more general process recommendations for residents, businesspeople, elected officials, and municipal employees.

A Summary of The Greenhouse Gas Emissions Inventory[3]

Using data available from the Delaware Valley Regional Planning Commission and other sources, GHG emissions attributable to activities within the boundaries of the five communities of Falls, Lower Makefield, Lower Southampton, and Middletown Townships, and Penndel Borough were calculated for the base year of 2005. Total emissions for the five communities were 1,594,903 metric tons of CO_2 equivalent emissions ($MTCO_2E$).[4] The *sectors* with the highest emissions were residential home energy use (32%) and transportation (31%) —see

[2] Union of Concerned Scientists. (2008). *Climate change in Pennsylvania: Impacts and solutions for the keystone state*. Cambridge, MA: Union of Concerned Scientists.

[3] See Volume I for a complete report on the Greenhouse Gas Emissions inventory results.

[4] Because there are several important greenhouse gases that are accounted for in an inventory of this type, a conversion is made to carbon dioxide equivalents and the results are reported in metric tons (one metric ton of 1,000 kilograms is equal to 2,205 U.S. pounds, or 1.1 U.S. tons). Metric tons of CO_2 equivalents are usually abbreviated as $MTCO_2E$.

Figure 1 below. The largest *sources* of GHG emissions were electricity (38%) and gasoline (25%)—see

Figure 2.

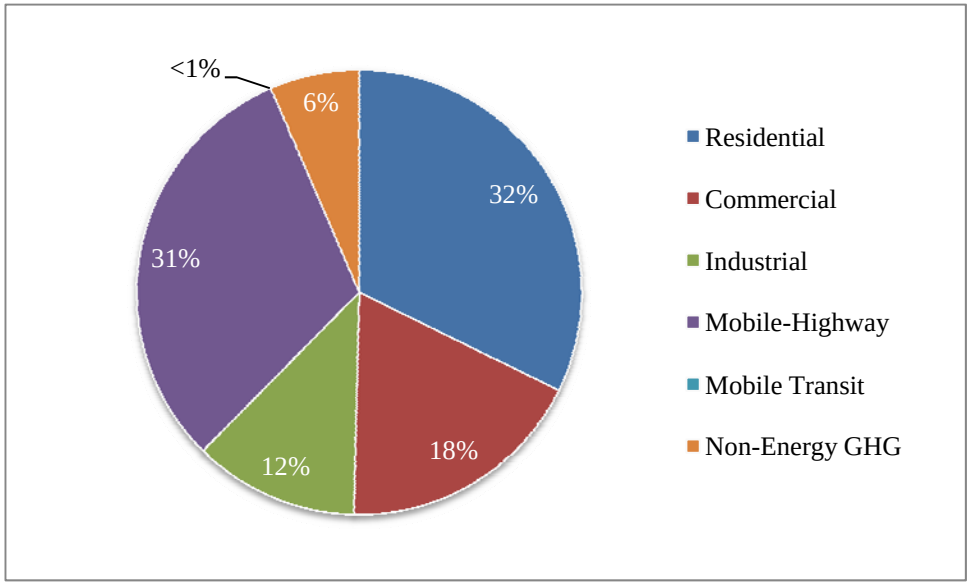

FIGURE 1: TOTAL EMISSIONS BY SECTOR, ALL COMMMUNITIES (2005)

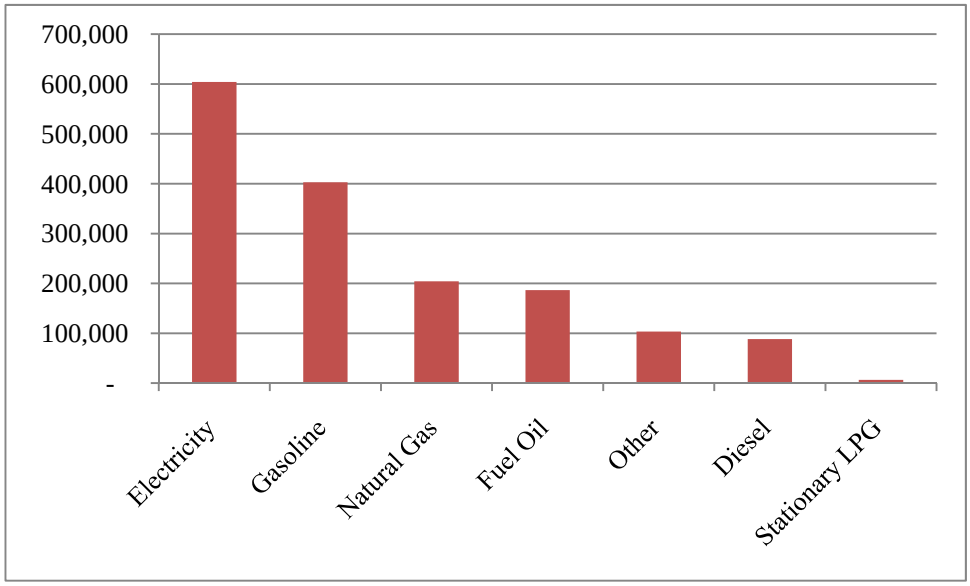

FIGURE 2: TOTAL EMISSIONS BY SOURCE (IN MTCO2E), 2005

Municipal government facilities and operations in the five communities were responsible for 9,455 $MTCO_2E$ in 2006. Municipal government emissions come from police, public works, code enforcement, administrative, and other functions.

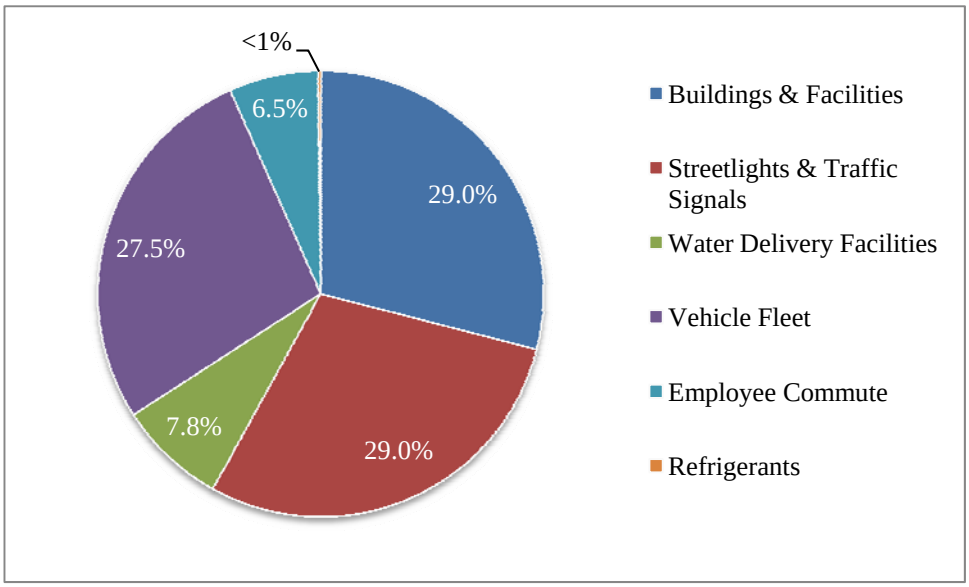

FIGURE 3: TOTAL GOVERNMENT EMISSIONS BY SECTOR (2006)

