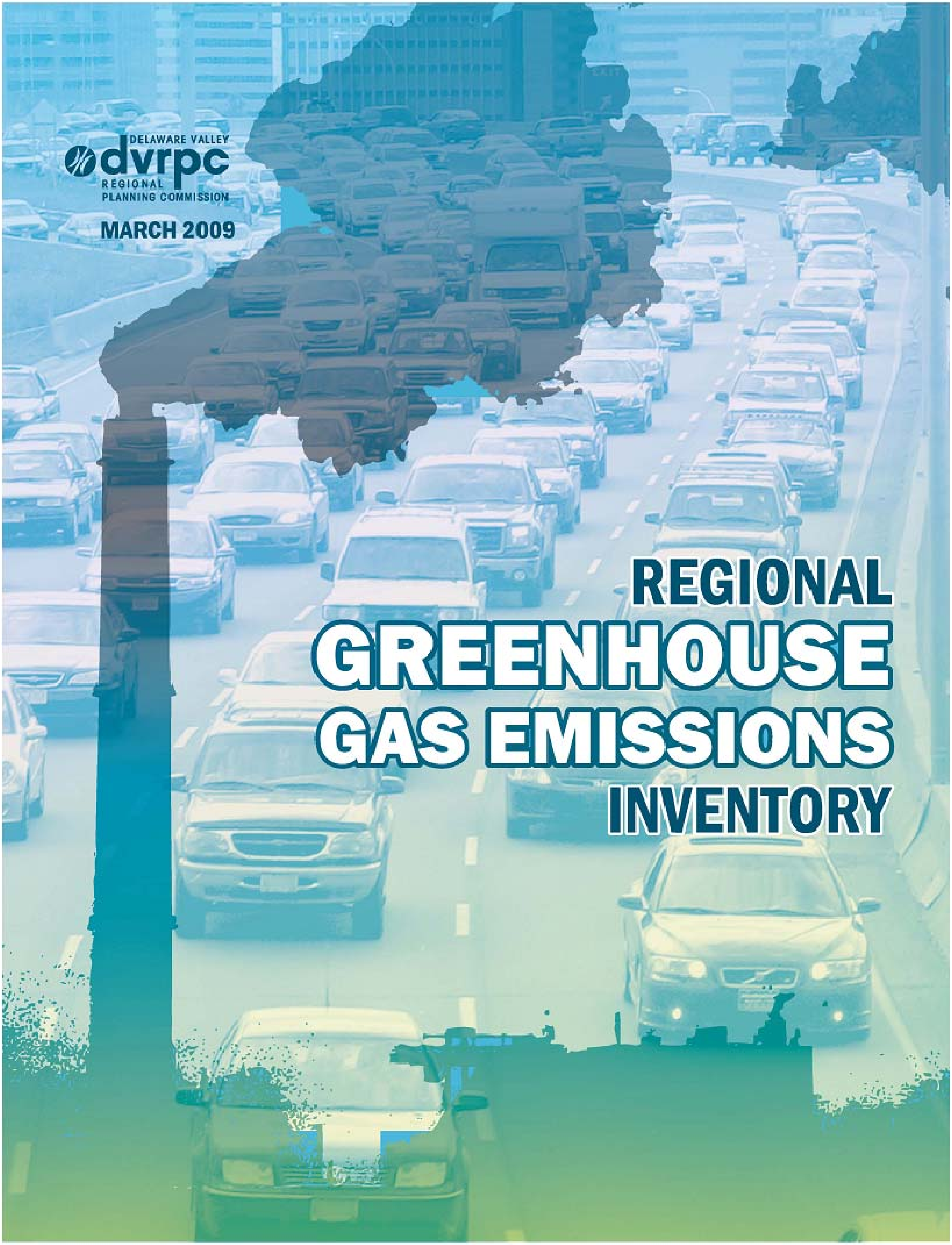


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MARCH 2009


# REGIONAL GREENHOUSE GAS EMISSIONS INVENTORY

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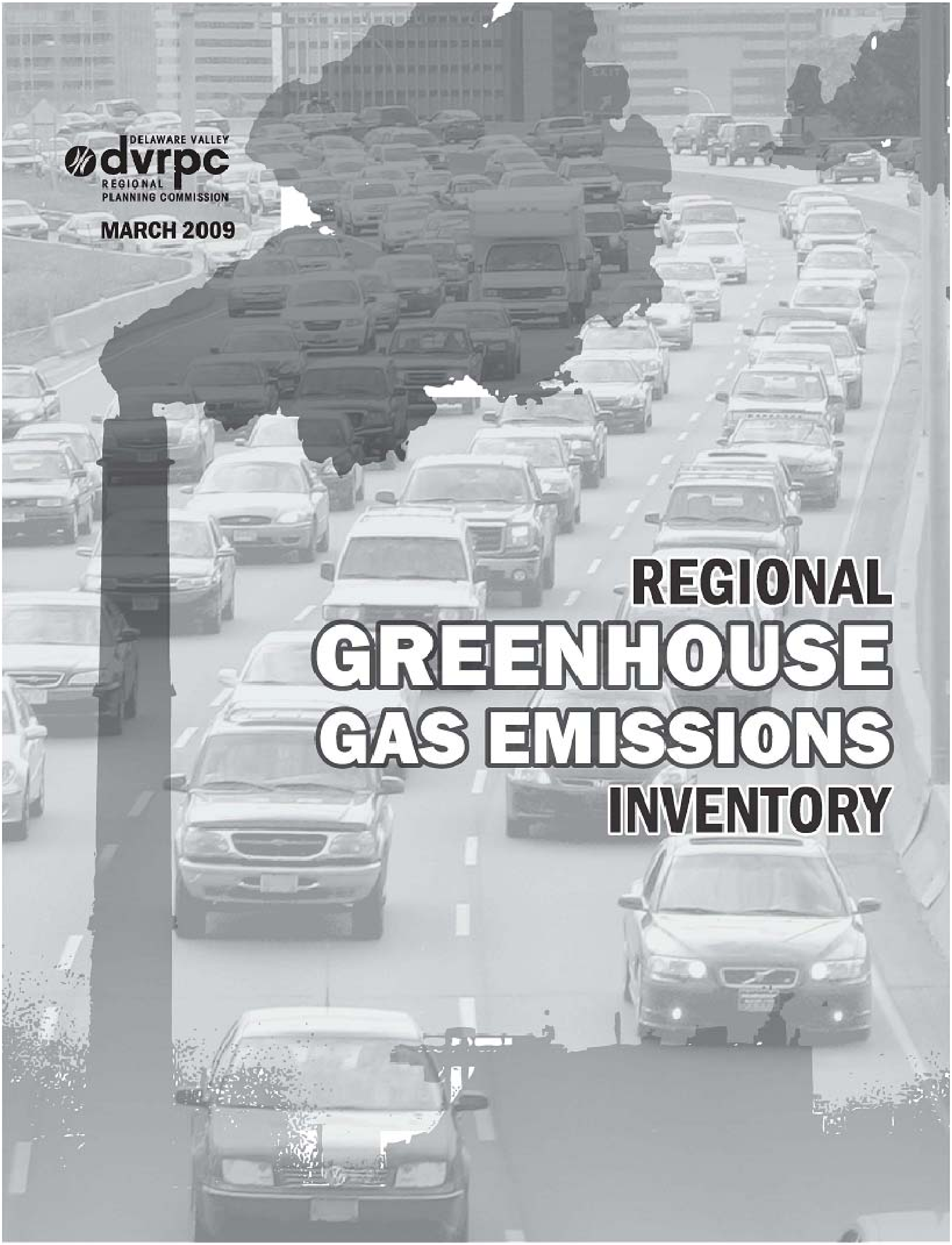

# REGIONAL GREENHOUSE GAS EMISSIONS INVENTORY

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals and the public with a common vision of making a great region even greater. Shaping the way we live, work and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region - leading the way to a better future.

Our logo is adapted from the official DVRPC seal, and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole, while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for its findings and conclusions, which may not represent the official views or policies of the funding agencies.

DVRPC fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. DVRPC's website may be translated into Spanish, Russian and Traditional Chinese online by visiting www.dvrpc.org. Publications and other public documents can be made available in alternative languages and formats, if requested. For more information, please call (215) 238-2871.

## Acknowledgements

The form and content of the Regional Greenhouse Gas Emissions Inventory was shaped through a series of meetings and consultations with an advisory group and other stakeholders. Appendix B contains a list of the individuals who participated in one or more meetings of the Greenhouse Gas Emissions Inventory Advisory Group or otherwise provided or facilitated feedback and guidance as the inventory was being prepared

Assistance on methodology development, data development, calculations, and report drafting was provided by a team at ICF International, Incorporated, led by Anne Choate and Phil Groth.

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## EXECUTIVE SUMMARY

There is overwhelming consensus within the global scientific community that the earth's climate is changing due in large part to atmospheric changes attributable to human activity. In order to provide regional leadership on this important issue, the Board of Commissioners of the Delaware Valley Regional Planning Commission (DVRPC), the metropolitan planning organization for the nine county Greater Philadelphia region,[1] established a Climate Change Initiatives program area.

The first task in this program area was to inventory greenhouse gas (GHG) emissions in the region. Identifying and quantifying the emissions sources in the region is a key first step to developing strategies for reducing emissions. This effort was accompanied by the allocation of the inventory to each of the region's nine counties and 352 municipalities.

The base year for this analysis is 2005. Greenhouse gas emissions, measured in metric tons of carbon dioxide equivalent ($MTCO_2E$), are calculated for energy used in the residential, commercial, and industrial sectors, as well as the transportation sector, which includes on-road transportation, passenger and freight rail, aviation, marine transportation, and off-road vehicles. Emissions resulting from waste management (solid waste and wastewater), agriculture processes (both animal and plant related), non-energy-related emissions from industrial processes, and fugitive emissions from fuel systems (natural gas systems and petroleum systems) are also included.

Within the DVRPC region, these sectors resulted in emissions of 90.3 million metric tons of carbon dioxide equivalent ($MMTCO_2E$) in 2005. Over 91 percent of these emissions resulted from energy consumption, including stationary energy consumption by the residential, commercial, and industrial sectors, and mobile energy consumption from the transportation sector. Waste management and industrial processes each accounted for an additional 3 percent of total emissions. When the net change in carbon stocks in the region's trees is taken into account, the region's total emissions are slightly higher, at 90.4 $MMTCO_2E$.[2]

Together, regional emissions accounted for about 1.2 percent of gross national emissions. With 1.9 percent of the nation's population in 2005, per capita emissions in the DVRPC region were about one third lower than in the nation as a whole. This is largely due to the region's lower per capita commercial and industrial energy consumption, on-road mobile emissions, and agricultural emissions.

The results from allocation of emissions to the municipal level clearly demonstrate that municipalities with higher density tend to produce lower per capita emissions.

The report begins with an overview of the 2005 Baseline Inventory, and follows with a discussion of the methods and data used to estimate 2005 emissions. It continues with a discussion of the methods used to allocate the inventory to the region's municipalities. The report contains an appendix that presents the results of the allocation by county and municipality and an appendix listing participants in the inventory advisory group and other stakeholders.

DVRPC will use this inventory in its work to develop policies and programs for the region to reduce greenhouse gas emissions. DVRPC will also use this inventory to support inventory efforts at the county and municipality level, as well as to support regional analysis of where investments in energy conservation and efficiency might be most productively made.

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[1] Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; Burlington, Camden, Gloucester, and Mercer in New Jersey.

[2] The emissions source category of *land use, land use change, and forestry* is generally handled separately from other emissions sources, as in some geographies, such as the United States as a whole, it is a net negative, removing $CO_2$ from the atmosphere. This is discussed in the report.

# 1 2005 Baseline Inventory

The Delaware Valley Regional Planning Commission (DVRPC), comprised of nine counties in Pennsylvania and New Jersey, including the City of Philadelphia, resolved to inventory greenhouse gas (GHG) emissions in the region. This effort was initiated at the request of the DVRPC Board of Commissioners in support of regional efforts to quantify and ultimately reduce emissions associated with climate change. This effort was accompanied by the allocation of the inventory to each of the region's nine counties and 352 municipalities.

## 1.1 What is a Greenhouse Gas Emissions Inventory and Why is it Important?

A greenhouse gas inventory is **an accounting of greenhouse gases emitted to or removed from the atmosphere over a period of time** (e.g., one year). Policy makers use inventories to track emission trends, develop strategies and policies to reduce greenhouse gas emissions, and assess progress. Scientists use them as inputs to atmospheric and economic models. An inventory begins with a defined baseline year.

An inventory can help with any or all of the following tasks:

- Identifying the greatest sources of greenhouse gas emissions within a particular geographic region.
- Understanding emission trends.
- Quantifying the benefits of activities that reduce emissions.
- Establishing a basis for developing an action plan.
- Tracking progress in reducing emissions.
- Setting goals and targets for future reductions.

Because it's hard to manage what's not measured, developing an inventory is usually the first step taken by states, regions, and localities—as well as organizations—that want to reduce their greenhouse gas emissions.

## 1.2 Key Steps and Issues in Establishing an Inventory

At its most basic, a greenhouse gas inventory is carried out by identifying activities that are responsible for greenhouse gas emissions, ascertaining the level of each activity, and then calculating the associated greenhouse gas emissions.[3] In order to determine the greenhouse gas emissions from driving a standard gasoline-powered car, for example, one needs to know how many miles are driven and the quantity of emissions generated per mile.

Each of these steps—defining the activities, measuring the level of the activity, and determining the consequent emissions—must be carefully defined in order to result in a credible, transparent, and easily reproducible inventory. To achieve this, DVRPC has based the inventory methodology on established guidelines, or protocols, wherever possible. While there are well-established protocols for carrying out a GHG emissions inventory at the state and municipal level, there is as yet no such protocol established for carrying out an inventory at the metropolitan area level. As DVRPC was initiating this project, US EPA headquarters expressed an interest in having DVRPC's efforts align with an ongoing effort to develop just such an emissions protocol. As such, this work has benefitted from, and provided benefit to, the development of a national standard protocol for metropolitan area inventories.[4]

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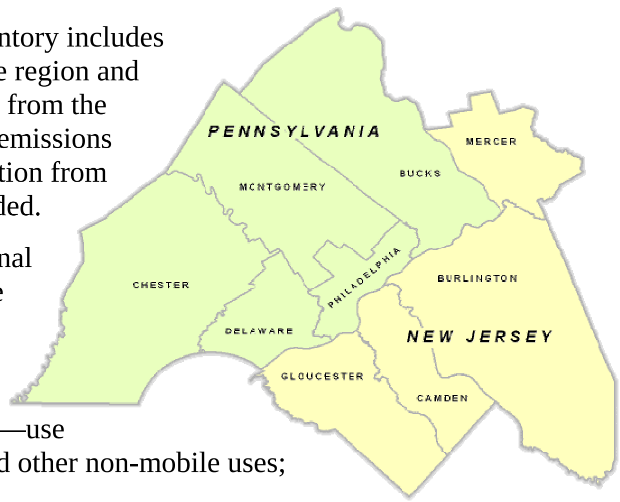
[3] For a detailed overview of greenhouse gas emissions inventory work, see: US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005*, April 2007. Available for download at: http://epa.gov/climatechange/emissions/usinventoryreport.html

[4] See: *Draft Regional Greenhouse Gas Inventory Guidance*, U.S. Environmental Protection Agency, Municipal Clean Energy Program, State and Local Branch, January 20, 2009.

The process of designing an inventory entails a number of decisions and procedural steps:

- **Inventory geography and boundaries:** The geography for this inventory is that of the nine-county DVRPC region (see Figure 1). As will be seen below, this inventory includes emissions from electricity imported into the region and from emissions from waste that is exported from the region. Product life-cycle emissions (e.g., emissions associated with the production and distribution from imported goods and services) are not included.

**Figure 1. The DVRPC Region**




- **Scope:** The activities selected for the regional inventory are based on those defined by the US Environmental Protection Agency and the Intergovernmental Panel on Climate Change. These categories are:
    - **Stationary Energy Consumption**—use of energy in homes, businesses, and other non-mobile uses;
    - **Mobile Energy Consumption**—use of energy in transportation, including on-road transportation, passenger and freight rail, aviation, marine transportation, and off-road vehicles;
    - **Agriculture**—non-energy emissions from agriculture, including both crops and livestock (e.g., methane emissions associated with livestock and nitrous oxide emissions associated with fertilizer application);
    - **Waste Management**—non-energy emissions related to managing solid waste, including trash and wastewater (e.g., methane emissions associated with the anaerobic decay of waste disposed of in landfills);
    - **Industrial Processes**—non-energy emissions associated with industrial activity (e.g., carbon dioxide emissions associated with cement production or emissions associated with coolants for air conditioners);
    - **Fugitive Emissions from Fuel Systems**—leakages in the production, distribution, and transmission of fossil fuels (e.g., methane leaks from natural gas transmission and distribution), and;
    - **Land Use, Land Use Change, and Forestry**—emissions from changes in the amount of carbon stored in soil and plants due to land use and forestry practices (e.g., from clearing forest land for residential, commercial, or agricultural use).
- **Greenhouse gases included:** In its 2005 national greenhouse gas emissions inventory, the US Environmental Protection Agency evaluated the impact of seventeen gases as contributing to changes in the atmosphere to trap heat. In this inventory, DVRPC evaluates the impact of the three gases which together comprise 98 percent of national emissions: carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$), as well as HFCs, PFCs, and $SF_6$ emissions from the substitution of ozone depleting substances.[5] Together, these greenhouse gases accounted for 99.5 percent of national greenhouse gas emissions in 2005.[6]

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[5] Different greenhouse gases have different capacities to trap heat in the atmosphere. In order to compare and sum the impacts of different gases, the United Nations' Intergovernmental Panel on Climate Change (IPCC) developed the Global

- **Quantification approach:** As detailed in Section 2 of this document, this inventory uses a blend of top-down data (e.g., state fuel consumption estimates) and bottom-up data (customer utility data). This mix was dictated by data availability, existing protocols, and resource limitations.
- **Level of effort:** Emissions inventories are never completely accurate (better data is always available with more effort) and are never finished (the mix of activities is always changing). Given limited resources, DVRPC directed its resources most intently toward inventorying the largest sources of emissions, and those sources that regional and sub-regional policies can help reduce.
- **Base year:** The base year for this analysis is 2005. 2005 was selected because it is the most current year for DVRPC's land use data, and population and employment estimates. In addition, 2005 was the most recent year available for a significant amount of other government-provided data (e.g., electricity generations emissions data). 2005 was also selected as it appeared to align with base years of several local inventories taking place in the region, and sets the rhythm for a five-year update cycle.
- **Engaging stakeholders**: DVRPC felt it was essential to engage regional stakeholders in the development of the inventory from the outset, to provide valuable input on establishing a baseline, provide data and information on data resources, build confidence in the methodologies used, provide input on key methodological and data questions, and build awareness of the inventory. DVRPC formed a regional greenhouse gas emissions advisory group, comprised of approximately 100 individuals, representing municipalities, counties, community groups, activists, the business community, state government (both PA and NJ), neighboring MPOs, and the federal government.[7]
- **Certification**: In some instances it may be appropriate for an inventory to go through a third-party review and certification process to assure that the inventory is high quality and that it is complete, consistent, and transparent. This may be required, for example, for a facility-level inventory that may serve as the basis for generating tradable carbon reduction certificates. Because the purpose of this inventory is informing public policy, and because the raw data was obtained from public or quasi-public sources, DVRPC did not deem it necessary to obtain such certification.

All emissions are reported in metric tons of carbon dioxide equivalent (MT$CO_2$E) or million metric tons of carbon dioxide equivalent (MM$TCO_2$E). A metric ton is 1,000 kilograms, or 2,206 pounds – about 10 percent larger than the 2,000 pound ton commonly used in the United States.