Buildings and Facilities, and Streetlights and Traffic Signals make up the two largest shares of municipal government emissions in the five communities at 29% each. Vehicle fleet is a close second and combined, these three largest sectors make up the bulk of government emissions (Figure 3). Employee commuting, reflecting fuel used by employees to travel to and from work, estimated using the results of surveys conducted in all five municipal offices, together with water delivery facilities accounted for most of the remaining emissions, with the refrigerants sector constituting less than 1 % of total emissions.[5]

Greenhouse Gas Emissions Projections

The Energy Information Agency of the Department of Energy forecasts a 2.25% drop in total metric tons of CO_2 equivalent emissions in the United States between 2007 and 2020, decreasing from 5,986 million $MTCO_2E$ in 2007 to 5,851 million $MTCO_2E$ in 2020.[6] Because national population is expected to increase over that time period (from 302 million to 343 million), this analysis forecasts a *reduction* in per capita emissions of 13.7%, from 19.8 $MTCO_2E$ in 2007 to 17.1 $MTCO_2E$ in 2020.

These reductions are expected to come in the form of more efficient use of energy due to rising energy prices and the implementation of stricter energy efficiency standards set for home appliances, new building construction, cars and light duty trucks, and other products.

[5] Solid Waste generated by municipal government operations has not been accurately tracked by the municipal governments and their waste haulers and, therefore, reliable data were largely unavailable.
[6] Annual Energy Outlook 2010, Report #:DOE/EIA-0383(2010), Release Date: May 11, 2010, US Department of Energy, Energy Information Agency (accessed on September 8, 2010 at http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2010).pdf).

Compounding the reductions will be the decreasing carbon intensity of energy used in residences, businesses, factories, and other buildings, as nuclear power and renewable sources of energy—wind, solar, tidal, and geothermal—make up greater shares of electricity generation.

	2005	2010	2015	2020	2025	2030	2035
Per capita emissions (USA) in $MTCO_2E$[a]	20.1	17.7	17.5	17.1	16.8	16.5	16.2
Forecast emissions reduction (compared to 2005)	na	-11.85%	-12.80%	-15.09%	-16.61%	-18.06%	-19.58%
Population, five communities[b]	136,300	139,307	142,150	144,840	147,373	149,764	151,968
Per capita emissions (project communities), in $MTCO_2E$[c]	11.7	10.3	10.2	9.9	9.8	9.6	9.4
Total emissions, five communities[c]	1,594,903	1,436,889	1,450,415	1,439,154	1,437,994	1,435,955	1,430,002
% change in total community emissions (2005 base)	na	-9.9%	-9.1%	-9.8%	-9.8%	-10.0%	-10.3%

[a] Source: US Department of Energy's Energy Information Agency Annual Energy Outlook reports for 2008 and 2010.
[b] Source: DVRPC Data Navigator, accessed at http://www.dvrpc.org/asp/mcddataNavigator/, Aug 2010.
[c] Source: Temple University Center for Sustainable Communities calculations. 2010 onwards, Projections.

TABLE 1: GREENHOUSE GAS EMISSIONS, PROJECTIONS, 2010-2035 (2005 BASE YEAR)

The five communities of Falls, Lower Makefield, Lower Southampton, and Middletown Towhnships, and Penndel Borough are forecast to have an estimated population increase of 6.3% between 2005 and 2020. If the 2005 per capita emissions for the five communities change at the same rate forecast for the United States as a whole, total GHG emissions will decrease by about 9.8% during this same period (**Table 1**).

Reducing Greenhouse Gas Emissions

To effectively reduce GHG emissions at the community level there must be a collaborative effort involving actions by individuals, households, business owners, employers, elected officials, municipal government employees, and other concerned stakeholders. Municipal leaders and officials in the five project communities have already begun work toward this goal by organizing and implementing a variety of efforts to reduce energy consumption, greenhouse gas emissions, and other environmental impacts. These efforts include the upgrading of traffic signals and streetlights, the purchase of hybrid vehicles for municipal government vehicle fleets, the completion of a municipal GHG emissions inventory and climate change action plan in Lower Makefield Township, the establishment of Environmental Advisory Councils, a public

speaker series on environmental issues, zoning revisions for residential solar and wind power, and other programs.

To continue these efforts, we recommend that a multi-municipal climate change action plan (CCAP) for reducing GHG emissions incorporate the following elements:

1. Set GHG emissions reduction targets for a first phase of implementation;

2. Identify significant opportunities for reducing emissions;

3. Coordinate emissions reduction efforts, including

    - Nomination of municipal government and volunteer representatives in each community to coordinate and monitor adoption and implementation of the CCAP;
    - Finalization of specific strategies to pursue between 2011 and 2020;
    - Adoption of CCAP by project communities; and
    - Implementation of CCAP strategies

4. Monitor and report on these efforts in a consistent and ongoing manner; and

5. Prepare for efforts to reduce GHG emissions beyond the first phase of reductions.

When successful, GHG emissions reductions benefit communities in several important ways. They encourage discussions and debate about the future of a community, its residents and businesses. They help mitigate the impacts of energy use on the natural environment—through reductions in pollutant emissions—and on the climate—through reductions in greenhouse gas emissions. And they conserve natural resources and help citizens save money by using less energy to heat, cool, and clean their homes, travel, communicate, and engage in all of their other day-to-day activities.

Setting GHG Emissions Reduction Targets

Conducting a baseline inventory of GHG emissions (Phase I of this project, documented in volume 1 of this report) has been important for understanding the scope and sources of emissions present in the five communities. This analysis has provided a baseline for setting reductions goals to work towards. In collaboration with township and borough managers and members of the communities' Environmental Advisory Councils, several emissions reduction targets were considered. Based on these discussions and our own analysis, we recommend setting a reduction target that is feasible, but ambitious within a timeframe of ten years.