### 1.3 Emissions Summary

Within the DVRPC planning region, gross emissions of greenhouse gases totaled 90.3 million metric tons of carbon dioxide equivalent (MMT$CO_2$E) in 2005. These emissions are summarized in Table 1, below. When the small amount of carbon emitted from the net loss of trees is included, net emissions were estimated to be 90.4 MMT$CO_2$E. Over 92 percent of the gross emissions resulted from energy consumption, including stationary energy consumption by the residential, commercial, and industrial sectors, and mobile energy consumption from the transportation sector. Waste management and industrial processes each accounted for an additional 3 percent of total emissions, while agriculture, fugitive

Warming Potential (GWP) concept, where the GWP of each greenhouse gas is compared to that of $CO_2$, whose GWP is defined as 1. The GWP of methane ($CH_4$) is 21, and nitrous oxide ($N_2O$) is 310. GWPs for some gases are much higher—the GWP for $SF_6$, for example is 23,900. For more information, see US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005*, April 2007, page ES-2.

[6] US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005*, April 2007, page ES-5.

[7] Advisory group participants and other stakeholders consulted are listed in Appendix B of this report.

emissions from fuel systems, and emissions resulting from loss of forest land together contributed an additional 2.5 percent.

### Table 1. Summary of DVRPC Regional Greenhouse Gas Emissions—2005

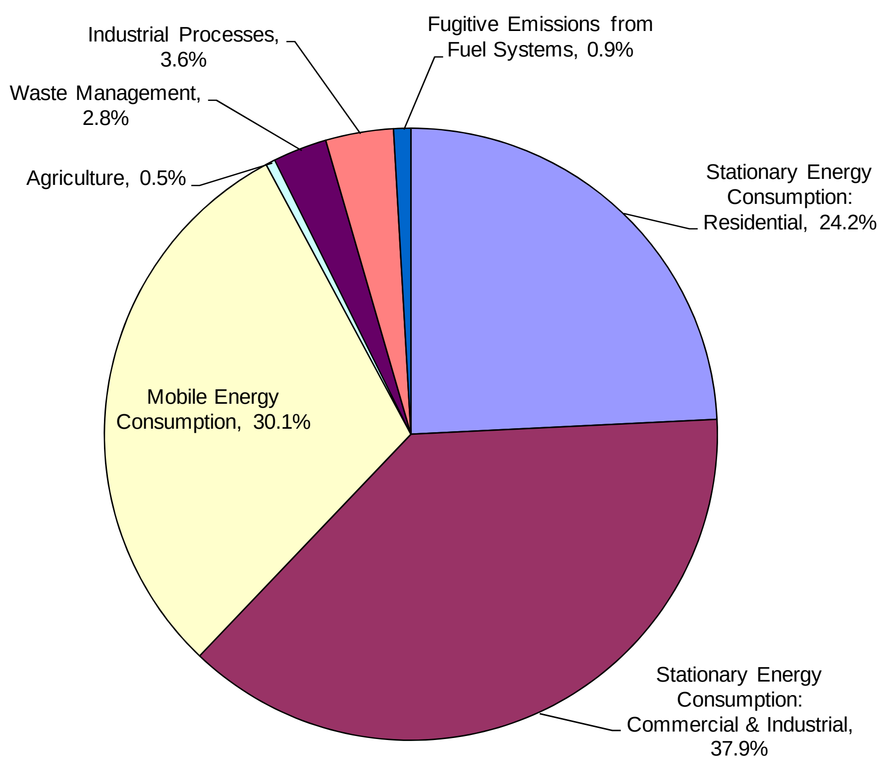
| Emissions Source Category | Emissions ($MMTCO_2E$) | Percent of Total |
|---|---|---|
| Stationary Energy Consumption—Residential | 21.9 | 24.2% |
| Stationary Energy Consumption—Commercial & Industrial | 34.2 | 37.9% |
| Mobile Energy Consumption | 27.1 | 30.1% |
| Agriculture | 0.5 | 0.5% |
| Waste Management | 2.6 | 2.8% |
| Industrial Processes | 3.2 | 3.6% |
| Fugitive Emissions from Fuel Systems | 0.8 | 0.9% |
| **Gross Emissions** | **90.3** | **100%** |
| Land Use, Land Use Change, and Forestry[8] | 0.2 | |
| **Net Emissions** | **90.4** | |

Source: DVRPC, 2009

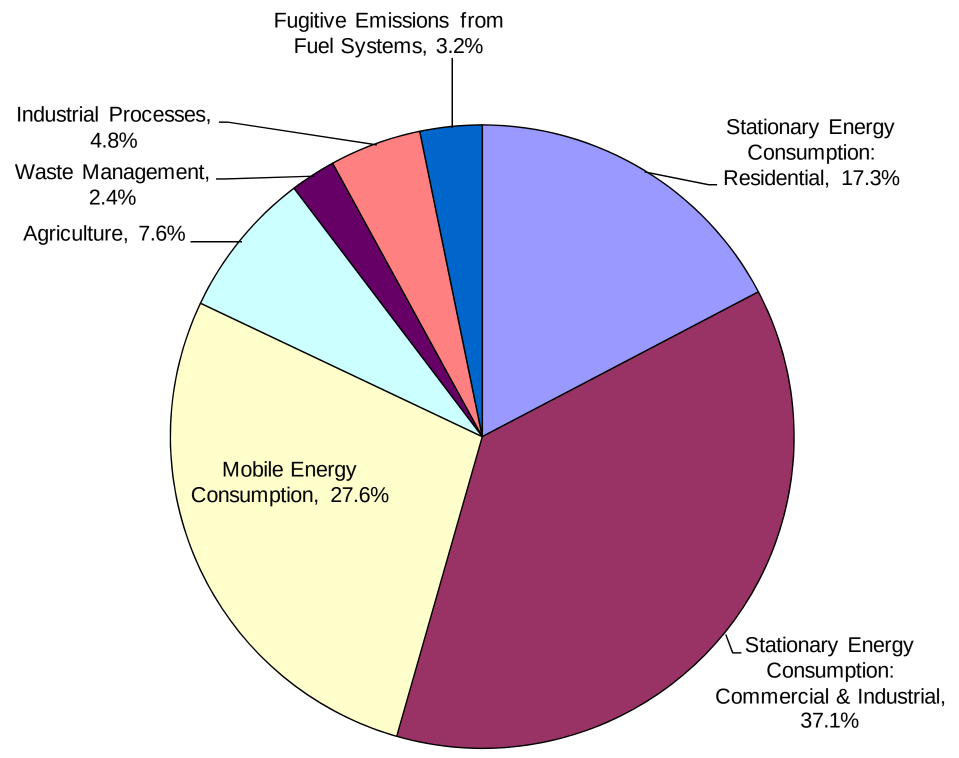
In Figure 2 below, each slice on the graph represents a single emissions source category. The size of the slice represents emissions from a given source category as a percentage of gross emissions. The relative contribution of each source category to total emissions in the DVRPC region is shown beside a similar graph for the United States. Note that the contribution of some source categories in the region, such as combustion of fuel for mobile sources, is similar to the contribution of those same source categories at the national level. In other cases, like agriculture, the relative share of emissions is quite different.

[8] The category of land use, land use change, and forestry is generally discussed separately from other emissions sources, in part because for some geographies, such as the United States as a whole, it is a net negative, removing $CO_2$ from the atmosphere. This is discussed below.

**Figure 2. Relative Contribution of Emission Sources to Total DVRPC and National GHG Emissions by Source Category—2005**




## DVRPC Region

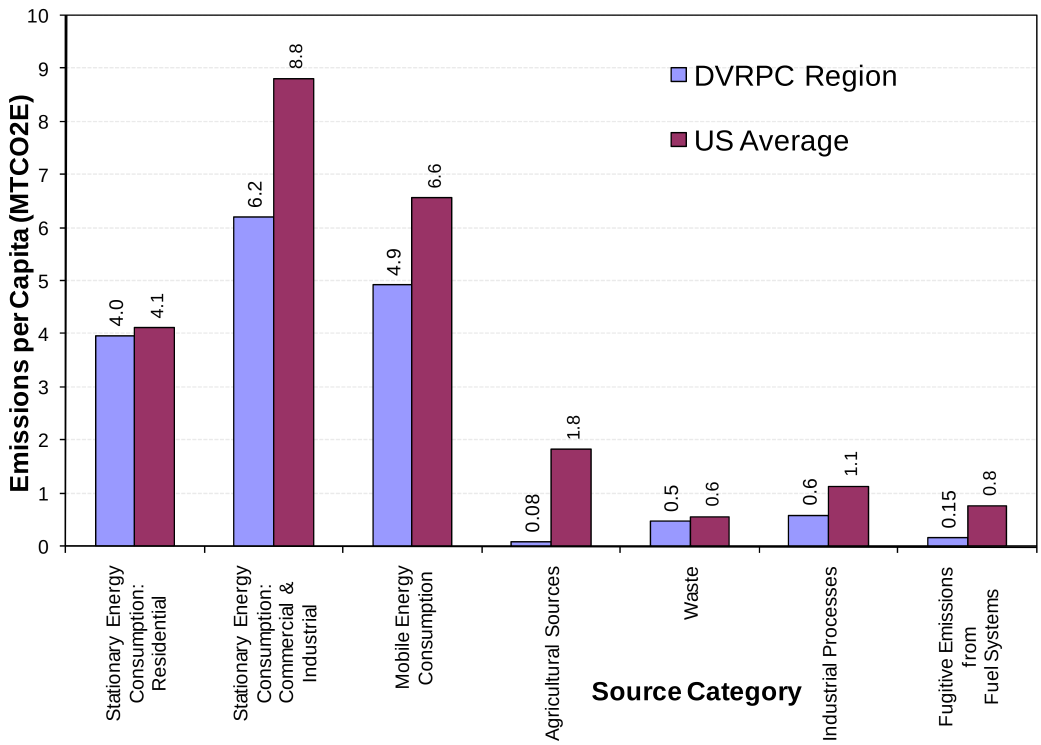



## United States

Source: DVRPC, 2009

Figure 3 presents the per capita emissions by source category for both the region and the nation. The region's per capita gross emissions of 16.5 $MTCO_2E$ per person are one third lower than the national average of 24.5 $MTCO_2E$ per capita. This difference is driven largely by the region's lower per capita transportation, commercial/industrial, and agricultural emissions.

**Figure 3. Comparison of 2005 DVRPC and National Per Capita Emissions, by Source Category ($MTCO_2E$)**




Source: DVRPC, 2009

The remainder of this section provides additional details on emissions from each of the source categories summarized above. The percentage at the end of each heading indicates the portion of regional emissions from that source category. Details on the methodology used for each source category is included in the following section.

## 1.4 Stationary Energy Consumption—Residential, Commercial, and Industrial (62.1%)

The source category "stationary energy consumption" includes emissions from residential, commercial, and industrial activities in the DVRPC planning region. This includes direct emissions from the combustion of natural gas, coal, kerosene, distillate, motor gasoline and other fuels, as well as indirect emissions from electricity consumption. To avoid double-counting, fuels combusted for the generation of electricity are excluded from the estimates of direct emissions, as they are accounted for as indirect emissions from electricity consumption. Residential energy consumption contributed 24.2 percent of total regional emissions. By contrast, residential energy consumption constituted just 17.3 percent of national emissions, although residential emissions on a per capita basis are slightly lower in this region.

Commercial and industrial energy consumption are reported together due to co-mingled utility data. As a percent of total regional emissions, commercial and industrial emissions were also slightly higher than the national values, at 37.9 percent versus 37.1 percent of total emissions, although again per capita emissions are lower in the region as compared to national averages.

Emissions from these sectors are detailed in Table 2 and Table 3 below.

**Table 2. GHG Emissions from Residential Energy Consumption—2005**

| Source | Fuel Type | Emissions MMTCO$_2$E |
|---|---|---|
| *Direct Emissions* | Natural Gas | 6.6 |
| | Coal | 0.003 |
| | Distillate Fuel Oil | 2.3 |
| | Kerosene | 0.2 |
| | LPG | 0.2 |
| *Indirect Emissions* | Purchased Electricity | 12.5 |
| **Total** | | **21.9** |
| | Percent of region | 24.2% |
| | Percent for nation | 17.3% |
| Per capita (MTCO$_2$E/person) | Region | 4.0 |
| | U.S. | 4.1 |

Source: DVRPC, 2009

**Table 3. GHG Emissions from Commercial and Industrial Consumption—2005**

| Source | Fuel Type | Emissions MMTCO$_2$E |
|---|---|---|
| *Direct Emissions* | Natural Gas | 7.6 |
| | Coal | 0.2 |
| | Petroleum Coke | 1.5 |
| | Distillate Fuel Oil | 1.7 |
| | Residual Fuel | 0.5 |
| | Kerosene | 0.2 |
| | LPG | 0.2 |
| | Other fuels | 1.0 |
| *Indirect Emissions* | Purchased Electricity | 21.3 |
| **Total** | | **34.2** |
| | Percent of region | 37.9% |
| | Percent for nation | 37.1% |
| Per capita (MTCO$_2$E/person) | Region | 6.2 |
| | U.S. | 8.8 |

Source: DVRPC, 2009

## *1.5 Mobile Energy Consumption (30.1%)*

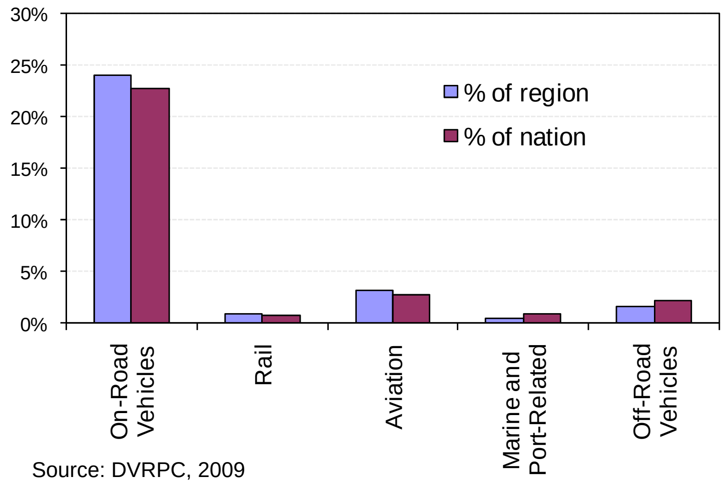
Fossil fuels used to power cars, trucks, mass transit, passenger and freight rail, aviation, and marine transport in the planning region resulted in emissions of approximately 27.1 MMTCO$_2$E in 2005, representing 30.1 percent of total emissions. A summary of major mobile sources is presented in Table 4 below, while additional detail regarding on-road mobile sources is presented in Table 5. As shown in Figure 4 below, the region's mobile GHG emissions align very closely with national emissions as a percent of total emissions, though the per capita emissions are significantly lower than the nation as a whole.

**Table 4. Summary of GHG Emissions from Mobile Sources—2005**

| Source | | Emissions MMTCO$_2$E |
|---|---|---|
| On-Road | | 21.8 |
| Rail | | 0.8 |
| Aviation | | 2.8 |
| Marine & Port-Related | | 0.4 |
| Off Road Vehicles | | 1.4 |
| **Total** | | **27.1** |
| | Percent of region | 30.1% |
| | Percent for nation | 27.6% |
| Per capita (MTCO$_2$E/person) | Region | 4.9 |
| | U.S. | 6.6 |

Source: DVRPC, 2009

**Figure 4. Mobile Energy Consumption – DVRPC vs. National GHG Emissions—2005**




Source: DVRPC, 2009

**Table 5. Detailed GHG Emissions from On-Road Mobile Sources—2005**

| Vehicle Type | | Emissions MMTCO$_2$E |
|---|---|---|
| Light-duty gas vehicles | | 7.2 |
| Light-duty gas trucks | | 9.7 |
| Heavy-duty gas vehicles | | 1.0 |
| Light-duty diesel vehicles | | 0.01 |
| Light-duty diesel trucks | | 0.03 |
| Heavy-duty diesel vehicles | | 3.7 |
| Motorcycles | | 0.04 |
| Public transit buses | | 0.06 |
| **Total** | | **21.8** |
| | Percent of region | 24.1% |
| | Percent for nation | 22.8% |
| Per capita (MTCO$_2$E/person) | Region | 3.9 |
| | U.S. | 6.6 |

Source: DVRPC, 2009

## 1.6 Agricultural Sources (0.5%)

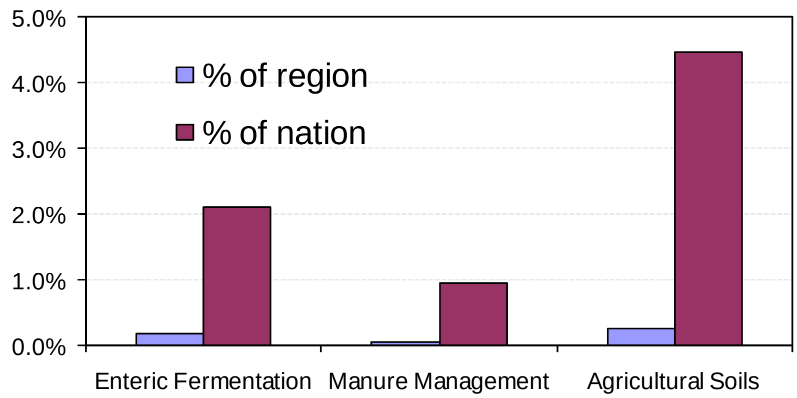
Sources of GHG emissions in the agricultural sector include enteric fermentation, manure management, and agricultural soils. Combined, these sources account for 0.45 $MMTCO_2E$, one-half percent of the region's total emissions. By contrast the agriculture sector represents 7.6 percent of total U.S. emissions.

**Table 6. Agriculture GHG Emissions—2005**

| **Source** | | **Emissions $MMTCO_2E$** |
|---|---|---|
| Enteric Fermentation | | 0.17 |
| Manure Management | | 0.04 |
| Agricultural Soils | | 0.24 |
| **Total** | | **0.45** |
| | Percent of region | 0.5% |
| | Percent for nation | 7.6% |
| Per capita ($MTCO_2E$/person) | Region | 0.1 |
| | U.S. | 1.8 |

Source: DVRPC, 2009

**Figure 5. Agriculture – DVRPC vs. National GHG Emissions—2005**




Source: DVRPC, 2009

## 1.7 Waste Management (2.8%)

The majority of the DVRPC planning region's solid waste is disposed in landfills, where methane is generated during the anaerobic decomposition of the organic matter in waste. Some landfills are equipped with landfill gas-to-energy systems. Based on reports to the U.S. EPA's Landfill Methane Outreach Program, an estimated 42 percent of the region's potential landfill methane emissions were avoided through landfill gas recovery efforts. When emissions are adjusted to reflect emissions avoided through landfill gas collection systems, net emissions from waste disposal were estimated at 1.9 $MMTCO_2E$ in 2005. Note that emissions associated with landfill gas-to-energy systems are accounted for in the regional electricity emissions factor when used to generate electricity, or included in industrial, residential, or commercial energy emissions when used for heating or process fuel.

An estimated 16 percent of waste in New Jersey, and 19 percent of waste in Pennsylvania was assumed to be incinerated. However, because these waste incineration facilities are used to generate electricity, their emissions are accounted for in the regional electricity emission factors. In addition to emissions from the region's landfills, methane and nitrous oxide are emitted during wastewater treatment. Emissions from the region's wastewater treatment plants accounted for 0.7 $MMTCO_2E$. As a percentage of the region's total emissions, waste management accounts for a slightly higher portion of regional emissions than it does for the nation as a whole, although per capita emissions are slightly below the national average, as shown in Table 7 below.