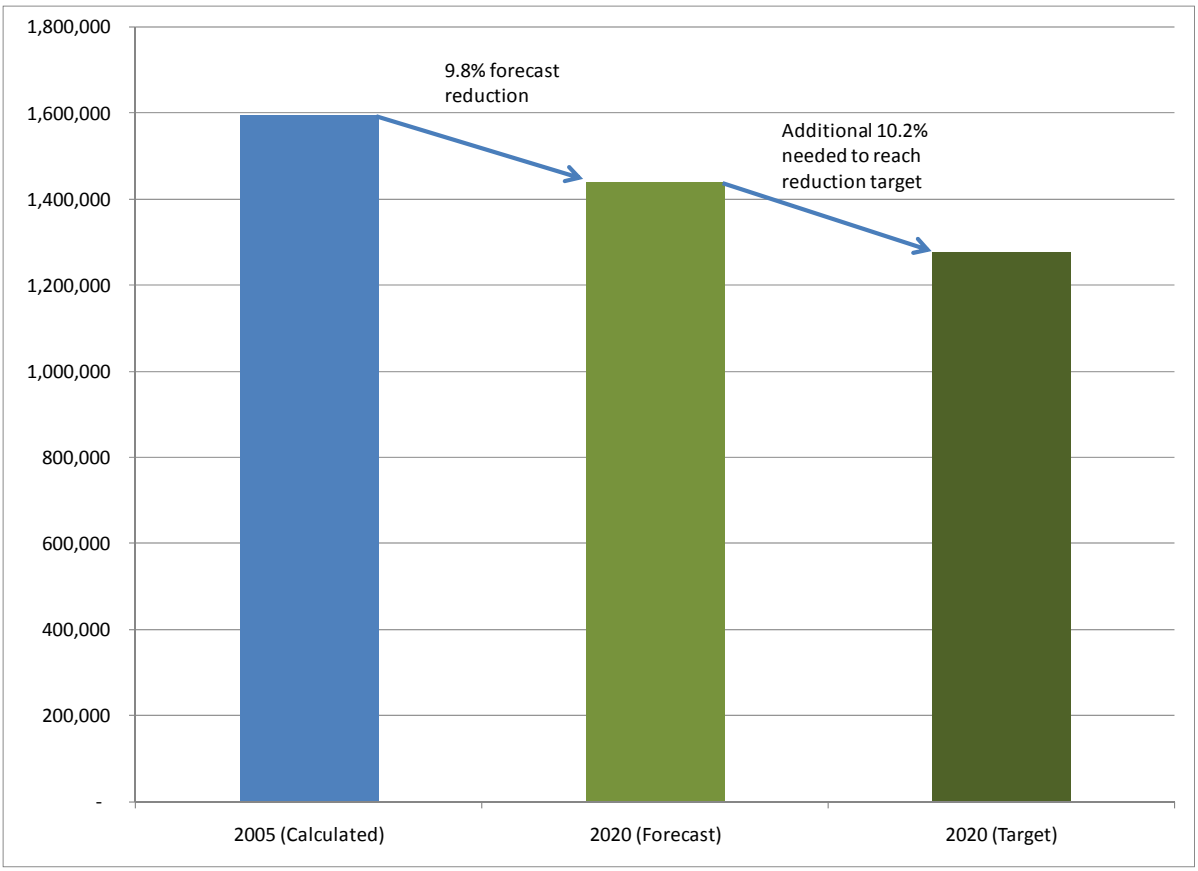

FIGURE 4: E EMISSIONS FORECAST AND TARGET FOR 2020 ($MTCO_2E$)

Consequently, the Center for Sustainable Communities proposes that the five communities work towards emissions reductions of 20% below 2005 community emissions (and 2006 municipal government emissions) by the year 2020. Key staffmembers and EAC members of the project communities have indicated agreement with this objective. Our projections indicate that about 9.8% of the reduction may occur without targetted efforts on the part of local leaders, residents, and business owners. As cars and trucks, home appliances, and business equipment are replaced over the next decade and the electricity grid becomes less carbon intensive, fewer GHGs should be emitted even without significant changes in behavior.

While there is uncertainty as to the reductions that will actually be observed in future years, technological, economic, and political changes are likely to lead to reductions in per capita emissions that approach these forecasts (see Figure 4 above). An additional 10.2% reduction in GHG emissions would have to come from more focused efforts on the part of municipal leaders, residents, and business owners to meet the 20% by 2020 target. It is important to note that the recommendations in this report are aimed at achieving 20% emissions reductions without taking the EIA forecast into account, in part because some of the strategies identified in this report may

overlap with those changes anticipated by the EIA's forecast. Beyond 2020, more significant reductions should be made; this is discussed in more detail below.

Significant Opportunities for GHG Emissions Reduction

The largest sources of GHG emissions in the five communities are:

- electricity used in residences, businesses, and industry (accounting for between 34 % and 43% of emissions in each of the five communities);
- gasoline and diesel used for transportation (accounting for 25% to 37% of all emissions); and
- natural gas and fuel oil—used for cooking, clothes driers and heating water and buildings—with a combined share of 20% to 29% of community emissions.

Reducing electricity, natural gas and fuel oil use requires constructing and retrofitting buildings to be more energy efficient, replacing inefficient appliances with more efficient ones, and using energy more conservatively. Reducing consumption of motor fuels requires 1) using more energy efficient forms of transportation (such as public transit, bicycles, walking, or smaller, more fuel efficient cars), 2) traveling less, or 3) both.

The strategies included below in the sections entitled *Reducing Municipal Government Emissions* and *Reducing Community Emissions* take these opportunities into account.

Coordination of Emissions Reductions Efforts through 2020

To coordinate GHG emissions reductions efforts in the five project communities, we recommend the following steps be followed:

- Identify a municipal employee and a volunteer in each community to be responsible for Climate Change Action Plan recommendations, implementation, and ongoing monitoring of progress;
- Finalize specific strategies from among those identified in this report to pursue between 2011 and 2020;
- Approve CCAP strategies to be undertaken in each of the five communities with municipal council resolutions; and
- Implement the strategies included in the adopted CCAP.

As community members and municipal government employees continue working on the project, the following resources will help in their ongoing efforts.

- Maintain contact and collaborate with the Delaware Valley Regional Planning Commission (DVRPC), the Bucks County Planning Commission, PECO's Smart

Ideas program, and ICLEI Local Governments for Sustainability (membership in ICLEI should be continued).

- DVRPC's Local Energy and Greenhouse Gas (GHG) Reduction Toolkit modules can be used to assess municipal government energy use on a building by building and vehicle by vehicle basis. DVRPC's toolkit makes use of the US EPA's Energy Star program for local governments, particularly the online "Portfolio Manager" tool that assesses energy use and energy savings opportunities for many different types of buildings and facilities local governments manage (see https://www.energystar.gov/istar/pmpam/). DVRPC has also initiated an Alternative Energy Ordinance Working Group that in 2011 will be releasing model ordinances for use by communities within the Delaware Valley.
- ICLEI – Local Governments for Sustainability Climate and Air Pollution Planning Assistant software to evaluate fifty five separate measures. See http://www.icleiusa.org/action-center/tools/cappa-decision-support-tool. (Data required: Detailed facilities, equipment, and vehicle data to be collected in collaboration with municipal governments.)

Ongoing Sustainability Coordination, Monitoring, and Evaluation

The municipal governments' elected officials and employees have an important role to play in providing leadership and coordination of sustainability efforts in the project communities. This first set of recommendations provides a strong foundation for all the other recommendations in the report.

- Develop and maintain a website for community communication and feedback.
- Update GHG emissions inventories for the five municipal governments and the five municipalities on an annual basis. These updates should be kept simple by focusing only on the main sources of emissions: electricity use, natural gas consumption, and motor fuels (gasoline and diesel) used for vehicle miles traveled. These sources of emissions comprise over four-fifths of calculated emissions for the baseline year (fuel oil is also a significant source of emissions, but it is relatively small, compared to these three main sources and is more difficult and less reliable to estimate). Using annual updates from PECO (for electricity and natural gas consumption), obtained through DVRPC, these updates should be simple to complete using ICLEI CACP software. While updated data on vehicle miles traveled at the municipal level will be provided by DVRPC only every five years, in the intervening years, estimates of changes in VMT can be calculated using PennDOT county-level data on highway miles traveled).
- Prepare annual reports of GHG emissions and progress towards the 20 by 2020 goal.

Preparing for Emissions Reductions Beyond 2020

A twenty percent reduction in GHG emissions by 2020 would be a significant achievement and would demonstrate the ability of community residents and leaders to address the climate change challenge and reduce municipal, residents', and businesses' consumption of, and spending on, electricity, gasoline and diesel, natural gas, and other sources of energy. But beyond 2020, if the more ambitious reduction goals recommended by climate scientists are to be reached—the Intergovernmental Panel on Climate Change recommends an 80% reduction in 1990 levels of U.S. GHG emissions by 2050—much more significant reductions will be required. These are unlikely to be achievable through energy conservation alone and will require significant changes in zoning, building codes, land use, and travel behavior.

During the period 2011 to 2020, we recommend that members of the five communities consider revisions to the municipal comprehensive plans that would incorporate more ambitious changes needed to reduce GHG emissions beyond the year 2020. Theses revisions could include ordinances for residential solar, wind, and other forms of renewable energy; zoning changes to permit higher-density and mixed-use development; and ordinances permitting the development of accessory apartments.

Reducing Municipal Government Emissions

Municipal government GHG emissions reductions are under direct control of elected officials and municipal government staff members. Members of the communities' Environmental Advisory Councils have the unique role of providing guidance and suggestions informed by their keen interest in protecting and improving the natural environment.

The analytical tools identified above, particularly DVRPC's GHG Reduction toolkit modules and ICLEI's Climate and Air Pollution Planning Assistant—if used with sufficiently detailed information available from the five municipal governments—have the potential to identify cost-effective program and policy changes to reduce municipal government GHG emissions.

In this volume of the report, Temple University's Center for Sustainable Communities has conducted preliminary analysis to identify eight promising strategies that are likely to be effective methods of achieving the "20 by 2020" GHG emissions reduction target for the five municipal governments. Each one is summarized in a text box (see the example below) that includes a) the estimated emissions reductions achievable, b) the percentage such reductions would represent of all municipal governments GHG emissions in 2006, and c) the percentage they would represent of emissions in the relevant municipal government sector (for example, vehicles or buildings and facilities). The CSC has worked with the data currently available, but more detailed follow-up analysis by municipal government staff members and volunteer EAC members will be needed.

When reviewing the following recommendations and conducting further analysis, community leaders should consider the following factors: time frame for implementation, ease of implementation, level of potential impact, educational value in communicating with the community and the media, cost of implementation, and return on investment. These factors will vary for each recommendation and should be assessed in collaboration with the communities' partners at ICLEI, DVRPC, Bucks County, and other agencies. DVRPC's and ICLEI's analytical tools permit consideration of all of these factors.

RECOMMENDED STRATEGY *[EXAMPLE]*

Brief description of strategy for GHG emission reductions.

GHG emissions change: *[estimated GHG emissions reductions, in $MTCO_2E$]*
2006 Municipal Government GHG emissions: *[estimated reductions as % of all government GHG emissions]*
2006 Municipal Governments Sector GHG emissions: *[estimated reductions as % of government GHG emissions for the relevant sector]*

Timing: *[Suggested timing for implementation]*

The municipal governments of Falls, Lower Makefield, Lower Southampton, Middletown, and Penndel can be community leaders in continuing to reduce energy consumption and greenhouse gas emissions. For municipal government emissions, elected officials can take action to be more efficient with the use of energy for building and vehicle fleet operations, reducing energy consumption, saving tax dollars and helping to attain national emissions reductions goals. By taking these actions and communicating clearly and consistently with residents and business owners, the five municipal governments will encourage and support households' and businesses' efforts to reduce their greenhouse gas emissions.

Buildings and Facilities

29% of government emissions

GHG emissions of 2,738 $MTCO_2E$ are attributable to municipal government buildings and facilities within the five project communities. While they have already taken some steps to increase the energy efficiency of their buildings (for example, by upgrading HVAC systems), there remain opportunities for making civic buildings and facilities more energy efficient.

Note that the estimations for the two strategies outlined below are preliminary, based upon information available to the Center for Sustainable Communities as part of this project. A more detailed analysis, based upon more specific information concerning the municipal buildings and facilities should be conducted using DVRPC's Local Energy and Greenhouse Gas (GHG) Reduction Toolkit and PECO's *Smart Ideas* web site (for commercial and municipal customers).

Preliminary analysis, based upon approximately 270,000 square feet of municipal buildings and facilities, indicates that the potential for reducing GHG emissions by improving building insulation, upgrading HVAC systems, and replacing windows, is significant.

RECOMMENDED STRATEGY: 1

Energy efficiency retrofits of existing facilities.

GHG emissions change: -353 $MTCO_2E$
2006 Municipal Government GHG emissions: -3.7%
2006 Municipal Governments Buildings / Facilities Sector GHG emissions: -12.9%

Timing: Conduct detailed energy audits by 2012, retrofits by 2013

[7]

A second strategy involves systematically replacing electronic and other equipment and using energy more efficiently in municipal buildings. Preliminary analysis, based upon estimated replacement of computers and monitors, printers, copiers, refrigerators, and vending machines with more energy efficient models, the installation of room occupancy sensors in 25% of municipal buildings space, and the implementation of lights out at night policies in 75% of municipal buildings space could reduce GHG emissions and save money on electricity bills.

RECOMMENDED STRATEGY: 2

Equipment replacement and lighting policies.

GHG emissions change: -105 $MTCO_2E$
2006 Municipal Government GHG emissions: -1.1%
2006 Municipal Governments Buildings / Facilities Sector GHG emissions: -3.8%

Timing: Gradual, as equipment normally replaced

Other potentially effective strategies could include formally adopting LEED standards for civic building retrofits, installing green or cool roofs on civic buildings, installing water-saving toilets, and educating municipal employees on energy-saving behaviors for the workplace.