**Table 7. Waste Management GHG Emissions—2005**

| **Source Category** | | **Emissions $MMTCO_2E$** |
|---|---|---|
| Wastewater | | 0.7 |
| Landfill Methane | | 1.9 |
| **Total** | | **2.6** |
| | Percent of region | 2.8% |
| | Percent for nation | 2.4% |
| Per capita ($MTCO_2E$/person) | Region | 0.5 |
| | U.S. | 0.6 |

Source: DVRPC, 2009

## 1.8 Industrial Processes (3.5%)

In 2005, industrial processes contributed 3.2 $MMTCO_2E$ to the region's GHG emissions total. In the DVRPC planning region, three industrial source categories were evaluated: cement manufacture, iron and steel production, and substitution of ozone-depleting substances (ODS). Although other sources of industrial emissions likely exist in the region, these were chosen because of their national magnitude and data availability.

**Table 8. Industrial Processes GHG Emissions—2005**

| **Source Category** | | **Emissions $MMTCO_2E$** |
|---|---|---|
| Cement | | 0.4 |
| Iron & Steel | | 0.9 |
| Ozone-depleting Substances Substitutes (ODS) | | 2.0 |
| **Total** | | **3.2** |
| | Percent of region | 3.5% |
| | Percent for nation | 4.7% |
| Per capita ($MTCO_2E$/person) | Region | 0.6 |
| | U.S. | 1.1 |

Source: DVRPC, 2009

## 1.9 Fugitive Emissions from Fuel Systems (0.9%)

In accordance with GHG accounting rules, fugitive methane emissions from coal, oil, and natural gas systems are calculated separately from carbon dioxide emissions associated with the combustion of fossil fuels. Emissions from coal mining activities in the region were zero, as there are no active or abandoned coal mines in the DVRPC region. However, fugitive emissions from regional oil refining activities were calculated, as were emissions associated with transmission and distribution losses from natural gas systems. In 2005, fugitive emissions from oil and gas systems totaled 0.82 $MMTCO_2E$.

**Table 9. Fugitive GHG Emissions from Fuel Systems—2005**

| Source | | Emissions $MMTCO_2E$ |
|---|---|---|
| Natural Gas Systems | | 0.78 |
| Petroleum Systems | | 0.04 |
| **Total** | | **0.82** |
| | Percent of region | 0.9% |
| | Percent for nation | 3.2% |
| Per capita ($MTCO_2E$/person) | Region | 0.15 |
| | U.S. | 0.76 |

Source: DVRPC, 2009

## *1.10 Land Use, Land Use Change, and Forestry*

The source category termed "land use, land-use change, and forestry" (LULUCF) by the United Nations' Intergovernmental Panel on Climate Change (IPCC) is complex and may seem counter intuitive. This category contains emissions and removals of $CO_2$ from forest management, other land-use activities, and land-use change. These emissions and removals of $CO_2$ are due to the loss or gain in the amount of carbon stored in trees and other plants in forests, parks, streets, and private property. When the total amount of plant material increases, carbon is stored or sequestered. When the total amount of plant material decreases, carbon is released or emitted. The DVRPC region as a whole had a net loss in this stored carbon in 2005, resulting in additional emissions of 0.15 $MMTCO_2E$.

Regional per capita net emissions for this sector are 0.027 $MTCO_2E$. In contrast this sector resulted in a net per capita *sequestration* or *uptake* of 2.74 $MTCO_2E$ in the 2005 national GHG emissions inventory. See Section 2.7 for more detail.

# 2 INVENTORY METHODOLOGY

This section presents the methods and data sources used to develop the 2005 baseline GHG inventory. Throughout all source categories, every effort was made to use the best regional data available and to use inventory methodologies that conform to the methodologies used at the state and national levels. In cases where activity data had to be approximated or new methods were developed, these actions are noted below. While this effort attempted to cover all major emissions sources, techniques for conducting a regional GHG inventory are continually updated as better data and more sophisticated methods become available.

## 2.1 Stationary Energy Consumption—Residential, Commercial, and Industrial (62.1%)

Stationary energy consumption describes the energy consumed for all purposes other than transportation. This source comprises both direct consumption (e.g., burning of natural gas for home heating) and indirect consumption (e.g., emissions associated with fuel consumed to generate electricity).

### 2.1.1 Methodology for Calculating the Direct Emissions from Fuel Consumption

Key direct fuels include natural gas, coal, distillate fuel oil, residual fuel oil, kerosene, liquefied petroleum gas (LPG), motor gasoline, industrial petroleum feedstocks, and other petroleum products. Combustion of these fuels leads to the emissions of GHGs ($CO_2$, $CH_4$ and $N_2O$). The respective GHG emissions from the direct fuel consumption by residential, commercial, and industrial end-use sectors are estimated following the methodology implemented in the State Inventory Tool[9] (SIT) (U.S. EPA, 2007):

For $CO_2$: Fuel consumption × carbon content per unit of fuel × 44/12 (ratio of $CO_2$ to C)
For $N_2O$: Fuel consumption × $N_2O$ emission factor per unit of fuel
For $CH_4$: Fuel consumption × $CH_4$ emission factor per unit of fuel

See the sections below for methods used in acquiring fuel consumption in the residential and commercial/industrial end-use source categories. The emission factors provided in Table 10 below were taken from the SIT, which in turn utilizes emission factors provided by the Energy Information Administration (EIA).

[9] The State Inventory Tool is an Excel-based tool developed by US EPA for calculating state level greenhouse gas inventories. The tool uses methods from the Intergovernmental Panel on Climate Change and the U.S. National Greenhouse Gas Inventory to generate a top-down estimate of greenhouse gas emissions at the U.S. state level. For additional information, see: http://www.epa.gov/climatechange/emissions/state_guidance.html

**Table 10: Fuel Emission Factors—2005**

| Fuel | lbs C/Million BTU | MT $N_2O$/Billion BTU | MT $CH_4$/Billion BTU |
|---|---|---|---|
| Coal | 60.27 (PA),62.02 (NJ) | 0.0014 | 0.3007 |
| Distillate Fuel (Oil) | 43.94 | 0.0006 | 0.0006 |
| Kerosene | 43.44 | 0.0006 | 0.0006 |
| LPG | 37.91 | 0.0006 | 0.0006 |
| Natural Gas | 31.87 | 0.0001 | 0.0001 |
| Residual Fuel | 47.33 | 0.0006 | 0.01002 |
| Still Gas | 38.57 | 0.0006 | 0.00301 |
| Motor Gasoline | 42.80 | 0.00060 | 0.00301 |
| Aviation Gasoline Blending Components | 41.56 | 0.00060 | 0.00301 |
| Petrochemical Feedstocks, Naphtha | 39.96 | 0.00060 | 0.00301 |
| Petrochemical Feedstocks, Other Oils | 43.94 | 0.00060 | 0.00301 |
| Petroleum Coke | 61.34 | 0.00060 | 0.00301 |
| Pentanes Plus | 40.18 | 0.00060 | 0.00301 |
| Unfinished Oils | 44.45 | 0.00060 | 0.00301 |
| Miscellaneous petroleum products | 44.45 | 0.00060 | 0.00301 |

Note: The emission factors vary by year for some fuels (LPG, Natural Gas) and by year and by state for coal.

Source: U.S. EPA, 2007

### 2.1.2 Methodology for Calculating the Indirect Emissions from Fuel Consumption

Indirect emissions result from the consumption of electricity that is in turn generated by the consumption of fuels. These emissions are driven by the fuel mix used to generate electricity consumed in the region. The indirect emissions for the residential, commercial, and industrial sectors are estimated by multiplying electricity consumption by the average regional $CO_2$, $CH_4$, and $N_2O$ emission rates, as in the following simple equations:

$CO_2$ emissions = Electricity consumption × Average Regional $CO_2$ Emission rate
$CH_4$ emissions = Electricity consumption × Average Regional $CH_4$ Emission rate
$N_2O$ emissions = Electricity consumption × Average Regional $N_2O$ Emission rate

The regional emission rates are based on the mix of fuels used to generate electricity consumed in the region, which is located in the PJM grid.[10] As shown in Table 11 below, coal—the most $CO_2$-intensive fuel—accounts for the largest portion of generation in the PJM region (56.6 percent), while nuclear power, which does not result in GHG emissions, is the second most common fuel with 32.9 percent. In 2005, the average $CO_2$ emission rate for the PJM region was 1,248 lbs $CO_2$/MWh. The average emissions rate for methane was 24.5 lbs $CH_4$/GWh and the average emissions rate for nitrous oxide was 21.4 lbs $N_2O$/GWh (U.S. EPA, 2008b). These factors include power consumed on-site by electricity generation facilities, but do not include transmission and distribution losses. Assuming national average transmission and distribution losses of 9 percent (EIA, 2008), this analysis increased the

[10] PJM Interconnection LLC (PJM) is a regional transmission organization serving all or parts of 13 states ranging from New Jersey to North Carolina to Illinois, plus the District of Columbia. Because electricity on this grid is shared by all consumers connected to the grid, the average emissions for the entire grid are appropriate for consumers in the DVRPC region.

electricity GHG emission rates by 9 percent to account for these losses. Together these factors result in a net emissions factor of 1368 lbs $CO_2E$/MWh.

**Table 11: PJM Region Electricity Generation Resource Mix—2005**

| Fuel | Percent of Generation |
|---|---|
| Coal | 56.6% |
| Nuclear | 32.9% |
| Gas | 5.9% |
| Oil | 2.2% |
| Biomass/wood | 0.9% |
| Hydro | 0.7% |
| Other fossil combustion | 0.5% |
| Wind | 0.1% |

Source: U.S. EPA, 2008b

The division of stationary energy consumption into sectors (residential, commercial, industrial) is in practice inherently ambiguous, and is somewhat dependent on the geographic level to which available data are disaggregated. On the national level, high-quality energy consumption statistics are available for each sector. On the local level, sector data is often not readily available. In the case of DVRPC, commercial and industrial sector data are often intermingled. While the data was available to estimate portions of these sectors separately, in this report these sectors have been combined, as it is not yet feasible to fully separate consumption in these areas. In addition, many data sources (EIA, local utilities) place multi-family residential buildings with more than four units within the commercial sector.[11]

### 2.1.3 Estimating Residential Fuel Consumption

The 'residential fuel' source category includes the direct emissions associated with purchased energy use other than electricity (which is discussed below)—that is, from the consumption of natural gas, coal, distillate fuel oil, kerosene, and liquefied petroleum gas (LPG). Procuring high-quality data regarding the consumption of the respective fuel by residences is among the most challenging aspects of the regional inventory process. For the DVRPC region, residential natural gas consumption was obtained from natural gas utilities in the region: Philadelphia Electric Company (PECO), Public Service Enterprise Group (PSEG), Philadelphia Gas Works, South Jersey Gas, and Elizabethtown Gas. This data was provided at either the ZIP code or municipality level, depending on the utility company. Data for about 60 percent of total gas consumption was provided at the municipality level, with the remainder provided at the ZIP code level.

For the remaining fuels, residential consumption data is not directly available. In these cases, residential consumption for each county in the DVRPC region was estimated by apportioning available statewide consumption data based on the relative use of each fuel type for home heating reported in the American Community Survey (ACS). The 2005 ACS provides estimates of the total number of households that use each type of house heating fuel by state and county (U.S. Census Bureau, 2005, Table B25040*)*. Residential fuel consumption in each county was estimated by dividing the number of households in each county using a given fuel by the number of households in the state using that fuel. These factors are presented in Table 12 below. This factor is then applied to the statewide residential consumption of that fuel. For instance, 16.4 percent of the New Jersey households that use coal are

[11] For example, PECO classifies customers as commercial or industrial, based on the voltage at which power is delivered. In some cases, multifamily apartment buildings may be among these customers. Similarly, some large commercial customers may select the industrial rate, and some small industrial customers may use the commercial rate.

located in the four New Jersey DVRPC counties, so 16.4 percent of New Jersey's residential coal usage is allocated to the region. Each fuel (coal, distillate fuel oil, kerosene, and LPG) is apportioned in this manner and then entered into the equations described in Section 2.1.1 above to estimate GHG emissions.

**Table 12: Portion of Statewide Households Using Specified Fuel for Heating, by County—2005**

| | Bottle, tank or LP gas | Fuel oil, kerosene, etc. | Coal or Coke |
|---|---|---|---|
| New Jersey | | | |
| Burlington | 5.2% | 4.4% | 2.6% |
| Camden | 3.5% | 5.1% | 12.1% |
| Gloucester | 3.6% | 4.3% | 1.8% |
| Mercer | 1.8% | 3.9% | 0.0% |
| *All DVRPC Counties in NJ* | 14.1% | 17.7% | 16.4% |
| Pennsylvania | | | |
| Bucks | 3.5% | 6.8% | 0.3% |
| Chester | 8.7% | 5.0% | 1.3% |
| Delaware | 1.4% | 4.1% | 0.4% |
| Montgomery | 4.0% | 7.0% | 0.4% |
| Philadelphia | 3.7% | 3.6% | 0.0% |
| *All DVRPC Counties in PA* | 21.3% | 26.4% | 2.4% |

Source: ACS, U.S. Census Bureau, 2005, Table B25040

### 2.1.4 Estimating Commercial/Industrial Fuel Consumption

As with the residential sector, commercial and industrial natural gas consumption was obtained from natural gas providers in the region. Some of the providers were able to give separate values for commercial and industrial sectors; others were not, due to concerns about customer confidentiality. In all cases, natural gas supplied to power plants was removed from estimated consumption to avoid double-counting.

The consumption of the remaining fuels in the commercial and industrial end-use source categories is not available on the local level. In these cases, a reasonable proxy was needed for allocating total statewide consumption of these fuels to the county level. The initial method was to apportion state level consumption to counties based on county employment totals. This apportionment uses two steps. First, county employment totals from the Bureau of Labor Statistics were divided by statewide totals to determine the portion of each state's employment that is located in the DVRPC region (BLS, 2008a and BLS, 2008b). Following this, state energy consumption in the commercial and industrial sectors was allocated to the Pennsylvania and New Jersey portions of the DVRPC region using these ratios. In the final step, employment estimates developed by DVRPC were used to allocate energy consumption to the county level.[12] These employment ratios are presented in Table 13 below. What this means, in essence, is that for each fuel, 18.8 percent of New Jersey's statewide consumption plus 32.6 percent of Pennsylvania's statewide consumption is allocated to the DVRPC region. Energy used in the electricity generation sector is excluded to avoid double-counting.

[12] DVRPC county-level employment estimates were used for this final allocation because they differed slightly from BLS employment estimates.

**Table 13: Regional Employment as a Percentage of State Employment by County—2005**

| | Percentage of statewide employment (BLS data) | Percentage of regional employment (DVRPC data) |
|---|---|---|
| New Jersey | | |
| Burlington | 5.1% | 27.7% |
| Camden | 5.4% | 28.8% |
| Gloucester | 2.6% | 14.0% |
| Mercer | 5.7% | 29.5% |
| *All DVRPC Counties in NJ* | 18.8% | 100.0% |
| Pennsylvania | | |
| Bucks | 4.7% | 13.9% |
| Chester | 4.2% | 12.7% |
| Delaware | 3.7% | 11.9% |
| Montgomery | 8.6% | 25.3% |
| Philadelphia | 11.3% | 36.3% |
| *All DVRPC Counties in PA* | 32.6% | 100.0% |

Source: BLS, 2008a; BLS, 2008b; DVRPC, 2009

Once this employment-based allocation was completed, DVRPC found that the implied consumption of some fuels in the region was too high. For instance, it allocated close to 8,000 billion Btus of coal energy to industry located in the City of Philadelphia, the equivalent of just under half a million tons of coal.[13] Officials in the City's Office of Air Management noted that they were not aware of any coal being used as an industrial fuel within the City.[14]

With this in mind, DVRPC used a second method to estimate commercial and industrial end-use fuel consumption. For those commercial and industrial fuels that are also used in the residential sector (coal, distillate fuel oil, kerosene, and LPG), DVRPC based its allocation on the use of those fuels by county at the household level, as described above in Section 2.1.3. An adjustment factor was applied in the calculations to account for the fact that county-level household and employment distributions differ from each other. These adjustment factors are presented in Table 14. This methodology assumed that both the commercial and industrial sectors would use these fuels at the same rate as the residential sector in each county. While this may not be fully accurate, it appears a more reasonable allocation method for these fuels than employment.

[13] Coal ranges in heat value from under 6,000 Btu/lb to close to 14,000 Btu/lb depending on source and type.
[14] Meeting with Kassahun Sellassie and Alison Riley, Philadelphia Air Management Services, December 19, 2008.

**Table 14: County Level Adjustment Factors for Industrial and Commercial Fuels—2005**

| | Percentage of statewide households (Census data) | Percentage of statewide employment (BLS data) | Adjustment Factor |
|---|---|---|---|
| New Jersey | | | |
| Burlington | 5.2% | 5.1% | 0.971 |
| Camden | 6.1% | 5.4% | 0.882 |
| Gloucester | 3.1% | 2.6% | 0.840 |
| Mercer | 4.0% | 5.7% | 1.412 |
| *All DVRPC Counties in NJ* | 18.5% | 18.8% | |
| Pennsylvania | | | |
| Bucks | 4.7% | 4.7% | 1.004 |
| Chester | 3.5% | 4.2% | 1.199 |
| Delaware | 4.2% | 3.7% | 0.891 |
| Montgomery | 6.0% | 8.6% | 1.438 |
| Philadelphia | 11.6% | 11.3% | 0.972 |
| *All DVRPC Counties in PA* | 30.0% | 32.6% | |

Source: DVRPC, 2009

### 2.1.5 Estimating Residential Electricity Consumption

As with natural gas consumption, actual residential sales data was provided by electricity distribution companies, either by ZIP code or municipality. Data for about 70 percent of total electricity consumption was provided at the municipality level, with the remainder provided at the ZIP code level. Companies that provided data include: PECO, PSEG, PPL, Metropolitan Edison, Atlantic City Electric, Hatfield Borough, Pemberton Borough, and Quakertown Borough. Data for several small areas on the edges of the region were not collected. Electricity consumption was estimated for these areas based on the average electricity consumption per household in the region.

### 2.1.6 Estimating Commercial and Industrial Electricity Consumption

Commercial and industrial sales data were provided by the same electrical companies. In some cases these sectors were reported separately; in other cases they were co-mingled, due to concerns about customer confidentiality. Data for the small areas not collected were estimated based on employment in missing areas and the average electricity consumption per employee throughout the region. Although this may be an imprecise estimate, the amount of the region’s electricity that was estimated in this manner is relatively small (less than 1 percent of commercial and industrial electricity). Also included in this sector was electricity used for street and traffic lighting. Only one provider—PECO—was able to report electricity for this purpose. The primary reason for this is that these lights are typically not metered and are instead billed on a per-light basis. To accurately estimate street and traffic light electricity consumption would require a complete inventory of all lights, their bulb types, and their daily usage—a task beyond the resources of this analysis. For the areas not reported, public lighting electricity is estimated based on the ratio of PECO’s reported sales to the total of PECO’s reported residential and commercial sales. As a result, public lighting consumption for the non-PECO areas was estimated to be equal to 0.84 percent of residential and commercial electricity sales.

## 2.2 Mobile Energy Consumption (30.1%)

### 2.2.1 Direct Emissions from Motor Vehicles

$CO_2$ emissions from motor vehicles for the DVRPC region were estimated using outputs from DVRPC's travel demand model. DVRPC modelers provided annual average daily vehicle miles traveled (VMT) by county and vehicle class from the DVRPC regional transportation model. $CO_2$ emission factors in grams per mile were provided as an output from MOBILE6, US EPA's vehicle emission modeling software, allowing emissions to be calculated by multiplying VMT by the emission factor. The annual VMT and VMT shares by vehicle type are provided in Table 15 below.