Streetlights and Traffic Signals

29% of government emissions

The communities of Falls, Lower Southampton, and Middletown Townships have converted traffic lights to LED technology, saving significant amounts of energy compared to

[7] See Appendix A for a description of the analysis and assumptions used in making these GHG emissions reductions estimates.

older traffic signal bulbs. While some township and borough streetlights use high-pressure sodium or metal halide, both relatively efficient lighting sources, many of the municipal streetlights are halogen or mercury vapor. Therefore, additional upgrades in street lighting technology should be investigated and implemented in the future.

Preliminary analysis indicates that by converting the 6,300+ street light lamps in the five communities, can save about 8.7% of the total 2006 level of municipal government GHG emissions. (NOTE: This is a conservative estimate, as data for Lower Makefield Township and Penndel Borough were not available and additional older, less efficient streetlight lamps may exist within the five project communities.)

RECOMMENDED STRATEGY: 3

Replace mercury vapor and high pressure sodium streetlights with LED technology.

GHG emissions change: -826 $MTCO_2E$
2006 Municipal Government GHG emissions: -8.7%
2006 Municipal Governments Street/Traffic Lights Sector GHG emissions: -30.1%

Timing: By 2013

Another strategy to consider would be to reduce the average number of hours of street lighting from 12 to 11. While this would require coordination and negotiation with PECO, the potential savings are large and might lead to region-wide implementation and savings.

Vehicle Fleet

27.5% of government emissions

The municipalities' vehicle fleets are a large source of those emissions over which the local governments have significant control. Replacing some of these vehicles with smaller and more energy efficient models that can provide the same functionality for municipal operations is a simple and effective approach to reducing GHG emissions. Preliminary analysis, based upon a fleet of about 220 municipal cars and light duty vehicles (pick up trucks and SUVs) in the five communities, indicates that by replacing a quarter of these vehicles with hybrid electric/gasoline vehicles and a quarter with smaller vehicles can have a significant impact on GHG emissions.

RECOMMENDED STRATEGY: 4

Replace municipal government vehicles with hybrid gasoline/electric vehicles and smaller vehicles, where practical.

GHG emissions change: - 282 $MTCO_2E$
2006 Municipal Government GHG emissions: -3.0%
2006 Municipal Governments Vehicle Sector GHG emissions: -10.9%

Timing: Gradual, as vehicles normally replaced

Reducing the *use* of municipal vehicles in terms of annual vehicle miles traveled is another approach to reducing GHG emissions and in many communities throughout the U.S. has been achieved with changes in municipal police patrols. Were the equivalent of three police officer-years of time, shared among the five communities, shifted from police car patrol to bicycle patrol, thousands of miles of police vehicle use would be avoided.

RECOMMENDED STRATEGY: 5

Convert three police-officer years of time to bicycle patrol.

GHG emissions change: -21 $MTCO_2E$
2006 Municipal Government GHG emissions: -0.2%
2006 Municipal Governments Vehicle Sector GHG emissions: -0.8%

Timing: Full implementation by 2013

Other potentially effective strategies could include formal anti-idling policies and changes in landscaping to reduce the use of small-engine equipment, such as lawnmowers and leaf blowers. Depending upon the extent of engine idling that occurs today, anti-idling policies enforced for heavy duty vehicles (dump trucks, for example) and construction equipment have the potential to reduce annual GHG emissions by 2 $MTCO_2E$ per vehicle.

Employee Commute

7% of government emissions

The municipal governments are only indirectly responsible for emissions from employees' commuting to work, but these recommendations can help reduce total government greenhouse gas emissions.

Opportunities to reduce emissions in this sector are large, as 97% of municipal employees commute to the workplace by driving alone. Only six of 190 respondents to employee commute surveys indicated that they use public transit, carpool, walk or bike regularly to get to work. Yet large numbers of municipal employees live within walking distance (one mile or less) and three-fifths of municipal employees live within bicycling distance (four miles or less). Encouraging changes in commuting habits is usually difficult to do and would require a concerted effort of

regular communication and appeals, incentives (through contests, small prizes, or other recognition), and changes to office design (for example, providing a shower for employees who bicycle to work to use and secure, weather-protected bicycle parking facilities). If annual drive-alone mileage were to decrease 10% (the equivalent of every employee substituting a drive-alone round-trip commute once every two weeks), an important quantity of GHG emissions could be eliminated.

RECOMMENDED STRATEGY: 6

Encourage municipal employees to carpool, take transit, or bike or walk to work.

GHG emissions change: -50 $MTCO_2E$
2006 Municipal Government GHG emissions: -0.5%
2006 Municipal Governments Employee Commute Sector GHG emissions: -8.2%

Timing: Begin 2011

Carbon Sequestration

Tree planting programs are an important way to offset greenhouse gas emissions and to help cool homes and streets at the same time (through the process of photosynthesis, trees remove CO_2 from the atmosphere and store carbon in their wood, bark and leaves). The potential for trees to absorb carbon dioxide varies by species, age and size, but, in general, can be significant when large numbers of trees are planted and maintained. Middletown Township already has an annual tree planting program and goal that the other municipalities could emulate.

RECOMMENDED STRATEGY: 7

Continue tree planting programs and increase the number of trees planted annually to 500.

GHG emissions change: -62 $MTCO_2E$
2006 Municipal Government GHG emissions: -0.7%

Timing: Ongoing[8]

Water Delivery Facilities:

7.8% of government emissions

This sector ranged from 1% of individual government emissions (Middletown) to 20% (Penndel), and Falls Township has since sold off its facilities, so they are no longer responsible

[8] NOTE that these emissions reductions would not directly be subtracted from municipal government emissions calculations based on energy use. Also NOTE that if this recommended level of annual tree planting is feasible and consistent for the ten-year period, 2011-2020, the level of carbon sequestration would be considerably higher than is estimated here.

for those emissions. Nonetheless, finding more efficient water delivery systems and ways to reduce water consumption by the municipal governments as well as the communities would be good policy and serve to reduce overall emissions.

RECOMMENDED STRATEGY: 8

Make energy efficiency improvements to water delivery system.

GHG emissions change: -199 $MTCO_2E$
2006 Municipal Government GHG emissions: -2.1%
2006 Municipal Govts Water Delivery Facilities Sector GHG emissions: -26.9%

Timing: Ongoing

Summary of Municipal Governments' Emissions Reductions Strategies

Should these eight recommendations be approved and successfully implemented, they would lead to a combined reduction of 1,901 $MTCO_2E$ in GHG emissions, or 20% below 2006 emissions of 9,452 $MTCO_2E$.