**Table 15. Annual VMT and VMT Shares by Vehicle Type—2005**

| | VMT | VMT Shares by MOBILE6 Vehicle Type (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **County** | **(mi/year)** | **LDGV** | **LDGT** | **HDGV** | **LDDV** | **LDDT** | **HDDV** | **MC** |
| **Bucks** | 4,833,950,500 | 44% | 47% | 2.3% | 0.05% | 0.19% | 5.52% | 0.60% |
| **Chester** | 5,057,476,500 | 44% | 47% | 2.4% | 0.05% | 0.19% | 5.70% | 0.60% |
| **Delaware** | 3,669,016,500 | 45% | 48% | 2.0% | 0.05% | 0.19% | 4.62% | 0.61% |
| **Montgomery** | 6,927,116,000 | 45% | 47% | 2.1% | 0.05% | 0.19% | 4.96% | 0.60% |
| **Philadelphia** | 5,663,157,500 | 45% | 47% | 2.2% | 0.05% | 0.20% | 5.12% | 0.60% |
| **Burlington** | 4,661,670,500 | 48% | 40% | 3.2% | 0.17% | 0.04% | 8.42% | 0.56% |
| **Camden** | 3,896,740,000 | 48% | 40% | 3.2% | 0.17% | 0.04% | 8.42% | 0.56% |
| **Gloucester** | 2,810,901,500 | 48% | 40% | 3.2% | 0.17% | 0.04% | 8.42% | 0.56% |
| **Mercer** | 3,501,773,500 | 48% | 40% | 3.2% | 0.17% | 0.04% | 8.42% | 0.56% |
| **Region** | 41,021,802,500 | | | | | | | |

LDGV = Light-duty gas vehicle, LDGT - Light-duty gas truck, HDGV - Heavy-duty gas vehicle, LDDV - Light-duty diesel vehicle, LDDT - Light-duty diesel truck, HDDV - Heavy-duty diesel vehicle, MC – Motorcycle

Source: DVRPC, 2009

$CH_4$ and $N_2O$ were estimated using the methodology employed in the EPA's State Inventory Tool and the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008). Because $CH_4$ and $N_2O$ emissions vary based on the age and emissions control technology of vehicles, the total estimated VMT in the DVRPC region was apportioned into VMT per model year based on the national distribution of VMT by vehicle age. Next, based on the known usage of various control technologies by model year, the annual VMT by model year were aggregated into VMT by control technology and multiplied by the control technology-specific emission factors to estimate the methane and nitrous oxide emissions. These emissions equate to approximately 3 percent of the $CO_2$ emissions from motor vehicles in the region, on a $CO_2E$ basis. More details on this method are available in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008).

Emissions from motor vehicles were also calculated for public buses in the region because these buses are not included in the DVRPC transportation model. Diesel consumption was collected from the National Transit Database (FTA, 2008) for the Southeastern Pennsylvania Transit Authority (SEPTA) and NJ Transit agencies. All of SEPTA's service was assumed to take place in the DVRPC region,[15] while NJ Transit provided the assumption that 18.6 percent of its bus service takes place in the DVRPC region. The total diesel consumption was then used to estimate emissions in the same manner as the direct fuel consumption calculations discussed above.

[15] That is, emissions from Regional Rail R2 operations that take place in the State of Delaware are included in totals.

### 2.2.2 Direct Emissions from Aviation

For this analysis, GHG emissions from aviation were estimated based on the region's share of total flight miles in and out of all U.S. airports. This approach includes emissions that occurred outside of the DVRPC region but directly result from air traffic in and out of the region's major airports. This methodology departs from the State GHG Inventory Guidance (EPA, 2007), which counts emissions based on location of aircraft fueling. The approach here seeks to estimate emissions from activities directly tied to the metropolitan area. Flight miles into and out of the Philadelphia International Airport (PHL) and Trenton Airport (TTN) were collected from a database provided by the US Bureau of Transportation Statistics, as were the total flight miles for all other airports in the United States (BTS, 2008).

The database provides the number of flights between each airport pair and the flight miles between those airports. The number of flights between each pair was multiplied by the route miles for each flight and summed for all domestic and international flights to determine the total route miles associated with United States airports in 2005. Next, only those flights either departing from or arriving at PHL or TTN were summed to estimate flight miles associated with the region. In this manner, it was estimated that 3.6 percent of all national flight miles originated from or ended in the region. Because those flights always involved the DVRPC region and another city (either the origin or destination of those flights), one-half of the emissions from these flights were assigned to the region. Emissions were thus estimated to be 1.8 percent of national emissions from aviation (EPA, 2008).[16]

[16] In accordance with IPCC guidelines, fuels used for international aviation are excluded from national emissions.

### 2.2.3 Direct and Indirect Emissions from Rail

These emissions result from the combustion of diesel fuel and indirect emissions associated with electricity consumption. Within the DVRPC region, there are several types of rail travel: local public transit, intercity passenger rail (Amtrak), and freight rail. For each of these sources, the emissions methodology is straightforward:

For $CO_2$: Fuel consumption × carbon content per unit of fuel × 44/12 (ratio of $CO_2$ to C)
For $N_2O$: Fuel consumption × $N_2O$ emission factor per unit of fuel
For $CH_4$: Fuel consumption × $CH_4$ emission factor per unit of fuel

First, energy consumption data were collected from the National Transit Database for local public transit agencies, including SEPTA, Port Authority Transit Corporation (PATCO), and NJ Transit (FTA, 2008). Public transit rail—including light rail, heavy rail, and commuter rail—in the region use both diesel fuel and electricity. For each of these three systems, consumption was multiplied by the appropriate emission factors. With SEPTA and PATCO, all of their operations were assumed to be within the DVRPC region (although one SEPTA line does run into Delaware), so consumption did not have to be adjusted. With NJ Transit, most of that agency's operations take place outside of the DVRPC region. They provided the following assumptions:

- 6 percent of commuter rail electricity use occurs in the region;
- 0.5 percent of commuter rail diesel use occurs in the region;
- Zero percent of light rail electricity use occurs in the region; and
- 100 percent of light rail diesel use occurs in the region.

The authors of the report attempted to obtain comprehensive data for Amtrak's routes in the region, but were not successful. Electricity sales in the electric railroad customer class were obtained from PECO, which allowed an estimation of Amtrak's consumption in the PECO service territory. SEPTA, PATCO, and NJ Transit electricity consumption were subtracted from the PECO electric railway total, and the remainder was assumed to be Amtrak's consumption. This approach likely underestimates Amtrak's consumption, and future efforts may allow for correction of this value.

Freight rail estimates were more difficult due to the fact that energy consumption in this sector is divided among a larger number of rail companies. An alternative method was developed that estimated DVRPC's share of national freight emissions based on the region's share of national rail freight rail flows. Freight flow data were obtained from the Freight Analysis Framework, which provides estimated tonnage of goods shipped by type of commodity and mode of transportation within 114 areas (FHWA, 2008). The 2002 data is based primarily on the Commodity Flow Survey and other components of the Economic Census.

From the total U.S. freight rail tonnage flows provided by the dataset, data pertaining specifically to the Philadelphia region were selected by sorting for flows either originating or ending in Philadelphia, then summed (Table 16). To avoid double counting flows attributed to the DVRPC region using this calculation, this Total Philadelphia figure was divided in half, resulting in a more accurate portion of freight rail flow, "DVRPC portion". The DVRPC portion of flow was then divided by the total U.S. flow to result in a DVRPC proportion of total U.S. freight flow. As data were not available for 2005, the 2002 proportion was used for this analysis. The 2005 GHG emissions from freight railroads as reported in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006* (EPA, 2008) were then multiplied by this proportion to estimate emissions from freight rail associated with the region. As with aviation, this methodology differs from state methods in that emissions that occur outside of the region are included here. Note also that this methodology looks only at tonnage, and does not take distance into account.

**Table 16. Summary of DVRPC-area and National Freight Rail Flows**

| | 2002 |
|---|---|
| Total U.S. ('000 tons) [a] | 1,804,570 |
| Total Philadelphia ('000 tons) [b] | 20,385 |
| DVRPC portion [c] | 10,193 |
| DVRPC % of total [d] | 0.56% |

a = Total U.S. freight rail flow (FHWA 2002)

b = Freight rail flow originating or ending in Philadelphia (FHWA 2002)

c = One-half of Total Philadelphia flow to avoid double counting

d = Percent of U.S. flow that is attributed to DVRPC region

Source: DVRPC, 2009

### 2.2.4 Direct Emissions from Marine Vessels

The emissions from marine vessels and associated activities in the DVRPC region were estimated using methods developed and data collected for an effort by the U.S. EPA to estimate air pollutant and GHG emissions from maritime transportation sources. While this work has not yet been published, it is to date the most comprehensive effort to estimate emissions from the nation's ports. For the DVRPC GHG inventory, the estimated emissions for the five ports in the DVRPC region—Philadelphia, Camden, Chester, Marcus Hook, and Paulsboro—were aggregated to estimate the region's total emissions in this sector. Included in this inventory are emissions from ocean going vessels, harbor craft, cargo handling equipment, and idling heavy trucks. The methods used for each of these sources are discussed below.

**Ocean Going Vessels**

Ocean going vessels (OGVs) with displacements of at least five liters per cylinder were considered in this category, while vessels with displacements of less than five liters per cylinder were included in the harbor craft inventory. Emissions for ships that stop in any port area, including private terminals, were included in the inventory. In addition to emissions directly within a port area, emissions of ships transiting to the port down rivers, bays and other waterways were also calculated along with cruises in the open ocean. Emissions per ship call and mode were determined using this equation:

$$E = P \times LF \times A \times EF$$

Where:

E = Emissions (grams [g])

P = Maximum Continuous Rating Power (kilowatts [kW])

LF = Load Factor (percent of vessel's total power)

A = Activity (hours [h])

EF = Emission Factor (grams per kilowatt-hour [g/kWh])

Emissions from ships were calculated using the mid-tier methodology described in the Best Practices and Current Methodology document (ICF Consulting, 2006). This method uses ship characteristics and calls at a given port to extrapolate the detailed typical port information.[17] In this methodology, U.S. Army Corps of Engineers (USACE) entrance and clearance data for 2004 together with ship characteristics data from Lloyd Register Fairplay was used to estimate the number of calls and ship characteristics at each port in 2005 (USACE, 2004; Lloyd Resister Fairplay, 2008). Entrances and clearances data were not available for 2005 at the time of this analysis so 2004 data were used. Because this estimate was activity-

[17] When available, local port data was used. Several ports provided recent inventories and these were used to develop inventories for those ports.

based and not based on fuel consumption, it is likely that some emissions from international bunker fuels are included here, despite the fact that they are excluded from the national GHG inventory.

**Harbor Craft**

Harbor craft (H/C) are a diverse group of vessel types that usually operate locally at a home port, although some types, such as tow boats and ferries, may travel between ports as part of their normal operation. None of the five ports in the DVRPC region are considered *principal ports*; they are considered as *like ports*. In a method similar to that used by the California Air Resources Board (CARB) in their H/C inventory (CARB, 2004), vessel counts by vessel type for each *like port* of interest were determined from the most recent version of the USCG's Merchant Vessels of the United States database (dated June 5, 2007). Annual H/C emissions at each typical port were determined as the product of the number of vessels of a given type operating in the harbor area, the load factor, the average annual activity, the average number of engines of each type per vessel, and the average rated horsepower.

**Cargo Handling Equipment**

Cargo handling equipment (CHE) at ports is specialized, commonly diesel-fueled, heavy-duty machinery responsible for loading and unloading vessels and transferring the cargo to or from either storage or other transportation modes that carry it to or from the port. While the array of CHE at ports is large, the amount of detailed information on CHE usage is small. Detailed emission inventories have been completed for only five ports nationwide; none of these ports are in the DVRPC region. In 2003, Philadelphia's port collected and prepared less detailed CHE information, which is included in this analysis. The methodology developed here is based largely on the EPA's NONROAD model. Annual CHE emissions at each typical port were then determined as the product of the number of pieces of equipment of a given type, the load factor, the adjusted annual activity, and the average rated horsepower.

**Heavy Duty Trucks**

While on-road truck emissions were calculated elsewhere in this analysis, emissions from the large amount of time trucks spend idling in the ports were included in this section. Truck emissions were calculated by multiplying emission factors by measures of truck activity (hours of operation or fuel use). Port truck activity was estimated based on waterborne cargo activity at each port, since these data were readily available for all port areas considered in this analysis. For the ports that had quantified truck emissions in their detailed emissions inventories, their estimates were used directly if their assumptions were comparable to the ones in this analysis. Because the truck emissions are considered as part of a national port inventory, average inputs were used for the five ports of interest to quantify maritime transportation-related truck emissions. The dataset covered the year of 2005. Idling emission factors (in grams per hour) were derived by multiplying 20 mph emission factors in grams per mile (in MOBILE6.2) by 20 to obtain idling emission factors in grams per hour (4,579 grams $CO_2$/hour).

### 2.2.5 Off-road Vehicles

Off-road $CO_2$ emissions for the DVRPC region were calculated using EPA's NONROAD2005 model (downloaded from www.epa.gov/otaq/nonrdmdl.htm). All datasets used to generate results were provided with the NONROAD model.  NONROAD provides estimates of various off-road equipment types by county, summed by equipment segment. The equipment segments represented in the model are agriculture, airport support equipment, commercial equipment, construction, industrial, lawn & garden, logging, other oil field equipment, other underground mining equipment, railway, recreational, and recreational marine. For the purposes of this analysis, commercial equipment, industrial equipment, and railway equipment were excluded. It was assumed that fuel consumption for these sectors was already included in the commercial, industrial, and freight/passenger rail sections.

The model was run using the same options that Pennsylvania Department of Environmental Protection's Bureau of Air Quality (BAQ) used to generate 2002, 2008, and 2009 off-road emissions of VOCs, $NO_x$, and CO:

Reid vapor pressure = 6.7 psi
Annual average temperatures of 49°F minimum, 66°F maximum, and 57°F average
Stage II vapor recovery = 100%
Percent oxygen = 0.0%

The full methodology used by BAQ can be viewed at: www.dep.state.pa.us/dep/deputate/airwaste/aq/plans/plans/philly/Technical_Appendices_TOC.pdf.

NONROAD's analysis is based on the model's default assumption of hours of operation for all equipment per year in the DVRPC region. The model output includes $CO_2$ emissions, in tons per year, for each type of equipment in each county. Regional emissions are summarized in Table 17 by category of off-road equipment.

**Table 17: Summary of Off-road Vehicle GHG Emissions—2005**

| Equipment Category | | Emissions $MMTCO_2E$ |
|---|---|---|
| Agriculture | | 0.0 |
| Airport Support Equipment | | 0.0 |
| Construction | | 0.7 |
| Lawn & Garden | | 0.5 |
| Logging | | 0.0 |
| Other Oil Field Equipment | | 0.0 |
| Recreational | | 0.0 |
| Recreational Marine | | 0.1 |
| **Total** | | **1.4** |
| % of region | | 1.4% |
| % for nation | | 2.2% |
| Per capita ($MTCO_2E$/person) | Region | 0.25 |
| | U.S. | 0.52 |

Source: DVRPC, 2009

## 2.3 Agricultural Sources (0.5%)

Emissions from the agricultural sector come from three sources: manure management, enteric fermentation, and agricultural soils.

### 2.3.1 Emissions from Manure Management

The management of manure results in $CH_4$ and $N_2O$ emissions. These emissions are driven by the number and type of livestock, as well as the manure management techniques used. The methodology used for estimating emissions from manure management was the same used to estimate emissions from manure management in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008). The formulas used in that methodology requires detailed animal population data.

County-level population data for dairy cattle, beef cattle, swine, poultry, sheep, and other animals at the county level was obtained from the United States Department of Agriculture's National Agricultural Statistics Service (USDA, 2008). The Agriculture Module of the State Inventory Tools was used to further disaggregate animal population data to the level required by the model (EPA, 2007). This methodology applies the state-level distribution of animal sub-types within each state to the county totals by broader animal type category for each county. Table 18 below provides an overview of these estimates for the DVRPC region. This population data was then used to calculate the $CH_4$ and $N_2O$ emissions from manure using the formulas laid out in the national GHG inventory (EPA 2008).

**Table 18: DVRPC Region Animal Population Data—2005**

| Animal | Number |
|---|---|
| Dairy Cattle | 25,000 |
| *Dairy Cows* | *16,811* |
| *Dairy Replacement Heifers* | *8,189* |
| Beef Cattle | 37,900 |
| *Beef Cows* | *12,340* |
| *Beef Replacement Heifers* | *3,299* |
| *Heifer Stockers* | *4,040* |
| *Steer Stockers* | *11,743* |
| *Feedlot Heifers* | *1,087* |
| *Feedlot Steer* | *3,534* |
| *Bulls* | *1,857* |
| Sheep | 8,065 |
| *Sheep On Feed* | *766* |
| *Sheep Not on Feed* | *7,299* |
| Goats | 551 |
| Swine | 25,797 |
| Horses | 17,945 |
| Poultry | |
| *Layers 20 weeks and older* | *565,783* |
| *Pullets* | *511,251* |
| *Broilers* | *114,279* |
| *Turkeys* | *36,575* |

Source: USDA, 2008; US EPA, 2008; DVRPC, 2009

### 2.3.2 Emissions from Enteric Fermentation

Enteric fermentation emissions are associated with dairy and beef cattle, swine, sheep, goats, and horses. For these animal types, GHG emissions from enteric fermentation consist of $CH_4$. Animal population data from Table 18 was used to calculate the $CH_4$ emissions from enteric fermentation using the formulas laid out in the national GHG inventory (EPA 2008).

### 2.3.3 Emissions from Agricultural Soils

Emissions from agricultural soils result from runoff from livestock manure, fertilizer use, and plant residues. In the national GHG inventory, emissions are estimated in a complex modeling process that includes a variety of county-level outputs, described in detail in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008). Model results for DVRPC counties were obtained in cooperation with the U.S. EPA and Colorado State University, and were incorporated in this inventory.

## 2.4 Waste Management (2.8%)

### 2.4.1 Solid Waste Management

Solid waste management can result in the emission of methane due to the anaerobic decomposition of the organic matter in waste that takes place in landfills. GHG emissions also result from the incineration of waste, but as discussed in Section 2.1.2, all waste incineration in the DVRPC region is used to produce electricity, thus those emissions are accounted for in electricity consumption. Therefore, only emission of landfill methane is discussed here.

Landfill methane emissions were estimated using the first order decay equation presented in EPA's AP-42 guidance (EPA, 1998) and implemented in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008) and EPA's State Inventory Tool (EPA, 2007). This equation is as follows:

$$Q_{Tx} = A \times k \times R_x \times L_o \times e^{-k(T - x)}$$

Where:

$Q_{Tx}$ = Amount of $CH_4$ generated in year T by the waste $R_x$,
T = Current year
x = Year of waste input,
A = Normalization factor, $(1-e^{-k})/k$
k = $CH_4$ generation rate ($yr^{-1}$)
$R_x$ = Amount of waste landfilled in year x
$L_o$ = $CH_4$ generation potential

This model functions by estimating annual landfill deposits for the time period 1960-2005. These were estimated based on population estimates provided by DVRPC and per capita waste generation factors provided by the U.S. EPA's *State Inventory Tool* (EPA, 2007). Because the per capita values for Pennsylvania did not include industrial waste, the estimated Pennsylvania total was increased by 7 percent to account for methane-generating industrial waste (*ibid.*). An estimated 16 percent of waste in New Jersey and 19 percent of waste in Pennsylvania was assumed to be incinerated (*ibid.*); therefore, the total waste generation was reduced by this amount, leaving the amount estimated to be landfilled each year. These waste generation estimates were then entered into the first-order decay model to estimate potential methane generation in the region.

Many of the region's landfills are equipped with landfill gas-management systems. The U.S. EPA's Landfill Methane Outreach Program database was used to determine emissions avoided in 2005 based on projects that were collecting landfill methane at that time in the DVRPC region. It was determined that 1.61 $MMTCO_2E$ of methane emissions were avoided through these gas-management systems, amounting to a reduction of about 42 percent of the region's potential landfill methane emissions (EPA, 2008c). This amount was subtracted from total potential methane generation to yield estimated methane emissions.

### 2.4.2 Municipal Wastewater Treatment

GHG emissions from wastewater treatment consist of $CH_4$ and $N_2O$, and are a direct result of treating municipal wastewater. $CH_4$ emissions arise from anaerobic treatment of organic matter. $N_2O$ emissions are associated with two distinct sources: emissions from centralized wastewater treatment processes themselves, and emissions from the effluent of centralized treatment systems that has been discharged into aquatic environments.

Estimates for both gases are carried out using methodologies from the *State Inventory Tool* and the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2007; EPA, 2008). These methodologies are based on population, the fraction of the population not on septic[18], and per capita emissions factors for each gas derived using formulas from the *State Inventory Tool* and the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. These formulas are based on estimates of per capita $BOD_5$[19], fraction of wastewater treated anaerobically, and annual protein consumption.[20] The resultant per capita emission factors are provided in Table 19. These are multiplied by population to arrive at annual emissions.

**Table 19: Per Capita Emission Factors for Wastewater Treatment—2005**

| Emission Category | Value (kg/year) |
|---|---|
| $CH_4$ | 67.26 |
| $N_2O$ associated with treatment | 1.12 |
| $N_2O$ associated with effluent | 58.37 |

DVRPC, 2009, based on EPA, 2007 and EPA, 2008

## 2.5 Industrial Processes (3.5%)

Over twenty industrial process (IP) sources are included in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. The methodology for most sources is relatively simple, and usually consists of multiplying an activity (e.g. production in tons) by the appropriate emissions factor. While national level activity data is readily available, activity data at the metropolitan geography and/or a suitable method for downscaling state or national data is very limited. For this inventory, DVRPC focused on the three industrial process sources that produce the most GHG emissions at a national level: substitution of ozone-depleting substances, iron and steel manufacturing, and cement manufacturing. Together, these three sources account for about 65 percent of national Industrial Process GHG emissions (EPA, 2008).

### 2.5.1 Ozone-Depleting Substances Substitutes

Several classes of ozone-depleting substances are being phased out under the terms of the *Montreal Protocol* and Clean Air Act Amendments of 1990 and replaced with substitutes that, while not harmful to the stratospheric ozone layer are potent GHGs (EPA, 2008). Ozone-depleting substance substitutes (ODS substitutes) are widely used chemicals present in refrigerators, air conditioners, fire extinguishers, foams, aerosols, and other products. Because their use is widespread and the methods and data needed to estimate emissions from this sector on the national level are complex, emissions in the region were estimated by multiplying the national per capita emissions (0.36 $MTCO_2E$) times the regional population. This methodology was provided by the *State Inventory Tool* (EPA, 2007).

### 2.5.2 Iron & Steel Manufacturing and Cement Manufacturing

For these two sources, local production volumes were not available. Emissions were estimated by apportioning national emissions based on the ratio of the number of regional firms in these sectors to the national number of firms in these sectors. Economic data were provided by the U.S. Census Bureau's *County Business Patterns* database (Census, 2008). National emissions were provided by the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008).

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[18] The Philadelphia Water Department provided estimates of the fraction of population not on septic as follows: Philadelphia = 100 percent; remainder of region = 90 percent.

[19] BOD represents the amount of oxygen that would be required to completely consume the organic matter contained in the wastewater through aerobic decomposition processes. A standardized measurement of BOD is the "5-day test" denoted as $BOD_5$.

[20] Data on annual per capita protein consumption for the United States have been published by the United States Department of Agriculture Food and Agriculture Organization (USDA, 2007).

## 2.6 Fugitive Emissions from Fuel Systems (0.9%)

### 2.6.1 Natural Gas Systems

$CH_4$ is emitted from the production, transmission, and distribution of natural gas. Because natural gas is not produced in the region, emissions for the DVRPC region were instead estimated based on the national emissions from transmission and distribution activities divided by national natural gas sales. The national average fugitive emissions rate was estimated by dividing national emissions from transmissions and distribution (EPA, 2008) by national consumption in 2005 (EIA, 2008b), for an implied emission factor of 2.99 $MTCO_2E$ per million cubic feet of natural gas consumed. This implied emission factor was then multiplied by regional consumption in 2005. This is conceptually parallel to the electricity transmission loss factor discussed in Section 2.1.2 above.

### 2.6.2 Petroleum Systems

Methane is emitted from the production, refining, and transportation of petroleum products. As with natural gas systems, the sector is very difficult to accurately estimate, particularly at the local level. Of the main petroleum system activities, only refining is likely to result in emissions in the DVRPC region. Emissions for the region were estimated by apportioning national emissions based on the ratio of regional petroleum refining capacity to national petroleum refining capacity. Regional capacity in 2005 was estimated at one million barrels per day, based on the capacity of five refineries in the region listed in the EIA's *Refining Capacity Report 2005* (EIA, 2005), versus national capacity in 2005 of 17.1 million barrels per day (EIA, 2008c). It was then assumed that regional emissions from petroleum refining were approximately 5.8 percent of national emissions of 0.6 $MMTCO_2E$ (EPA, 2008).[21]

## 2.7 Land Use, Land Use Change, and Forestry

The source category termed "land use, land-use change, and forestry" (LULUCF) by the United Nations' Intergovernmental Panel on Climate Change (IPCC) contains emissions and removals of $CO_2$ from forest management, other land-use activities, and land-use change. These emissions and removals of $CO_2$ are due to the loss or gain in the amount of carbon stored in trees and other plants in forests, parks, streets, and private property. When the total amount of plant material increases, carbon is stored or sequestered. When the total amount of plant material decreases, carbon is released or emitted.

Perhaps counterintuitively, this means that the greatest LULUCF emissions may come from those areas of the region that have historically been most heavily forested, because in these areas preparing forested land for development results in greater loss of trees—and hence greater emissions—than preparing agricultural or abandoned industrial land for development.

Emissions from this sector are calculated by estimating the change in forest carbon and the change in carbon stored in urban trees. These are summarized below.

### 2.7.1 Forest Carbon

Estimating the net change in forest carbon is a difficult process. For this analysis, DVRPC applies a method similar to that applied in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (EPA, 2008). For the national estimate, the US Forest Service uses the Carbon Calculation Tool and the Forest Inventory Analysis database (FIA). The FIA provides an inventory of all U.S. forest acreage by species. The inventory is compiled largely from state studies that are conducted at various intervals. By interpolating the values in between, a time series of forest acreage is constructed. The Carbon Calculation

[21] Conversations with regional petroleum industry professionals suggest that the total emissions from refineries in the region may be higher than this methodology estimates. DVRPC will refine the methodology used here in any future inventory work.

Tool then applies carbon stock factors (tons of carbon/acre), which are region- and species-specific, to this acreage time series. This results in a stored carbon estimate for each year. The change in these stocks is the net carbon emission or sequestration, depending on whether stocks decrease or increase.

Developing the estimate of forest carbon for DVRPC required three elements: carbon stock factors, the forest acreage, and the change in acreage. Carbon stock factors were obtained from the Carbon OnLine Estimator (COLE), provided by the National Council for Air and Stream Improvement (NCASI, 2008). COLE provides values for different forest types (i.e. species mixes), and, for each, breaks down the carbon factor by above ground live tree, down dead wood, soil, etc. The factors COLE provides are specific to the county level, so data for the nine counties were collected.

Forest acreage was obtained from the FIA Database (USDA Forest Service, 2008). A query for the nine counties was run using the "Area by Forest Type" report – this provides acreage by forest type (species mix). The data is drawn from New Jersey's study conducted from 2004 to 2006 and Pennsylvania's study that was conducted from 2001 to 2005. Forest land in the FIA is defined as land that is at least 10 percent stocked by forest trees; the minimum area for classification is 0.5 hectares. The stock factors were applied to the acreage (although some forest types had to be matched to a similar, not exact, stock factor), and a total carbon stock for the area was estimated for 2005.

DVRPC then provided detailed land use estimates for 2000 and 2005. The 2000 acreage of wooded land was subtracted from the 2005 acreage of wooded land and divided by five to estimate annual change of acreage. Although the county carbon stocks are based on the areas of different forest types in each county, it was assumed that any change in wooded land area by county affected all forest types in each county uniformly. A summary of the forest carbon stocks, average storage factors, and annual changes between 2000 and 2005 are presented in Table 20 below. Note that a hectare (ha) is equal to 2.471 acres. Philadelphia is discussed in Section 2.7.2, below.

**Table 20. Forest Carbon Sequestration Estimates—2005**

| County | 2005 Forest Carbon Stocks (MT) | Forest Acres | Average Carbon Storage Factor (MT C/ha) | Annual Change in Acreage and Carbon Stock | | Net Sequestration (MT) |
|---|---|---|---|---|---|---|
| | | | | Percent Change | Change in C Stock (MT) | |
| Burlington | 28,869,938 | 273,683 | 260.7 | -0.24% | -67,963 | -249,198 |
| Camden | 2,196,777 | 18,725 | 289.9 | -0.54% | -11,768 | -43,151 |
| Gloucester | 4,945,429 | 46,342 | 263.7 | -0.76% | -37,357 | -136,976 |
| Mercer | 3,825,205 | 39,581 | 238.8 | -0.63% | -24,191 | -88,699 |
| Bucks | 10,700,114 | 93,276 | 283.5 | -0.43% | -46,418 | -170,198 |
| Chester | 10,388,879 | 93,603 | 274.3 | -0.69% | -72,088 | -264,322 |
| Delaware | 1,260,236 | 11,889 | 261.9 | -1.31% | -16,560 | -60,718 |
| Montgomery | 2,475,485 | 24,871 | 246.0 | -0.21% | -5,299 | -19,429 |
| **Total or Avg.** | 64,662,063 | 601,970 | 265.4 | | -281,643 | **-1,032,690** |

Source: NCASI, 2008; USDA Forest Service, 2008; DVRPC, 2009

### 2.7.2 Urban Trees

In the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, the change in carbon stored in urban trees is estimated based on the results of studies of 14 urban forests by the U.S. Forest Service. The average net sequestration rate (kg C per sq. m of tree canopy) is calculated using these 14 urban forests. The City of Philadelphia was one of the cities studied, thus values for sequestration by Philadelphia's urban forest were obtained directly from *Inventory of U.S. Greenhouse Gas Emissions and Sinks (*EPA, 2008).

The urbanized area in the DVRPC region outside of Philadelphia required some additional analysis. The basic method requires multiplying the urban area first by the average tree cover, and then by the carbon sequestration rate per area of tree cover. The urbanized area of Greater Philadelphia was provided by the U.S. Census Bureau (Census Bureau, 2002a). This value included only the areas of the metropolitan region in New Jersey and Pennsylvania, and excluded the urbanized area that extends into Delaware. For the parts in New Jersey and Pennsylvania, all of the area lies inside the DVRPC area (Census Bureau, 2002b). The area of the city of Philadelphia lies entirely inside this urbanized area, and had already been analyzed for urban forestry, so it was subtracted from the urbanized area. This provided a value for the urbanized area in the eight DVRPC counties outside of the city of Philadelphia. This value was then multiplied by the national urban tree coverage estimate, 27.1 percent, to determine tree coverage area (EPA, 2008).

This urban tree coverage was multiplied by the national urban tree sequestration factor to get an annual sequestration estimate (MT C/year). This and the values for the city of Philadelphia were summed to obtain an urban tree sequestration for the DVRPC area, as shown in Table 21.

**Table 21. Urban Trees Sequestration Estimates—2005**

| Geography | Urbanized Area (ha) | Tree Cover Area (ha) | Annual Carbon Storage Factor (MT C/ha) | Annual Net Sequestration (MT C) | Annual Net $CO_2$ Sequestration (MT $CO_2$) |
|---|---|---|---|---|---|
| Philadelphia | 33,967 | 5,333 | 1.97 | 10,530 | 38,609 |
| Remainder of Region | 381,252 | 103,319 | 2.23 | 230,191 | 844,032 |
| **Total or Avg.** | **415,219** | **108,652** | | **240,720** | **882,641** |

Source: EPA, 2008; Census Bureau, 2002b; DVRPC, 2009

### 2.7.1 Net Land Use, Land Use Change, and Forestry (LULUCF) Emissions

Net emissions $CO_2$ emissions associated with LULUCF in the DVRPC region are the sum of forest carbon (emissions of 1,032,690 MT) and urban carbon (sequestration of 882,641 MT), or net emissions of 150,049 MT.

# 3 Allocation of the 2005 Inventory

To provide the DVRPC's member communities with assistance in their GHG planning activities, the 2005 GHG inventory was allocated both to the region's nine counties and to the region's 352 municipalities, referred to here as using the census term "Minor Civil Divisions", or MCDs. These MCDs include the region's cities, townships, and boroughs. Because of the large number of MCDs, it was necessary that the methods used be simple and replicable on a large scale, since completing 352 individual inventory efforts was beyond the scope of this effort. Because of this, it is important that municipalities and counties using the allocated inventory values understand where they came from, what their limitations are, and where efforts to improve them at the local level might best be directed.

Despite these limitations, this effort provides MCDs with an excellent starting point, and for some emissions categories provides information that DVRPC believes is as good as is feasible to acquire for municipal efforts to inventory community-wide emissions. DVRPC encourages municipalities and counties to use this inventory to support their inventory efforts, as well as to support analysis of where investments in energy conservation and efficiency might be most productively made. DVRPC has additional detailed information that is not presented in this report that it will share with municipalities and counties upon request.

This section first presents an overview of the allocation results, and then discusses the methods used to produce the allocation. The county- and municipality-level results of this allocation are presented in Appendix A: 2005 Allocated Inventory.

## 3.1 Overview of Allocation Results

Figure 6 shows how the municipalities in the region differ from each other in density of population and employment. Figure 7 and Figure 8 illustrate the results of the municipality level greenhouse gas emissions allocation and their relationship to density in two different views.[22]

Figure 7 shows greenhouse gas emissions per acre by municipality for the DVRPC region.[23] As might be expected, the denser areas of the region produce more of the emissions, as these are the areas where people live and where businesses are located.

Figure 8 shows the allocated greenhouse gas emissions at the municipality level normalized by the sum of population and employment, which together serve to indicate the level of human activity. This view indicates a clear correlation between municipalities with higher density of population and employment, and lower per capita greenhouse emissions. In general, these municipalities have amenities closer together than municipalities with less dense population and employment. This allows shorter trips, and the ability to walk for some trips that might require driving in less dense municipalities. In addition, these municipalities may provide sufficient density to make mass transit feasible for some residents and employees. In addition, residential and commercial buildings may be smaller per capita or employee, and may be directly connected to adjacent housing or businesses (e.g., rowhouses or businesses with apartments above them), providing the energy efficiency benefits of shared walls. Further analysis of the data would be required to develop a better understanding of these relationships.

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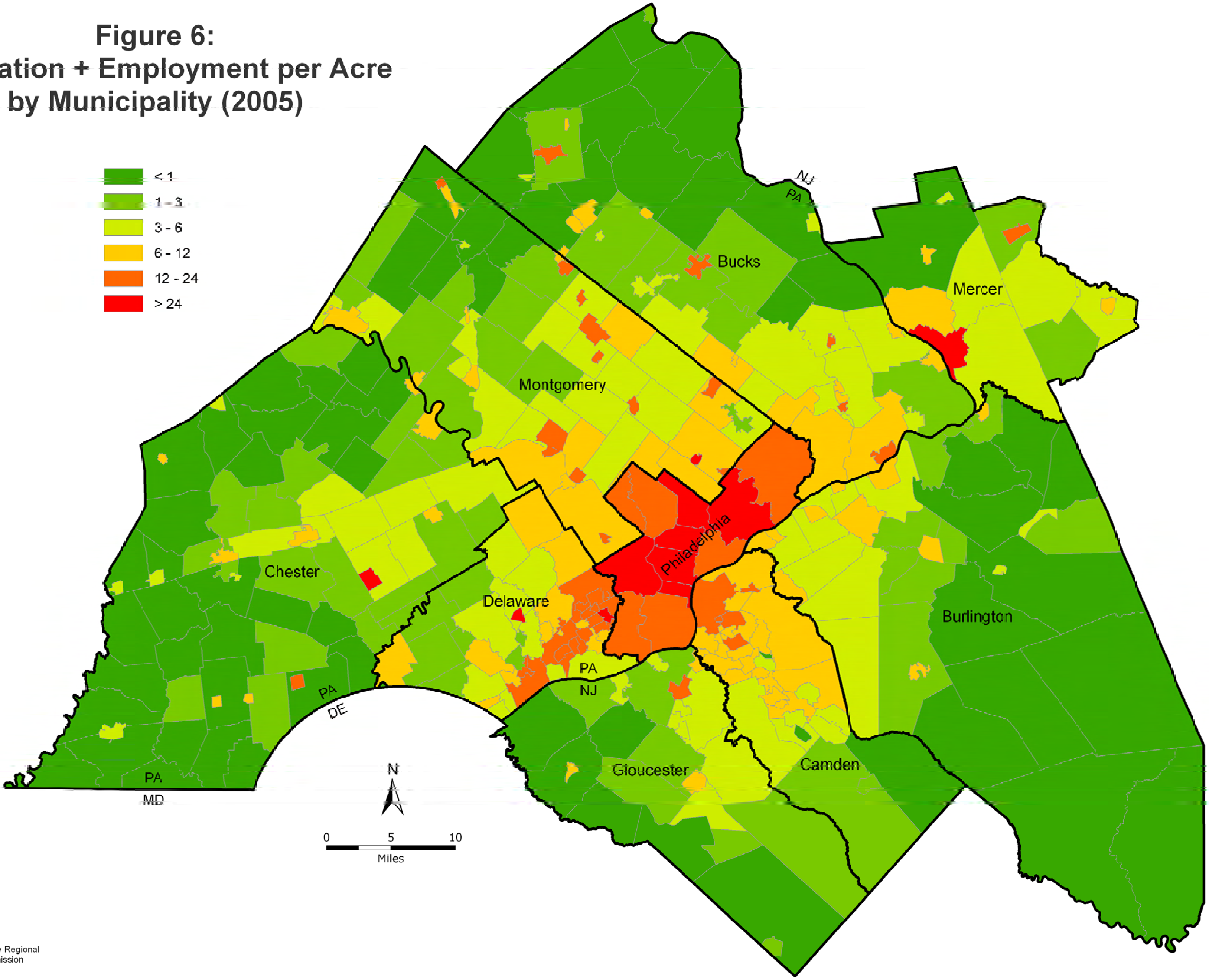
[22] Emissions associated with industrial natural gas and electricity energy consumption are not included in this analysis, as these emissions are not available for all municipalities.