	Strategy	
1	Energy efficiency retrofits of existing facilities	-353
2	Office equipment replacement and lighting policies	-105
3	Replace mercury vapor and high pressure sodium streetlights with LED technology	-826
4	Replace municipal government vehicles with hybrid gasoline/electric vehicles and smaller vehicles, where practical.	-282
5	Convert three police-officer years of time to bicycle patrol.	-21
6	Encourage municipal employees to carpool, take transit, tele-commute, or bike or walk to work one day every two weeks.	-50
7	Continue tree planting programs and increase the number of trees planted annually to 500.	-62
8	Energy efficiency improvements to water delivery facilities	-199
	Total GHG Emissions Reduction (20% below 2006, 9,452 $MTCO_2E$)	**-1,898**

TABLE 2: SUMMARY OF RECOMMENDED STRATEGIES FOR MUNICIPAL GOVERNMENT GHG EMISSIONS REDUCTIONS

Reducing Community Emissions

The municipal governments do not have direct responsibility for the greenhouse gas emissions attributable to residents and businesses in the community, but decisions that the governments make have indirect impacts on the amounts and types of energy consumed in the

community. Elected officials and municipal government employees in Falls, Lower Makefield, Lower Southampton, and Middletown Townships, and Penndel Borough have the ability to take a leadership role in reducing greenhouse gas emissions—a role that will be made more effective through a firm commitment to reducing municipal government's GHG emissions through strategies like those described in the preceding section—and helping community members save money through lower energy use. The following recommended strategies are designed to help community members, both residents and business owners, achieve the **20 by 2020** GHG emissions reduction target.

The eight recommendations in this Climate Action Plan keep this role in mind, emphasizing ***advisory and educational actions*** that can be taken in the short-term, ***planning efforts*** that may require additional time for the medium-term, and ***full implementation of broader actions*** that can be accomplished in the long-term.

Education and Communication

The municipal government can inspire, encourage, educate, and challenge residents, business owners, and their own employees to practice energy efficiency, both to save money on energy costs and reduce greenhouse gas emissions. Such a program should begin with simple promotional strategies using existing municipal communication methods (web sites, social media, community television, newsletters, and press releases) and coordination with PECO's *Smart Ideas* and *e-audits* energy efficiency programs and county and regional public programs.

RECOMMENDED STRATEGY: 9

Implement a residential energy efficiency education campaign.

GHG emissions change: -66,462 $MTCO_2E$
2005 Total Communities GHG emissions: -4.2%
2005 Residential Sector GHG emissions: -13.0%

Timing: Preliminary measures in 2011 with ongoing efforts in 2012 and beyond [9]

Over time, this strategy should be strengthened with the implementation of a community energy efficiency challenge that helps residents monitor and reduce their electricity, natural gas, and fuel oil consumption.

Residential

32% of total community emissions

Energy use in the community's homes represents the single largest source of GHG emissions in Falls, Lower Makefield, Lower Southampton, Middletown, and Penndel. The

[9] See Appendix B for a description of the analysis and assumptions used in making these GHG emissions reductions estimates

majority of housing units in each of the five municipalities are more than 40 years old[10] and energy efficiency is likely to be poor in many cases due to the age of structures, windows, and insulating materials. By promoting a program of retrofitting the community's houses and apartments, significant energy savings and GHG emissions reductions could be achieved. The municipal governments can use purely voluntary methods to encourage such retrofits, provide low or zero interest loans, or require energy retrofits when considering renovations or at the point of sale.

Implementing a program of energy retrofits of existing residential buildings, including windows and appliance replacements, and insulation and HVAC upgrades, has a large potential for reducing residential GHG emissions. Such a program could be based upon required upgrades to renovated housing units and/or at the point of sale. Alternatively, municipal governments can encourage such upgrades by offering low or zero interest loans to homeowners.

RECOMMENDED STRATEGY: 10

Implement a program of energy retrofits of existing residential buildings.

GHG emissions change: -58,868 $MTCO_2E$
2005 Total Communities GHG emissions: -3.7%
2005 Residential Sector GHG emissions: -11.5%

Timing: 2012 to 2020

If 7.5% of households installed photovoltaic (PV) systems of an average size of 2.5 KW and 7.5% installed solar hot water heaters, significant GHG emissions reductions could be achieved in the five communities.

RECOMMENDED STRATEGY: 11

Encourage homeowners and landlords to install solar photovoltaic (PV) systems and solar hot water heaters.

GHG emissions change: -12,796 $MTCO_2E$
2005 Total Communities GHG emissions: -0.8%
2005 Residential Sector GHG emissions: -2.5%

Timing: 2012 to 2020

The municipal governments could provide assistance to homeowners and rental property owners in the form of advice and encouragement (via the public education campaign described above), coordination with state and federal government and PECO energy efficiency programs, and potentially low or zero interest loans.

[10] See Table H34 of the 2000 U.S. Census, available at http://factfinder.census.gov.

The passage of a water ordinance encouraging reductions in water usage could reduce energy consumption for water treatment and transport. The installation of low flow shower heads and water-saving toilets, modifications in yard and garden landscaping, and other changes in water usage practices could result in lower GHG emissions.

RECOMMENDED STRATEGY: 12

Water ordinance leading to reductions in water usage.

GHG emissions change: -2,690 $MTCO_2E$
2005 Total Communities GHG emissions: -0.2%

Timing: 2012 to 2015

Non-Residential (Commercial and Industrial)

30% of Community emissions

The municipal governments of the five communities can encourage businesses to reduce energy consumption with a program similar to the residential energy efficiency education program described above in recommendation #9.

RECOMMENDED STRATEGY: 13

Implement a commercial energy efficiency education campaign.

GHG emissions change: -3,654 $MTCO_2E$
2005 Total Communities GHG emissions: -0.2%
2005 Non-Residential GHG emissions: -1.3%

Timing: Preliminary measures in 2011 with ongoing efforts in 2012 and beyond

Transportation

31% of Community emissions

Some of the factors that contribute to emissions from the transportation sector in Falls, Lower Makefield, Lower Southampton, Middletown, and Penndel are land use and zoning patterns that have resulted in low residential population density, a strict separation of land uses into residential, commercial, and industrial areas, a low level of public transit service, and inconsistent and, in places inadequate, provision of sidewalks, pedestrian crossing lights, and bicycle lanes. While the existing design of the five communities makes it relatively easy in some areas to travel on foot, by bicycle, and using public transit, there remain opportunities to make the communities much more pedestrian, bicycle, and transit friendly. Two principal approaches

should be used to encourage reductions in the overall amount of travel the community residents make and changes in modes of travel from less efficient options (private vehicles driven with single occupants) to more efficient options (public transit, carpooling, walking, and bicycling).

To help residents accomplish both of these goals, providing information on public transit options, safe bicycling routes, walking, and trip reduction strategies that is easy to understand and use is important. We recommend the development of a web site and public education campaign, including challenges and local examples of successful travel behavior change.

RECOMMENDED STRATEGY: 14

Encourage reduction in *motorized* vehicle miles traveled through a community low-carbon transportation education program.

GHG emissions change: -34,319 $MTCO_2E$
2006 Total Communities GHG emissions: -2.2%
2005 Mobile Highway GHG emissions: -6.9%

Timing: 2012 to 2015

If households in the five communities would reduce vehicle miles traveled (VMT) by reducing the number of vehicles they own, making fewer trips and combining trips when they must drive, an additional VMT reduction of 8% could be achieved and significant GHG emissions reductions would result.