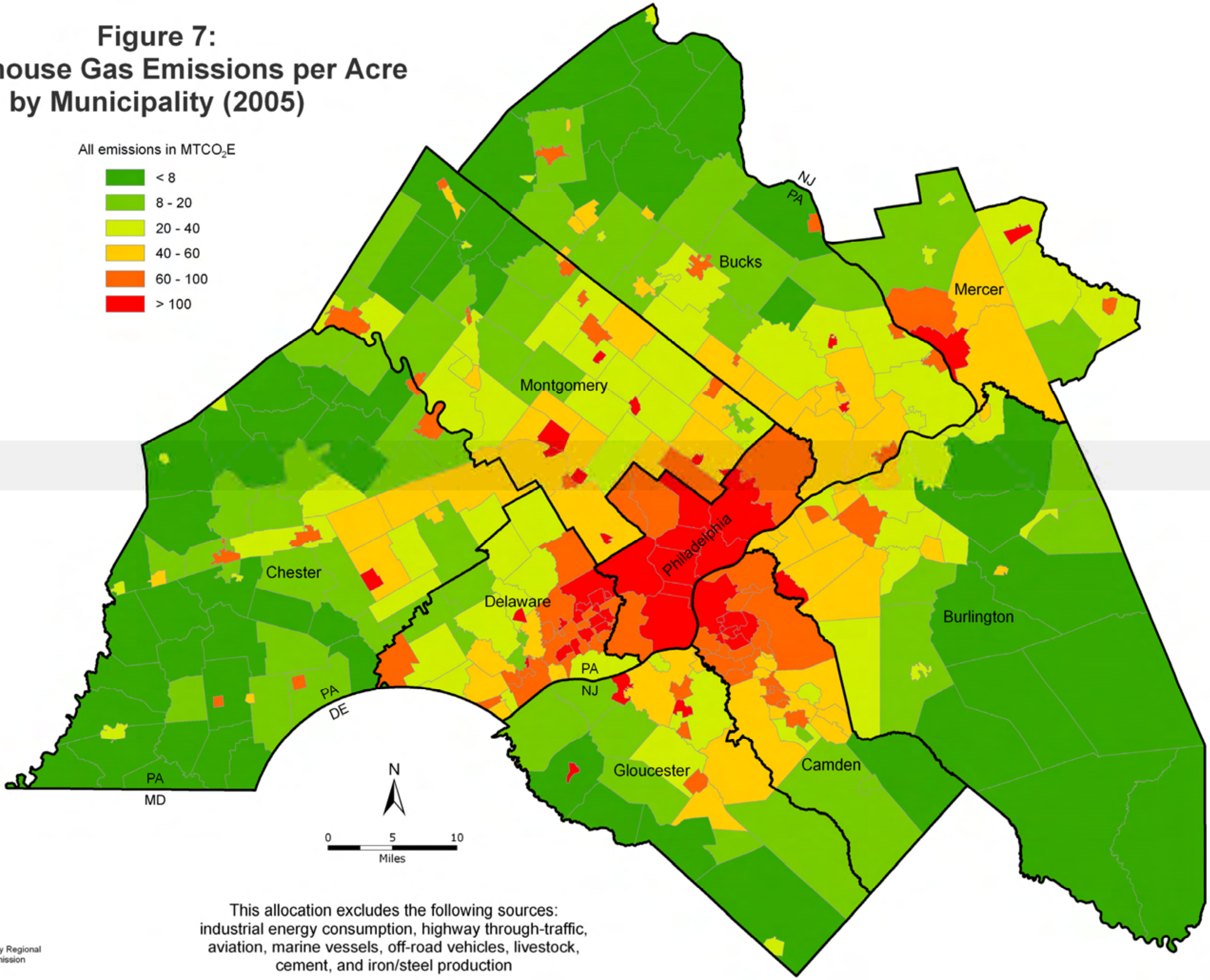
[23] For these maps, the City of Philadelphia is subdivided into its twelve planning areas, with emissions calculated for each based on population and employment.

# Figure 6: Population + Employment per Acre by Municipality (2005)




Delaware Valley Regional Planning Commission
March 2009

# Figure 7: Greenhouse Gas Emissions per Acre by Municipality (2005)




This allocation excludes the following sources: industrial energy consumption, highway through-traffic, aviation, marine vessels, off-road vehicles, livestock, cement, and iron/steel production

Delaware Valley Regional Planning Commission
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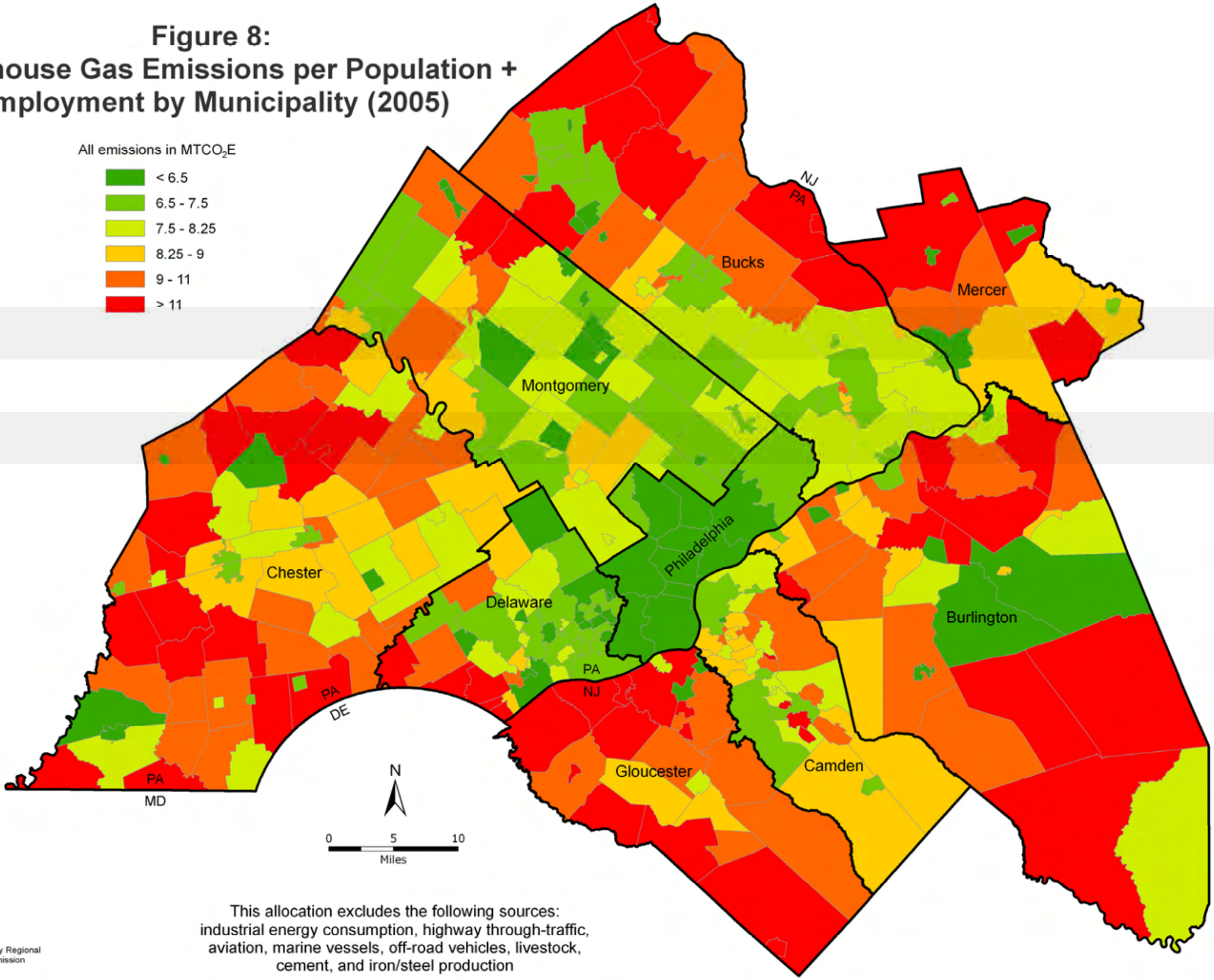
# Figure 8: Greenhouse Gas Emissions per Population + Employment by Municipality (2005)




This allocation excludes the following sources: industrial energy consumption, highway through-traffic, aviation, marine vessels, off-road vehicles, livestock, cement, and iron/steel production

### 3.2 Sources Included and Omitted

Due to data availability and the nature of some emission source categories, it was not possible to allocate all emissions included in the 2005 GHG inventory to the County or MCD level. In some cases, suitable data were not available. For example, emissions from industrial energy due to non-utility fuel consumption were not able to be allocated to the MCD level because no local level information exists. The quantity and type of fuels used vary widely between different industrial sectors and facilities. Industrial energy consumption other than utility gas and electricity was estimated for the region as a whole based on proxy data, as discussed in Section 2.1.4. Those fuels that used actual residential fuel usage patterns as a factor in estimating consumption were allocated to the county level, but not to the MCD level (coal, distillate, kerosene, and LPG).

In other cases, assigning emissions to MCDs may not make sense. For example, the region's marine ports and airports are both major sources of emissions, yet they are concentrated in a few specific geographic areas. It is not clear how to allocate emissions from these activities fairly. Allocating them to the areas in which they occur would ignore the fact that the entire region depends on economic activity and services associated with marine ports and airports. At the same time, it is equally unclear how these emissions could be allocated fairly throughout the region. These issues are in active discussion in national inventory dialogue and research. Based on these considerations, the emission sources that were included and excluded from the allocation process are provided in Table 22 below. For context, each source is presented beside estimated emissions. As the table indicates, 90 percent of the region's gross emissions were allocated to the region's counties, and 84 percent to the region's MCDs. Note that emissions associated with industrial natural gas and electricity consumption are allocated only to some municipalities as discussed below. The remainder of this section provides details on the allocation methodologies.

The portion of Table 22 labeled "confidence in allocation" is a general guide to how accurate the allocation is for each of the emissions sources. This information should be useful to municipal level efforts that might wish to enhance the accuracy of their inventories. For example, as described above in Section 2.4.1, landfill methane is estimated based on statewide per capita waste generation estimates for PA and NJ, as well as regional averages for methane recovery from landfills. If a municipality had current and historic municipal level waste generation data and information on the landfills and other disposal methods used for that waste, it could use that information to arrive at information that would be more accurate for that municipality. Note, however, that any such efforts should be guided not only by a desire for greater accuracy, but also by the relative magnitude of the emissions source. As Table 22 indicates, DVRPC believes that over 90 percent of the allocated emissions are allocated using the same methodology as would be used to carry out an inventory for a single municipality.

## Table 22. Overview of Inventory Allocation

| Emissions Source Category | 2005 Emissions ($MMTCO_2E$) | Allocated | | Confidence in Allocation | | |
|---|---|---|---|---|---|---|
| | | County | MCD | Good | Better | Best |
| **Stationary Energy— Residential** | | | | | | |
| *Fuel Type* | | | | | | |
| Natural Gas | 6.65 | x | x | | | x |
| Coal | 0.0033 | x | x | | | x |
| Distillate Fuel Oil | 2.33 | x | x | | | x |
| Kerosene | 0.16 | x | x | | | x |
| LPG | 0.23 | x | x | | | x |
| Purchased Electricity | 12.49 | x | x | | | x |
| **Stationary Energy— Commercial** | | | | | | |
| *Fuel Type* | | | | | | |
| Natural Gas | 5.61 | x | x | | | x |
| Coal | 0.04 | x | x | | x | |
| Distillate | 0.87 | x | x | | x | |
| Kerosene | 0.07 | x | x | | x | |
| LPG | 0.05 | x | x | | x | |
| Residual Fuel | 0.11 | x | x | x | | |
| Motor Gasoline | 0.01 | x | x | x | | |
| Purchased Electricity | 9.84 | x | x | | | x |
| **Stationary Energy— Industrial** | | | | | | |
| *Fuel Type* | | | | | | |
| Natural Gas | 1.97 | x | some MCDs | | | x |
| Coal | 0.20 | x | | x | | |
| Distillate | 0.87 | x | | x | | |
| Kerosene | 0.11 | x | | x | | |
| LPG | 0.12 | x | | x | | |
| Residual Fuel | 0.35 | | | | | |
| Petroleum Coke | 1.53 | | | | | |
| Other Fuels | 0.98 | | | | | |
| Purchased Electricity | 11.45 | x | some MCDs | | | x |
| **Mobile Energy** | | | | | | |
| Highway (ex. thru & airport traffic) | 20.00 | x | x | | | x |
| Public transit (buses and rail) | 0.34 | x | x | | | x |
| Highway through & airport traffic | 1.74 | | | | | |
| Freight Rail | 0.28 | | | | | |
| Intercity Rail (electric) | 0.20 | | | | | |
| Aviation | 2.82 | | | | | |
| Marine & Port-Related | 0.38 | | | | | |
| Off-Road Vehicles | 1.37 | x | | x | | |
| **Agriculture** | | | | | | |
| Manure Management | 0.04 | x | | | x | |
| Enteric Fermentation | 0.17 | x | | | x | |
| Agricultural Soils | 0.24 | x | x | | | x |
| **Waste Management** | | | | | | |
| Landfill Methane | 1.88 | x | x | | x | |
| Wastewater | 0.69 | x | x | | x | |
| **Industrial Processes** | | | | | | |
| Cement Manufacture | 0.39 | | | | | |
| Iron & Steel Production | 0.88 | | | | | |
| ODS Substitutes | 1.97 | x | x | | | x |
| **Fugitive Emissions** | | | | | | |
| Natural Gas Systems | 0.78 | x | x | | | x |
| Petroleum Systems | 0.04 | | | | | |
| **Land Use, Land Use Change, and Forestry** | | | | | | |
| LULUCF Net | 0.15 | x | x | | | x |
| **Total ($MMTCO_2E$)** | **90.4** | **81.2** | **75.9** | **2.8** | **3.8** | **74.6** |
| | **100%** | **90%** | **84%** | **3%** | **5%** | **92%** |

Source: DVRPC, 2009

## 3.3 Allocation Methodology

### 3.3.1 Stationary Energy Consumption—Residential

Residential energy consumption data were allocated in different ways, depending on the fuel type and data source. For electricity and natural gas consumption data that were already available by MCD, no further allocation was needed. About 60 percent of the natural gas consumption and 70 percent of the electricity consumption was provided by electricity and natural gas companies at the MCD level, with the remainder provided at the ZIP code level. For data provided at the ZIP code level, a GIS analysis was performed to map the ZIP code-based data to MCDs, since many of the ZIP code areas covered parts of multiple MCDs.

First, population per MCD per ZIP code was estimated using a proportional overlay technique using GIS data provided by DVRPC. ZIP code areas were compared to the MCD boundaries and Census 2000 tract areas to show where they intersect. The intersecting areas were divided by the tract areas and the results were expressed as ratios. The population count per Tract was multiplied by these ratios to determine the estimated population for each of the intersected areas, and then the intersecting areas were aggregated by ZIP code. The population results were summed to arrive at the population estimate per MCD per ZIP Code. These populations were then used to allocate electricity and natural gas consumption to MCDs. For example, if ZIP Code 55555 had reported electricity sales of 1,000,000 kWh and it was estimated that 30 percent of the population of the ZIP Code area fell under MCD A, 25 percent were in MCD B, and 45 percent were in MCD C, then it would be assumed that of that ZIP Code's consumption, 300,000 kWh (30 percent) would be allocated to MCD A, 250,000 kWh (25 percent) to MCD B, and 450,000 kWh (45 percent) to MCD C. If any of those MCDs fell entirely within the ZIP Code area, then those MCDs would be complete. If other ZIP codes covered other parts of an MCD, then this process was repeated for all other ZIP codes. This method assumes that the population is uniformly distributed within each Census tract, and that all consumers in a given ZIP code consume equally.

Emissions from other fuels—fuel oil, coal, LPG, and kerosene—were allocated based on MCD level household heating fuel use data obtained from the 2000 Census (SF-3, Table H40). Regional fuel consumption was apportioned to the MCDs by dividing the number of households using a given fuel within an MCD by the total number of households in the region using that fuel (New Jersey and Pennsylvania were calculated separately).

### 3.3.2 Stationary Energy Consumption – Commercial

Emissions from commercial energy consumption in stationary sources were calculated in a similar manner as the residential sector. Electricity and natural gas consumption data by MCD were used where available. The remaining electricity and natural gas data were allocated from ZIP codes to MCDs in the same method discussed above. This method assumes that commercial energy use within a given ZIP code is distributed to the various MCDs within that ZIP code in a manner corresponding to the distribution of population to the various MCDs.

For those commercial fuels that are also used in the residential sector (coal, distillate fuel oil, kerosene, and LPG), the allocation is based on the use of those fuels by municipality at the household level, similar to the methodology described above in Section 2.1.3. A municipal level adjustment factor is applied in the calculations to account for the fact that municipal-level household and employment distributions differ from each other. This methodology assumed that both the commercial and industrial sectors would use these fuels at the same rate as the residential sector in each county. While this may not be fully accurate, it appears a more reasonable allocation method for these fuels than employment.

The remaining commercial fuels (residual fuels and motor gasoline) were allocated based on employment counts. This method assumes that consumption of these fuels correlates with employment. In the absence of locally available data, DVRPC believes this is the best proxy to use to allocate these emissions to the MCD level.

### 3.3.3 Stationary Energy Consumption – Industrial

Because of the uncertainties regarding the location of commercial energy use, the allocation of industrial energy to the county or MCD level is limited to emissions associated with industrial use of utility natural gas or electricity for those MCDs for which all natural gas or electricity is reported at the MCD level. Thus, those MCDs for which the use of either natural gas or electricity is reported entirely or in part by ZIP code are excluded from the allocation of these emissions sources. Even with this exclusion, 74 percent of the emissions associated with industrial natural gas and 84 percent of the emissions associated with industrial electricity are allocated to the MCD level.

### 3.3.4 Mobile Emissions – Highway (excluding through traffic and airport traffic)

To estimate GHG emissions from on-road mobile sources, DVRPC developed the following methodology to estimate VMT on a municipal level. This methodology was developed as a balance between the desire for accuracy and the need to accomplish these calculations using existing data and modeling resources.

The methodology begins with an estimate of total regional VMT. This estimate is provided by the Highway Performance Monitoring System (HPMS), a federal program that monitors travel throughout the country. The HPMS program takes counts on highway facilities throughout the DVRPC region on a three year cycle. The regional VMT is estimated by the HPMS based on these counts. For 2005, the HPMS estimated total daily VMT in the DVRPC region to be 112.3 million.

The HPMS total includes through trips (trips that pass through the region but do not stop in the region). Using DVRPC's travel demand model, daily total through trip VMT were estimated as 6.4 million. As these cannot be allocated to an origin or destination within the region, they were subtracted from total VMT, resulting in total daily non-through trip VMT of 105.9 million (allocation of emissions associated with through trips is discussed below).[24]

VMT was apportioned to municipalities based on the number of trips made to and from each municipality and by the distance of those trips. A vehicle trip table from DVRPC's 2005 regional simulation was obtained; this gave the number of trips occurring between each Travel Analysis Zone (TAZ) in the region. This trip table consisted of auto, light truck, heavy truck, and taxi trips. It did not include transit bus trips or trips made by non-motorized modes. Through trips were then removed from the trip table. Different trip tables were obtained for each time period used in the DVRPC model—peak, midday, and evening.

A TAZ to TAZ distance table (skim matrix) was also obtained for the 2005 simulation for each time period. The distance between each TAZ pair was determined from the shortest path through the congested network as determined in the final iteration of highway assignment. A correction was required for external-internal trips (those trips that have one end inside of the region and one end outside of the region). The distance table only contains the portion of the trip from the internal TAZ to the regional cordon line or boundary. Using this distance directly will significantly underestimate the VMT due to these trips, especially for trips originating near the regional boundary, where a significant portion of the trip can occur outside of the region. A correction was applied which assigns a distance to external-internal trips for a particular TAZ to be at least equal to the average internal-internal trip (that is, trips that have both origin and destination within the DVRPC region) for the same TAZ.

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[24] The transportation modeling community carries out analysis in terms of the daily travel averaged over the entire year. Daily VMT for 2005 is converted to annual VMT by multiplying by 365.

A second correction was required for intra-zonal trips (trips that begin and end in the same TAZ). The distance table does not have a value for these trips as they are not assigned to the network in the regional simulation. Using a standard transportation modeling approach, these intrazonal trips are assigned a distance equal to half the distance to the nearest neighboring TAZ.

Once these corrections were made, a preliminary VMT estimate was made for each TAZ pair by multiplying the trip table by the distance table for each time period (peak, midday, and evening). When aggregated, the total VMT estimate for the region was about 2.5 percent higher than the total from the HPMS data. Because this method assumes that the HPMS data is more accurate, preliminary VMT estimates for each TAZ are multiplied by a correction factor to realign them with the HPMS total. In this way the HPMS VMT minus the through-trip VMT acted as a control total for this study. For each TAZ pair, half the VMT was allocated to the origin and half to the destination. For example, for a trip from home to work, half of the VMT is allocated to the work location and half to the home location.

The $CO_2$ emissions for each TAZ were calculated by multiplying the VMT by the composite emissions factor of 506.2 g/mile. This composite emissions factor comes from EPA's MOBILE 6.2 post-processer, and assumes the same region-specific vehicle type mix as used for air quality conformity analysis for the 2005 simulation year.[25] The $CO_2$ emissions per TAZ were rolled up into municipality totals using a correspondence table that matched TAZs with municipalities.[26] For the City of Philadelphia, the data was broken down into 12 county planning areas (CPAs). Non-$CO_2$ emissions were then estimated based on the average $N_2O$ and $CH_4$ emissions rates per VMT in the region.

The data and methodology raise two additional caveats worth mentioning:

- Trips made by travelers to the airport are assumed by modeling convention to be leaving the region. Thus, one half of the VMT from the traveler trips to the airport are not allocated to any particular MCD, with the MCD of origin being allocated the other half (the entire trip is included in the regional inventory). The VMT from trips made by employees that work at the airport are allocated as with all other TAZs.
- As noted, this methodology does not allocate VMT or emissions associated with through trips.

### 3.3.5 Mobile Emissions – Transit (Public Buses and Trains)

To allocate emissions from public transit, the region's total emissions were apportioned to MCDs based on the count of workers who made the journey to work by public transit according to the 2000 U.S. Census (SF-3, Table P30). These estimates were collected for each MCD, and each MCD's share of total emissions was assumed to be equal to its count of workers who commute via public transit divided by the total number in the region. This allocation is based on two assumptions: that commuting patterns are a good proxy for total ridership and that all riders utilize the system equally. Regarding the former assumption, commuting accounts for only a portion of total trips, yet this portion is likely to vary by municipality: suburban residents who commute via commuter rail and center city residents who commute via subway both use public transit to commute, but it is less likely that the suburban resident would also use transit for non-commuting trips, as opposed to center city residents. Regarding the second assumption, the commuting trips from the suburbs into Philadelphia may typically be longer and thus more fuel-intensive than trips that originate in the downtown area.

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[25] DVRPC recognizes that applying a uniform emissions factor across all TAZs assumes that the vehicle mix, vehicle speed, and other factors that affect $CO_2$ emissions per mile traveled are the same for all TAZs. In any future inventory work, DVRPC will consider applying refinements to this model to take into account—at least partially—the differences in such factors in the region's TAZs. For instance, vehicle mix and vehicle speed by TAZ and time period is known.

[26] An MCD will contain one or more TAZ, depending on the MCD's size. TAZ boundaries do not cross MCD boundaries.

### 3.3.6 Mobile Emissions—Off-Road Vehicles

As noted in Section 2.2.5 above, emissions from off-road vehicles were estimated at the county level. There was not sufficient information to allocate these emissions to the MCD level.

### 3.3.7 Agriculture—Manure Management and Enteric Fermentation

As noted in Sections 2.3.1and 2.3.2 above, emissions from manure management and enteric fermentation were estimated at the county level. There was not sufficient information to allocate these emissions to the MCD level.

### 3.3.8 Agricultural Soil Emissions

Emissions from agricultural soils were allocated to municipalities based on the amount of agricultural land reported in each community. Detailed land use data for each MCD was provided by DVRPC, and each MCD's emissions from agricultural soils was estimated to be the emissions of its county times the acres of agricultural land in a given MCD divided by the acres of agricultural land in that county. This method accounts for the different agricultural practices and soil types in each county, but assumes that these factors are the same for all MCDs within a given county.

### 3.3.9 Landfill Methane Emissions

As discussed in Section 2.4.1, landfill methane emissions were estimated on a per capita basis, thereby making it straightforward to allocate emissions to communities in the region. The only major distinctions between communities in that methodology were the different per capita waste generation and landfilling rates in New Jersey and Pennsylvania. The emissions for the two states were estimated separately, and then allocated to their respective communities. This method does not account for local differences in waste generation and landfill methane capture technologies. Individual communities may be able to improve their estimates, if they have locally-specific information about waste generation rates and the presence and effectiveness of methane collection systems at the landfill(s) used.

### 3.3.10 Wastewater Treatment

Because emissions from wastewater treatment were estimated based on population, these emissions are allocated based on MCD populations.

### 3.3.11 Industrial Processes—Ozone-Depleting Substances Substitutes

As discussed in Section 2.5.1 above, emissions associated with ODS substitutes were estimated for the region using regional population multiplied by the national per capita emissions. These emissions were allocated to the MCD level by multiplying MCD populations by national per capita emissions.

### 3.3.12 Fugitive Methane Emissions from Natural Gas Systems

As discussed in Section 2.6.1 above, fugitive emissions from natural gas systems were estimated using the national emission factor derived by dividing national fugitive emissions by national natural gas consumption, that is, a certain portion of loss is assumed in natural gas transmission. This same factor was applied to residential and commercial natural gas consumption as estimated at the MCD level (as discussed above) to estimate emissions from this source at the municipal level.

### 3.3.13 Land Use, Land-Use Change, and Forestry

Net carbon sequestration/emissions from forests and urban trees were estimated based on detailed MCD-level land use estimates provided by DVRPC and on urban forest studies conducted by the U.S. Forest Service.

For forest carbon, DVRPC's wooded land use area estimates for 2000 and 2005 were used to estimate the annual change in forested land by MCD. The annual change for each MCD was then multiplied by the appropriate county average carbon storage factor (Table 20) to estimate net change in forest carbon stocks. This method assumes that the carbon storage factor for forested land within each MCD is the same as the average for each county. Although this is not likely to be the case, it is difficult to improve on this estimate without detailed field measurements. Because of this, the sum of the MCD-level LULUCF emissions differs slightly from the county totals that were used in the regional inventory.

Allocating sequestration from urban trees to MCDs utilized a method similar to the one employed for the regional inventory. However, rather than relying on U.S. Census Bureau data to calculate urban areas within each MCD, the urbanized area in each MCD was estimated to be the total area of the MCD, with land classified as "agricultural", "wooded", and "water" subtracted from the total. The estimated urbanized area for each MCD was then multiplied by the national average urbanized area tree coverage (a different factor was used for Philadelphia) and the carbon sequestration rate, as discussed in Section 2.7.2.

The sum of the forest carbon and urban trees sequestration/emissions results in a net LULUCF sequestration/emissions value for each municipality.

## REFERENCES


American Forests, 2003. "Urban Ecosystem Analysis; Delaware Valley Region." Available online: http://www.americanforests.org/resources/urbanforests/analysis.php

Bureau of Labor Statistics, 2008a. http://www.bls.gov/ro2/qcew9320.htm. Website accessed on June 26, 2008.

Bureau of Labor Statistics, 2008b. http://www.bls.gov/ro3/fax_9624.htm. Website accessed on June 26, 2008.

California Air Resources Board (CARB). 2004. *DRAFT Emission Estimation Methodology for Commercial Harbor Craft Operating in California*. http://www.arb.ca.gov/msprog/offroad/marinevess/documents/method073004.pdf.

DSIRE, 2008a. "New Jersey Incentives for Renewables and Efficiency: Renewables Portfolio Standard." June 24, 2008. Available online at: http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=NJ05R&state=NJ&CurrentPageID=1&RE=1&EE=1.

DSIRE, 2008b. "Pennsylvania Incentives for Renewables and Efficiency: Alternative Energy Portfolio Standard." October 27, 2008. Available online at: http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=PA06R&state=PA&CurrentPageID=1&RE=1&EE=1.

Federal Transit Administration (FTA), 2008. National Transit Database. http://www.ntdprogram.gov/ntdprogram/.

IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The National Greenhouse Gas Inventories Programme, The Intergovernmental Panel on Climate Change, H.S. Eggleston, L. Buenida, K. Miwa, T Ngara, and K. Tanabe (eds.). Hayama, Kanagawa, Japan.

Knuth, Sarah, 2006. Measuring Greenhouse Gas Emissions in Montgomery County, Pennsylvania 1990-2004. Penn State University.

ICF Consulting, 2006. *Best Practices and Current Methodologies in Preparing Port Emission Inventories, Final Report*, Prepared for U.S. Environmental Protection Agency Sector Strategies Program, available at http://www.epa.gov/cleandiesel/ports/.

Lloyds Register Fairplay, 2008. *Internet Ship Register*, available at http://www.ships-register.com/

NCASI, 2008. Carbon On-Line Estimator. Available online: http://ncasi.uml.edu/COLE/ Accessed June 2008.

U.S. Army Corps of Engineers Navigation Data Center, 2004. *Vessel Entrances and Clearances*, available at http://www.iwr.usace.army.mil/ndc/db/entclrn/data/entrclrn04/.

U.S. Bureau of Transportation Statistics (BTS), 2008. Air Statistics Database. Available online at: http://www.transtats.bts.gov/Fields.asp?Table_ID=293.

U.S. Census Bureau, 2008. *2005 County Business Patterns (NAICS)* Available online at: http://censtats.census.gov/cgi-bin/cbpnaic/cbpdetl.pl.

U.S. Census Bureau, 2005 American Community Survey, table B25040. (LINK: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS&_submenuId=datasets_2&_lang=en)

US Census Bureau, 2002a. Urbanized Areas by State. http://www.census.gov/geo/www/ua/st2kua.txt.

US Census Bureau, 2002b. Urbanized area outline map. Map 69076. Available online at: http://www.census.gov/geo/www/maps/ua2kmaps.htm.

US Census Bureau, 2000. Census 2000 Summary File 1 (SF 1) 100-Percent Data. April 1, 2000. Available online at: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_tabId=DEC1&_submenuId=datasets_1&_lang=en&_ts=244981907298.

US Census Bureau, 1990. Census of Population and Housing, Summary Tape File 1 (100% Data). April 1, 1990. Available online at: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_lang=en&_ts=244981816219&_ds_name=DEC_1990_STF1_&_program=

USDA, 2008. National Agricultural Statistics Service. Available online at: http://www.nass.usda.gov/.

USDA Forest Service, 2008. FIDO online database tool. http://199.128.173.26/fido/mastf/standardrpt.html

USDA Forest Service, 2001. "U.S. Forest Facts and Historical Trends (Metric Units version)." http://fia.fs.fed.us/library/briefings-summaries-overviews/docs/ForestFactsMetric.pdf.

USDA, 2007. Economic Research Service. U.S. Food Supply: Nutrients and Other Food Components, Per Capita Per Day. Washington DC. Available online at http://www.ers.usda.gov/Data/FoodConsumption/NutrientAvailIndex.htm.

U.S. Department of Transportation Federal Highway Administration, 2008. Freight Analysis Framework (FAF)$^{2.2}$ Commodity Origin-Destination Database 2002-2035. Available online at: http://ops.fhwa.dot.gov/freight/freight_analysis/faf/.

U.S. Energy Information Administration (EIA), 2008. *Annual Energy Review 2007.* June 2008 (221). Available online: http://www.eia.doe.gov/emeu/aer/contents.html.

U.S. EIA, 2008b. *Natural Gas Annual 2006.* Available online at: http://tonto.eia.doe.gov/dnav/ng/ng_sum_lsum_dcu_nus_a.htm.

U.S. EIA, 2008c. *Number and Capacity of Petroleum Refineries.* Available online at: http://tonto.eia.doe.gov/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm.

U.S. EIA, 2005. *Refining Capacity Report 2005.* Available online at: http://www.eia.doe.gov/oil_gas/petroleum/data_publications/refinery_capacity_data/refcap_historical.html.

U.S. EIA, 2004. *Residential Energy Consumption Survey 2001.* Available online at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html.

U.S. EPA, 2008. U.S. Greenhouse Gas Inventory Reports. *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006.*

U.S. EPA, 2008b. EGrid. http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html.

U.S. EPA, 2008c. *Landfill Gas-to-Energy Project Database,* Landfill Methane Outreach Program. Available online at: http://www.epa.gov/lmop/.

U.S. EPA, 2007. State Inventory Tool Modules. U.S. Environmental Protection Agency, Clean Energy Environment State Program. Last updated and released in March, 2007.

U.S. EPA, 1998. *Compilation of Air Pollution Emission Factors, Publication AP-24*, Section 2.4 Municipal Solid Waste Landfills. Available online at: http://www.epa.gov/ttn/chief/ap42/index.html.

# APPENDIX A: 2005 ALLOCATED INVENTORY

## 2005 Greenhouse Gas Emissions Allocated to Counties (1000s $MTCO_2E$)

| County | Stationary Energy | | | Mobile Energy | Agri-culture | Waste | | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF[27] | Net Emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Residential | Commercial | Industrial | | | Landfill | Waste water | | | | | |
| Burlington | 1,887 | 1,749 | 563 | 2,046 | 23 | 170 | 56 | 159 | 68 | **6,721** | 138 | **6,859** |
| Camden | 2,033 | 1,815 | 501 | 1,838 | 0 | 196 | 65 | 183 | 66 | **6,696** | (28) | **6,669** |
| Gloucester | 1,236 | 1,441 | 574 | 1,208 | 16 | 104 | 34 | 98 | 61 | **4,772** | 71 | **4,843** |
| Mercer | 1,420 | 1,771 | 336 | 1,649 | 70 | 139 | 46 | 130 | 58 | **5,618** | 28 | **5,646** |
| Bucks | 2,696 | 1,465 | 1,297 | 2,644 | 108 | 202 | 78 | 222 | 33 | **8,746** | 21 | **8,766** |
| Chester | 2,092 | 1,344 | 1,706 | 2,505 | 180 | 153 | 60 | 169 | 26 | **8,235** | 118 | **8,353** |
| Delaware | 2,134 | 942 | 1,806 | 2,233 | 3 | 180 | 70 | 198 | 49 | **7,614** | (12) | **7,602** |
| Montgomery | 3,296 | 2,183 | 3,143 | 3,833 | 51 | 253 | 98 | 278 | 69 | **13,203** | (154) | **13,050** |
| Philadelphia | 4,952 | 3,379 | 4,641 | 3,751 | 0 | 480 | 187 | 528 | 213 | **18,132** | (37) | **18,095** |

Source: DVRPC, 2009

As noted in Table 22, county allocations exclude the following emissions sources:

- industrial fuels other than coal, distillate, kerosene, and LPG;
- highway through-traffic and airport traffic;
- freight rail;
- intercity rail;
- aviation;
- marine and port related sources;
- cement and iron/steel production; and
- fugitive emissions from petroleum systems.

[27] LULUCF is "Land Use, Land Use Change, and Forestry," as described in section 1.10.