RECOMMENDED STRATEGY: 15

Encourage residents to reduce total vehicle miles traveled.

GHG emissions change: -36,313 $MTCO_2E$
2006 Total Communities GHG emissions: -2.3%
2005 Mobile Highway GHG emissions: -7.3%

Timing: 2012 to 2015

In the long run, emissions from the transportation sector can be reduced further still if land use changes in the five communities facilitate higher population densities (by permitting accessory apartments to be added to existing housing units, for example), greater mixing of appropriate land uses (housing and commercial), and the redesign of transport networks to make walking and bicycling safer and more convenient, along with improvements in public transit service to make it more frequent, extensive, convenient, safe and affordable. Such changes would require an ambitious effort to coordinate public discussion and acceptance of some or all of these changes and to collaborate with county, regional, and private agencies and businesses.

Encouraging residents and business owners to buy a hybrid vehicle or other high fuel-efficiency vehicle when they buy a vehicle (whether a new car from a dealer or a used car), can

make a significant difference in GHG emissions from the transportation sector. Assuming 14% of the 96,000 vehicles in the five communities are replaced with hybrid or other very high fuel efficiency vehicles,[11] more than 44,000 tons of GHG emissions could be avoided.

RECOMMENDED STRATEGY: 16

Encourage residents to purchase hybrid vehicles.

GHG emissions change: -44,212 $MTCO_2E$
2006 Total Communities GHG emissions: -2.8%
2006 Total Communities Transportation GHG emissions: -8.9%

Timing: 2012 to 2020

Non-energy GHG sources[12]

6% of Community emissions

Though the potential to achieve significant reductions in GHG emissions from this sector of emissions is low, educational and promotional efforts that increase recycling and the planting of trees, reduce waste, and ensure capture and proper disposal of refrigerants and other chemicals can reinforce actions that have larger impacts on the emissions of GHGs by maintaining a community focus on environmental responsibility, energy efficiency, and cost savings.

RECOMMENDED STRATEGY: 17

Reduce emissions from solid waste disposal through increased recycling, composting of kitchen and yard waste, and waste reduction.

GHG emissions change: -1,331 $MTCO_2E$
2005 Total Communities GHG emissions: -0.1%
2005 Non-Energy GHG emissions: -1.3%

Timing: 2012 to 2015

The final recommended strategy for reducing emissions is to promote the purchase of renewable energy. As the electricity market in Pennsylvania has been transformed in 2010 and 2011, residential and business customers have been able to select alternative providers to PECO (the utility that transmits electricity to Bucks County communities) and other long-established electric utilities. Several of these competitors to PECO offer renewably-generated electricity (from hydro-electric, solar, and wind) as a part or all of the electricity they sell to consumers. Many residential and business customers in Falls, Lower Makefield, Lower Southampton, Middletown, and Penndel have participated in PECO's wind energy program. Encouraging those

[11] The average household ownership of vehicles in the US is 1.92 per household. Market forecasts for hybrid vehicle sales as a percentage of all vehicle sales in 2020 is slightly over 7%, so this strategy would require efforts to go beyond expected hybrid sales in the five communities.
[12] "Non-energy greenhouse gas sources" consist of agriculture emissions, landfill emissions, wastewater treatment, industrial processes, and fugitive emissions from natural gas systems, as well as land-use, land-use change, and forestry (LULUCF).

customers to continue with PECO's program or another provider's green electricity program can help reduce GHG emissions from electricity use in the five communities.

RECOMMENDED STRATEGY: 18

Purchase electricity from renewable energy providers.

GHG emissions change: -59,521 $MTCO_2E$
2006 Total Communities GHG emissions: -3.7%

Timing: Begin in 2011, with continued promotion through 2020

One example of programs that communities have used to encourage green energy purchases is the US EPA's Green Power Communities program.[13]

Summary of Community Emissions Reductions Strategies

If these ten strategies prove successful, the goal of reducing GHG emissions in the five communities by 20% by 2020 can be met, as roughly 320,000 $MTCO_2E$ will be avoided. These reductions come from greater energy efficiency: retrofits of existing buildings and buying ENERGY STAR appliances, for example, result in lower energy requirements to do the things people are already doing (such as refrigerating food and maintaining homes and businesses at comfortable inside temperatures). These reductions also will come through changes in the way people go about their daily lives, such as walking and bicycling for some trips that previously had been made with private cars or combining trips so that fewer miles have to be traveled to accomplish the same errands.

	Strategy	$MTCO_2E$ Reduction
9	Implement a residential energy efficiency education campaign	-66,462
10	Implement a program of energy retrofits of existing residential buildings	-58,868
11	Encourage homeowners and landlords to install solar photovoltaic (PV) systems and solar hot water heaters	-12,796
12	Water ordinance leading to reductions in water usage	-2,690
13	Implement a commercial energy efficiency education campaign	-3,654
14	Encourage reduction in vehicle miles traveled through a community low-carbon transportation education program.	-34,319
15	Encourage residents to reduce vehicle miles traveled	-36,313
16	Encourage residents to buy hybrid vehicles	-44,212
17	Reduce emissions from solid waste disposal through increased recycling, composting of kitchen and yard waste, and waste reduction	-1,331
18	Green power purchase	-59,521
	Total GHG Emissions Reduction (20% below 2005, 1,594,903 $MTCO_2E$)	**-320,166**

TABLE 3: SUMMARY OF ESTIMATED COMMUNITY GHG EMISSIONS REDUCTIONS

[13] See http://www.epa.gov/greenpower/communities/index.htm.

Table 3 summarizes the community-level GHG emissions reduction strategies and the estimated changes in GHG emissions (in $MTCO_2E$) that can be achieved with successful implementation.

Conclusion

Community leaders and residents of the five project communities—Falls, Lower Makefield, Lower Southampton, and Middletown Townships, and Penndel Borough—have made important efforts in recent years to protect the natural environment. Each community has pursued initiatives to save energy, reduce consumption, and improve the natural environment. A few examples of these efforts include the GHG emissions inventory completed in 2007 by Lower Makefield Township and its recently released municipal climate change action plan, the upgrading of energy-inefficient traffic signals, office lights, and streetlights in Falls Township and Penndel Borough, the passage of a zoning ordinance to encourage solar and wind energy use in Lower Southampton Township, and replacement of an outdated HVAC system in Middletown Township. More recently, with funding and assistance from the Pennsylvania Department of Environmental Protection, the five communities committed to participating in the Greenhouse Gas Emissions Inventory and Climate Action Plan project that this report documents.

In recent years, the people, businesses, and municipal governments of the five communities have been responsible for almost 1.6 million metric tonnes of carbon dioxide equivalent emissions every year—1,594,903 $MTCO_2E$ in the base year of 2005. This represents the consumption of significant quantities of motor fuels, natural gas, coal, and other fossil fuels, energy use that is costly to consumers and taxpayers and contributes to changes in Earth's climate that may have serious and damaging impacts on animal and plant communities and human economic, political, and social systems. Reducing those emissions, if done with care and thoughtfulness, can save money and resources and mitigate human impacts on the natural environment.

This report describes eighteen strategies that by the year 2020 can reduce annual community-wide GHG emissions by over 300,000 $MTCO_2E$ (including municipal government emissions reductions of 1,900 $MTCO_2E$), a 20% reduction over baseline years. Each strategy will require a concerted effort by representatives of the five municipal governments in collaboration with volunteers from the communities' Environmental Advisory Councils and other community groups. Some will be more straightforward than others—replacing existing streetlight lamps with energy-efficient LED lamps is simpler than encouraging changes in travel behavior, for example—but all hold potential to benefit the communities by reducing energy costs, mitigating environmental impacts, and providing opportunities to collaboratively plan for safer, healthier, more economically vibrant communities.

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(Our apologies for any inadvertent omissions.)

Appendix A: Municipal Government GHG Emissions Reduction Recommended Strategies

	Strategy	Climate & Air Pollution Planning Assistant modules[14]	Assumptions	$MTCO_2E$ Reduction
1	Facilities energy efficiency retrofits	*Retrofits*	Retrofits of 270,000 square feet of municipal government facilities in the five communities with an average 12.5% savings in electricity and natural gas use.	-353
2	Office equipment replacement and lighting policies	*Computers, Monitors, Printers, Copiers, Refrigerators, Vending Machines, Occupancy Sensors,* and *Lights Out at Night*	Replacement of 100 computers and monitors, 40 printers, 20 copiers, 20 refrigerators, and 20 vending machines with ENERGY START models. Installation of room occupancy sensors (in 25% of floor space) and the implementation of lights out at night policies (in 75% of floor space), both assuming 5% energy savings.	-105
3	Replace streetlights with LED technology	*LED Streetlights*	6,337 existing streetlights (with estimated breakdown of 50% sodium, 30% mercury vapor and 20% metal halide with average wattages of 110 for sodium and metal halide lamps and 140 for mercury vapor lamps) replaced with energy efficient LED lamps.	-826
4	Replace municipal government vehicles	*Hybrids* and *Small Vehicles*	Replace 25%of the 220 vehicles in the 2011 municipal fleets with hybrid vehicles and 25% with smaller, more fuel efficient vehicles. Current vehicles average mpg of 19.7 and 12,042 annual miles driven; hybrid vehicles average mpg of 46 and smaller vehicles average mpg of 29.	-282
5	Police-officer bicycle or foot patrol	*Bicycle Police*	Three police officer-years of bicycle patrol would reduce annual vehicle usage by 36,126 miles in police vehicles averaging 16 mpg.	-21
6	Municipal employee alternative commute	*Reduce Fleet*	Reduce by 10% vehicle miles traveled for municipal employees commute (calculated 1.04 million miles in 2010) by encouraging an average of one private-vehicle commute every two weeks to be replaced by bicycle, walking, or transit.	-50
7	Tree planting programs	*Forest*	500 trees planted, each absorbing 0.14 metric tons of CO_2 annually (a conservative estimate).	-62
8	Energy efficiency improvements in water delivery	*Water System*	50,000 households provided service with estimated daily usage of 200 gallons, 0.00125 kWh energy use per gallon pumped, and 8% energy savings realized.	-199
	Total GHG Emissions Reduction		**(20.1% reduction from 2006 level of 9,452 $MTCO_2E$)**	**-1,898**

[14] The Climate & Air Pollution Planning Assistant is a sophisticated spreadsheet-based decision support tool produced by ICLEI USA. The software can be obtained by ICLEI members at http://www.icleiusa.org/action-center/tools/cappa-decision-support-tool. A copy of the software with appropriate data entered has been provided to the five partner community members of this project by Temple University's Center for Sustainable Communities.

Appendix B: Community GHG Emissions Reduction Recommended Strategies

	Strategy	C&APPA modules[15]	Assumptions	$MTCO_2E$ Reduction
9	Residential energy efficiency education campaign	*Resident Efficiency Education*	50,000 households targeted with educational messages, average per household electricity usage of 11,000 kWh and natural gas usage of 510 therms (500 CCF), and 15% reductions in electricity and natural gas consumption.	-66,462
10	Energy retrofits of existing residential buildings	*Retrofits*	Half of the 50,000 households in the five communities make energy efficiency improvements to an average of 1,500 square feet of living space for annual energy use reductions of 15% (electricity) and 15% (natural gas).	-58,868
11	Solar PV and hot waters systems	*Solar PV* and *Solar Hot Water*	7.5% of hhs (3,750) install 2.5 KW PV systems, with 5 sun hours per day; 7.5% of hhs (3,750) install solar hot water heaters with avg daily hot water use of 50 gals and 2/3 water heating savings.	-12,796
12	Ordinance for reductions in water usage	*Water Ordinance*	Reduction of 25% in water usage at the household level with an estimated current usage rate of 200 gallons per household per day.	-2,690
13	Commercial energy efficiency education campaign	*Business Efficiency Education*	Each of 400 participating small businesses in the five communities will make energy efficiency improvements that save 11,500 kWh of electricity use and 510 therms of natural gas use.	-3,654
15	Encourage switch to shared and non-motorized travel	*Trans Education*	50,000 households in the five communities targeted with a transportation educational efforts and an average switch of 8% of motorized vehicle travel to shared (buses, trains and carpools) and non-motorized (bicycles and walking) forms of travel.	-34,319
16	Encourage residents to reduce vehicle miles traveled	*Reduce Fleet*	Encourage households to reduce vehicle miles traveled by 8% (based on DVRPC data on VMT of 949 million for the five communities) by reducing vehicle ownership, fewer motorized vehicle trips and combining vehicle trips when they are necessary.	-36,313
17	Encourage residents to buy hybrid vehicles	*Hybrids*	14% of 96,000 vehicles (national household ownership is 1.92 vehicles / hh for 50,000 hhs) is replaced with hybrid or other very high fuel efficiency vehicles.	-44,212
18	Reduce emissions from solid waste disposal	*Curb Recycle, Kitchen Composting, Yard Composting, and Pay Throw*	Reduce solid waste disposal by 600 lbs per person per year and green waste disposal by 600 lbs per person per year.	-1,331
19	Green Power Purchase	*Green Power Purchase*	An average of 20% of electricity purchased (for residents and businesses) from renewable sources, assuming average annual energy use is 4,000 kWh.	-59,521
	Total GHG Emissions Reduction (20% below 2006 emissions of 1,594,903 $MTCO_2E$)			**-320,166**

[15] See footnote 14 for details of decision support tool used in this analysis.