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Burlington County, NJ – 2005 Greenhouse Gas Emissions Allocated to Municipality ($MTCO_2E$)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Bass River Township | 7,983 | 3,040 | 0 | N/A | 5,019 | 139 | 590 | 195 | 552 | 0 | 17,516 | (660) | 16,856 |
| Beverly City | 6,719 | 3,244 | N/A | N/A | 8,168 | - | 1,008 | 333 | 943 | 178 | 20,591 | 96 | 20,687 |
| Bordentown City | 5,215 | 3,976 | N/A | N/A | 18,708 | - | 1,505 | 497 | 1,409 | 110 | 31,421 | 125 | 31,546 |
| Bordentown Township | 29,967 | 26,575 | N/A | N/A | 55,554 | 86 | 3,893 | 1,285 | 3,642 | 1,137 | 122,139 | 9,814 | 131,953 |
| Burlington City | 25,078 | 26,336 | N/A | N/A | 42,921 | <0.5 | 3,695 | 1,219 | 3,457 | 714 | 103,421 | (1,277) | 102,144 |
| Burlington Township | 87,141 | 99,825 | N/A | N/A | 100,890 | 125 | 8,270 | 2,729 | 7,738 | 2,957 | 309,675 | 9,377 | 319,053 |
| Chesterfield Township | 35,566 | 19,721 | N/A | N/A | 13,647 | 1,368 | 2,357 | 778 | 2,205 | 1,095 | 76,737 | 4,301 | 81,038 |
| Cinnaminson Township | 74,961 | 54,676 | N/A | N/A | 61,777 | 25 | 5,717 | 1,887 | 5,349 | 2,406 | 206,796 | 969 | 207,765 |
| Delanco Township | 27,595 | 18,683 | N/A | N/A | 18,860 | 36 | 1,496 | 494 | 1,400 | 800 | 69,364 | 3,897 | 73,262 |
| Delran Township | 75,287 | 52,151 | N/A | N/A | 62,203 | 52 | 6,572 | 2,169 | 6,149 | 2,149 | 206,732 | 8,309 | 215,041 |
| Eastampton Township | 30,588 | 29,166 | N/A | N/A | 22,283 | 175 | 2,539 | 838 | 2,376 | 906 | 88,870 | 520 | 89,390 |
| Edgewater Park Township | 29,473 | 15,427 | N/A | N/A | 23,888 | 30 | 3,026 | 999 | 2,831 | 924 | 76,599 | 2,719 | 79,318 |
| Evesham Township | 198,687 | 150,309 | N/A | N/A | 199,651 | 239 | 17,723 | 5,849 | 16,581 | 5,179 | 594,218 | 2,583 | 596,801 |
| Fieldsboro Borough | 1,708 | 1,066 | N/A | N/A | 2,393 | - | 220 | 72 | 206 | 36 | 5,701 | 653 | 6,354 |
| Florence Township | 72,710 | 68,435 | N/A | N/A | 43,158 | 270 | 4,316 | 1,424 | 4,038 | 2,451 | 196,803 | 12,270 | 209,073 |
| Hainesport Township | 24,935 | 16,640 | N/A | N/A | 34,155 | 116 | 2,232 | 737 | 2,088 | 530 | 81,433 | 7,850 | 89,283 |
| Lumberton Township | 34,259 | 38,544 | N/A | N/A | 43,194 | 543 | 4,689 | 1,547 | 4,387 | 1,194 | 128,356 | (1,232) | 127,124 |
| Mansfield Township | 37,222 | 22,325 | N/A | N/A | 29,353 | 1,135 | 2,890 | 954 | 2,704 | 1,049 | 97,632 | 3,602 | 101,234 |
| Maple Shade Township | 70,330 | 227,010 | N/A | N/A | 70,453 | 1 | 7,360 | 2,429 | 6,886 | 11,317 | 395,787 | (335) | 395,452 |
| Medford Township | 138,153 | 86,400 | N/A | N/A | 106,054 | 700 | 8,913 | 2,942 | 8,339 | 4,429 | 355,930 | 16,405 | 372,335 |
| Medford Lakes Borough | 7,774 | 3,321 | N/A | N/A | 13,539 | - | 1,579 | 521 | 1,478 | 144 | 28,357 | (582) | 27,774 |
| Moorestown Township | 123,630 | 155,161 | N/A | N/A | 123,760 | 212 | 7,552 | 2,492 | 7,066 | 4,372 | 424,245 | 1,033 | 425,278 |
| Mount Holly Township | 18,874 | 18,670 | N/A | N/A | 49,881 | 1 | 4,025 | 1,328 | 3,766 | 445 | 96,991 | (814) | 96,177 |
| Mount Laurel Township | 189,836 | 242,986 | N/A | N/A | 211,691 | 221 | 15,336 | 5,061 | 14,348 | 5,138 | 684,618 | (1,436) | 683,182 |
| New Hanover Township | 9,324 | 76,298 | N/A | N/A | 43,902 | 137 | 3,637 | 1,195 | 3,387 | 3,974 | 141,853 | (535) | 141,319 |
| North Hanover Township | 25,196 | 11,360 | N/A | N/A | 40,797 | 923 | 2,869 | 947 | 2,684 | 727 | 85,504 | 3,826 | 89,329 |
| Palmyra Borough | 32,330 | 15,281 | N/A | N/A | 26,135 | - | 2,883 | 952 | 2,698 | 868 | 81,147 | 572 | 81,719 |
| Pemberton Borough | 4,076 | 3,203 | N/A | N/A | 7,722 | 2 | 499 | 165 | 467 | 14 | 16,148 | 3,012 | 19,160 |
| Pemberton Township | 48,398 | 37,229 | N/A | N/A | 114,447 | 1,372 | 10,904 | 3,599 | 10,202 | 2,543 | 228,695 | 1,351 | 230,046 |
| Riverside Township | 21,450 | 12,394 | N/A | N/A | 24,759 | - | 3,015 | 995 | 2,821 | 495 | 65,929 | (750) | 65,179 |
| Riverton Borough | 8,623 | 5,298 | N/A | N/A | 9,771 | - | 1,033 | 341 | 967 | 208 | 26,241 | (347) | 25,894 |
| Shamong Township | 37,368 | 7,518 | N/A | N/A | 25,980 | 559 | 2,591 | 855 | 2,424 | 188 | 77,483 | 7,434 | 84,917 |
| Southampton Township | 19,966 | 5,368 | N/A | N/A | 48,374 | 1,705 | 4,125 | 1,361 | 3,860 | 182 | 84,941 | 5,782 | 90,723 |
| Springfield Township | 44,578 | 37,208 | N/A | N/A | 15,805 | 1,969 | 1,343 | 443 | 1,257 | 1,442 | 104,043 | 2,182 | 106,225 |
| Tabernacle Township | 46,786 | 12,420 | N/A | N/A | 26,804 | 666 | 2,775 | 916 | 2,596 | 168 | 93,131 | 30,412 | 123,543 |
| Washington Township | 13,010 | 3,712 | 0 | N/A | 3,213 | 426 | 244 | 80 | 228 | 170 | 21,084 | 2,019 | 23,103 |
| Westampton Township | 56,785 | 56,775 | N/A | N/A | 46,301 | 384 | 3,268 | 1,079 | 3,058 | 1,760 | 169,410 | (1,560) | 167,850 |
| Willingboro Township | 145,414 | 59,337 | N/A | N/A | 90,906 | 3 | 12,616 | 4,163 | 11,804 | 4,463 | 328,707 | (3,445) | 325,262 |
| Woodland Township | 16,679 | 7,851 | N/A | N/A | 11,396 | 508 | 517 | 171 | 484 | 309 | 37,914 | 8,391 | 46,305 |
| Wrightstown Borough | 3,554 | 13,738 | N/A | N/A | 15,668 | 4 | 281 | 98 | 279 | 546 | 34,169 | 1,392 | 35,561 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Camden County, NJ – 2005 Greenhouse Gas Emissions Allocated to Municipality ($MTCO_2E$)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Audubon Borough | 38,713 | 22,534 | N/A | N/A | 28,539 | - | 3,460 | 1,142 | 3,238 | 1,048 | 98,675 | (798) | 96,828 |
| Audubon Park Borough | 3,753 | 2,318 | N/A | N/A | 3,071 | - | 408 | 135 | 382 | 119 | 10,187 | (80) | 9,987 |
| Barrington Borough | 27,012 | 13,077 | N/A | N/A | 21,385 | <0.5 | 2,667 | 880 | 2,495 | 766 | 68,282 | (931) | 66,585 |
| Bellmawr Borough | 43,872 | 46,796 | N/A | N/A | 46,145 | <0.5 | 4,259 | 1,406 | 3,985 | 1,698 | 148,162 | (1,492) | 144,972 |
| Berlin Borough | 31,901 | 41,112 | N/A | 3,917 | 36,724 | <0.5 | 2,815 | 929 | 2,634 | 386 | 120,417 | 639 | 120,670 |
| Berlin Township | 24,890 | 29,049 | N/A | N/A | 32,067 | <0.5 | 2,042 | 674 | 1,911 | 1,014 | 91,646 | (37) | 90,596 |
| Brooklawn Borough | 9,574 | 7,938 | N/A | N/A | 9,609 | - | 876 | 289 | 820 | 241 | 29,346 | (243) | 28,862 |
| Camden City | 235,643 | 340,350 | N/A | N/A | 178,333 | - | 30,343 | 10,014 | 28,391 | 10,696 | 833,771 | (6,686) | 816,388 |
| Cherry Hill Township | 322,176 | 376,819 | N/A | N/A | 315,331 | <0.5 | 27,206 | 8,979 | 25,456 | 11,943 | 1,087,910 | (9,373) | 1,066,594 |
| Chesilhurst Borough | 6,105 | 1,576 | N/A | 12 | 5,329 | <0.5 | 667 | 220 | 624 | 23 | 14,557 | (117) | 14,417 |
| Clementon Borough | 40,420 | 24,444 | 0 | N/A | 16,759 | - | 1,870 | 617 | 1,750 | 731 | 86,591 | (503) | 85,358 |
| Collingswood Borough | 52,731 | 53,010 | N/A | N/A | 41,198 | - | 5,327 | 1,758 | 4,984 | 1,578 | 160,586 | (1,057) | 157,951 |
| Gibbsboro Borough | 11,975 | 16,778 | N/A | N/A | 14,405 | <0.5 | 934 | 308 | 874 | 377 | 45,651 | 501 | 45,775 |
| Gloucester Township | 213,994 | 125,930 | N/A | N/A | 191,443 | <0.5 | 25,132 | 8,295 | 23,515 | 8,191 | 596,499 | 977 | 589,286 |
| Gloucester City City | 49,009 | 37,868 | N/A | N/A | 32,311 | - | 4,381 | 1,446 | 4,099 | 1,181 | 130,295 | (1,010) | 128,104 |
| Haddon Township | 65,300 | 58,324 | N/A | N/A | 47,650 | - | 5,513 | 1,820 | 5,159 | 1,988 | 185,753 | (1,021) | 182,745 |
| Haddonfield Borough | 55,869 | 23,592 | N/A | N/A | 45,942 | - | 4,385 | 1,447 | 4,103 | 1,524 | 136,861 | (1,283) | 134,055 |
| Haddon Heights Borough | 36,574 | 14,953 | N/A | N/A | 25,936 | - | 2,810 | 927 | 2,629 | 956 | 84,786 | (789) | 83,041 |
| Hi-Nella Borough | 3,952 | 1,809 | N/A | N/A | 2,785 | - | 384 | 127 | 359 | 112 | 9,527 | (96) | 9,320 |
| Laurel Springs Borough | 10,686 | 9,876 | 0 | 14 | 6,267 | - | 734 | 242 | 686 | 171 | 28,676 | (247) | 28,257 |
| Lawnside Borough | 12,636 | 18,424 | N/A | N/A | 16,331 | - | 1,051 | 347 | 983 | 509 | 50,282 | 599 | 50,373 |
| Lindenwold Borough | 58,195 | 28,226 | N/A | N/A | 46,842 | - | 6,531 | 2,155 | 6,111 | 1,455 | 149,516 | (1,136) | 146,925 |
| Magnolia Borough | 15,556 | 5,433 | N/A | N/A | 12,582 | - | 1,660 | 548 | 1,554 | 433 | 37,766 | (390) | 36,942 |
| Merchantville Borough | 11,117 | 8,252 | N/A | N/A | 11,951 | - | 1,445 | 477 | 1,352 | 307 | 34,901 | (347) | 34,247 |
| Mount Ephraim Borough | 16,297 | 8,259 | N/A | N/A | 14,238 | - | 1,690 | 558 | 1,581 | 451 | 43,073 | (103) | 42,519 |
| Oaklyn Borough | 19,544 | 9,084 | N/A | N/A | 13,224 | - | 1,557 | 514 | 1,457 | 523 | 45,903 | (350) | 45,030 |
| Pennsauken Township | 125,811 | 180,222 | N/A | N/A | 145,316 | - | 13,439 | 4,436 | 12,575 | 4,997 | 486,796 | (4,202) | 477,597 |
| Pine Hill Borough | 42,039 | 18,565 | N/A | N/A | 27,448 | - | 4,277 | 1,411 | 4,001 | 1,273 | 99,014 | (1,163) | 96,578 |
| Pine Valley Borough | 4,261 | 4,663 | N/A | 2 | 374 | - | 8 | 3 | 8 | 359 | 9,677 | (46) | 9,273 |
| Runnemede Borough | 35,085 | 29,506 | N/A | N/A | 28,437 | - | 3,223 | 1,064 | 3,016 | 1,205 | 101,535 | (955) | 99,375 |
| Somerdale Borough | 22,378 | 11,217 | N/A | N/A | 16,466 | - | 1,950 | 644 | 1,825 | 667 | 55,146 | (592) | 53,887 |
| Stratford Borough | 26,236 | 21,712 | N/A | N/A | 26,109 | - | 2,727 | 900 | 2,551 | 485 | 80,721 | (765) | 79,471 |
| Tavistock Borough | 5,945 | 2,246 | N/A | N/A | - | - | 9 | 3 | - | 149 | 8,352 | (59) | 8,144 |
| Voorhees Township | 128,968 | 129,040 | N/A | N/A | 129,700 | <0.5 | 10,983 | 3,625 | 10,276 | 3,548 | 416,140 | (2,119) | 410,474 |
| Waterford Township | 51,130 | 19,461 | N/A | N/A | 39,922 | <0.5 | 4,052 | 1,337 | 3,792 | 1,068 | 120,762 | (1,371) | 118,324 |
| Winslow Township | 165,905 | 69,550 | N/A | 67,923 | 115,522 | <0.5 | 14,188 | 4,683 | 13,275 | 3,680 | 454,726 | 8,966 | 460,011 |
| Woodlynne Borough | 7,368 | 2,835 | N/A | N/A | 4,586 | - | 1,038 | 343 | 972 | 161 | 17,304 | (114) | 17,029 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Gloucester County, NJ – 2005 Greenhouse Gas Emissions Allocated to Municipality ($MTCO_2E$)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Clayton Borough | 31,598 | 19,768 | N/A | 11,512 | 29,144 | 105 | 2,769 | 914 | 2,591 | 1,158 | 99,559 | (2,839) | 96,720 |
| Deptford Township | 135,873 | 122,328 | N/A | N/A | 130,126 | 122 | 11,213 | 3,701 | 10,491 | 4,656 | 418,510 | (1,629) | 416,880 |
| East Greenwich Township | 34,505 | 37,228 | N/A | N/A | 23,106 | 636 | 2,362 | 780 | 2,210 | 2,019 | 102,846 | (674) | 102,172 |
| Elk Township | 19,745 | 24,162 | N/A | 341 | 16,510 | 929 | 1,429 | 472 | 1,337 | 1,692 | 66,617 | 4,868 | 71,484 |
| Franklin Township | 78,283 | 59,489 | N/A | 319 | 74,419 | 1,370 | 6,280 | 2,073 | 5,876 | 3,213 | 231,323 | 16,411 | 247,734 |
| Glassboro Borough | 58,104 | 85,334 | N/A | 14,450 | 74,470 | 79 | 7,272 | 2,400 | 6,804 | 3,008 | 251,921 | 2,716 | 254,637 |
| Greenwich Township | 26,018 | 39,710 | N/A | N/A | 27,859 | 110 | 1,877 | 620 | 1,757 | 1,786 | 99,737 | 8,727 | 108,464 |
| Harrison Township | 54,119 | 18,078 | N/A | 2,421 | 39,337 | 838 | 4,298 | 1,418 | 4,021 | 619 | 125,149 | 455 | 125,604 |
| Logan Township | 20,557 | 113,621 | N/A | 51,707 | 53,980 | 685 | 2,340 | 772 | 2,189 | 2,471 | 248,323 | 32,490 | 280,813 |
| Mantua Township | 105,535 | 38,910 | N/A | N/A | 59,058 | 445 | 5,721 | 1,888 | 5,352 | 2,713 | 219,622 | 3,972 | 223,594 |
| Monroe Township | 149,764 | 102,893 | N/A | 9,960 | 108,196 | 603 | 11,860 | 3,914 | 11,096 | 5,320 | 403,606 | 15,154 | 418,760 |
| National Park Borough | 13,653 | 2,748 | N/A | N/A | 9,119 | - | 1,215 | 401 | 1,137 | 207 | 28,480 | (436) | 28,044 |
| Newfield Borough | 10,412 | 7,983 | N/A | 2,738 | 18,564 | 30 | 626 | 207 | 586 | 177 | 41,322 | 68 | 41,391 |
| Paulsboro Borough | 29,458 | 127,590 | N/A | N/A | 24,952 | - | 2,298 | 758 | 2,150 | 5,818 | 193,025 | (1,102) | 191,923 |
| Pitman Borough | 38,557 | 21,250 | N/A | 27,802 | 30,667 | 5 | 3,488 | 1,151 | 3,263 | 1,061 | 127,244 | (650) | 126,594 |
| South Harrison Township | 13,705 | 4,878 | N/A | 12 | 12,819 | 890 | 1,088 | 359 | 1,018 | 565 | 35,335 | 2,246 | 37,581 |
| Swedesboro Borough | 21,291 | 31,532 | N/A | 6,805 | 17,393 | 6 | 773 | 255 | 723 | 44 | 78,823 | (106) | 78,717 |
| Washington Township | 198,095 | 161,360 | N/A | N/A | 163,991 | 190 | 19,108 | 6,306 | 17,879 | 5,316 | 572,245 | (2,877) | 569,368 |
| Wenonah Borough | 24,470 | 5,456 | 0 | N/A | 8,434 | <0.5 | 879 | 290 | 823 | 329 | 40,682 | (438) | 40,244 |
| West Deptford Township | 88,442 | 296,580 | N/A | N/A | 88,334 | 165 | 7,883 | 2,602 | 7,376 | 13,788 | 505,169 | (2,786) | 502,383 |
| Westville Borough | 10,207 | 6,313 | N/A | N/A | 18,749 | - | 1,684 | 556 | 1,575 | 183 | 39,266 | (609) | 38,657 |
| Woodbury City | 29,741 | 30,955 | N/A | N/A | 53,797 | - | 3,934 | 1,298 | 3,681 | 707 | 124,113 | (411) | 123,702 |
| Woodbury Heights Borough | 14,813 | 51,959 | N/A | N/A | 12,309 | - | 1,139 | 376 | 1,066 | 2,716 | 84,379 | (543) | 83,836 |
| Woolwich Township | 28,934 | 31,146 | N/A | 2,260 | 27,696 | 1,075 | 2,851 | 941 | 2,668 | 1,236 | 98,807 | (1,476) | 97,330 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Mercer County, NJ – 2005 Greenhouse Gas Emissions Allocated to Municipality ($MTCO_2E$)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **Residential** | **Commercial** | **Industrial Gas** | **Industrial Electricity** | **Mobile Energy** | **Agri-culture** | **Landfill** | **Waste-water** | **Industrial Processes** | **Fugitive Methane** | **Gross Emissions** | **LULUCF** | **Net Emissions** |
| East Windsor Township | 42,718 | 86,515 | N/A | N/A | 158,462 | 602 | 10,159 | 3,353 | 9,505 | 4,746 | 316,058 | 9,454 | 325,512 |
| Ewing Township | 170,072 | 287,337 | N/A | N/A | 163,521 | 131 | 14,130 | 4,663 | 13,220 | 8,995 | 662,068 | (235) | 661,833 |
| Hamilton Township | 378,930 | 331,436 | N/A | N/A | 325,236 | 633 | 34,110 | 11,257 | 31,913 | 13,455 | 1,126,970 | 13,893 | 1,140,863 |
| Hightstown Borough | 18,500 | 6,401 | N/A | N/A | 30,573 | 3 | 2,008 | 663 | 1,879 | 346 | 60,373 | 727 | 61,100 |
| Hopewell Borough | 3,373 | 3,072 | 0 | N/A | 9,537 | 13 | 773 | 255 | 723 | 19 | 17,764 | (864) | 16,899 |
| Hopewell Township | 127,064 | 130,750 | N/A | N/A | 81,200 | 2,285 | 6,732 | 2,222 | 6,299 | 3,726 | 360,279 | 198 | 360,477 |
| Lawrence Township | 156,640 | 228,808 | N/A | N/A | 153,907 | 433 | 11,915 | 3,932 | 11,148 | 5,964 | 572,748 | 1,176 | 573,923 |
| Pennington Borough | 6,421 | 2,805 | 0 | N/A | 10,957 | <0.5 | 1,023 | 338 | 957 | 87 | 22,588 | (1,069) | 21,519 |
| Princeton Borough | 20,795 | 60,127 | N/A | N/A | 44,524 | - | 5,159 | 1,702 | 4,827 | 964 | 138,097 | (1,699) | 136,398 |
| Princeton Township | 94,838 | 172,735 | N/A | N/A | 71,818 | 154 | 6,544 | 2,160 | 6,123 | 4,029 | 358,402 | (7,999) | 350,403 |
| Trenton City | 220,037 | 299,899 | N/A | N/A | 214,597 | - | 32,155 | 10,612 | 30,085 | 8,246 | 815,630 | (2,689) | 812,942 |
| Washington Township | 60,339 | 63,294 | N/A | N/A | 53,505 | 936 | 4,409 | 1,455 | 4,125 | 2,923 | 190,986 | 8,103 | 199,089 |
| West Windsor Township | 119,888 | 98,286 | N/A | N/A | 193,718 | 618 | 9,860 | 3,254 | 9,225 | 4,058 | 438,907 | 8,671 | 447,578 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Bucks County, PA – 2005 Greenhouse Gas Emissions Allocated to Municipality (MTCO$_2$E)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **Residential** | **Commercial** | **Industrial Gas** | **Industrial Electricity** | **Mobile Energy** | **Agri-culture** | **Landfill** | **Waste water** | **Industrial Processes** | **Fugitive Methane** | **Gross Emissions** | **LULUCF** | **Net Emissions** |
| Bedminster Township | 47,920 | 16,162 | 304 | N/A | 22,452 | 10,514 | 1,608 | 625 | 1,771 | 31 | 101,387 | 382 | 101,768 |
| Bensalem Township | 234,333 | 196,792 | 14,949 | 119,727 | 273,646 | 140 | 19,036 | 7,398 | 20,973 | 3,832 | 890,825 | (4,695) | 886,131 |
| Bridgeton Township | 5,721 | 1,230 | 0 | N/A | 7,963 | 232 | 463 | 180 | 510 | - | 16,299 | 1,127 | 17,426 |
| Bristol Borough | 40,175 | 26,600 | 872 | 18,422 | 41,641 | - | 3,181 | 1,236 | 3,505 | 867 | 136,498 | (905) | 135,593 |
| Bristol Township | 224,569 | 125,446 | 16,038 | 131,455 | 178,224 | 15 | 17,666 | 6,865 | 19,464 | 2,404 | 722,146 | (1,992) | 720,154 |
| Buckingham Township | 102,994 | 28,864 | 1,653 | 5,324 | 67,289 | 7,853 | 6,043 | 2,348 | 6,658 | 1,243 | 230,269 | 1,951 | 232,220 |
| Chalfont Borough | 21,597 | 10,222 | 7,845 | N/A | 15,658 | 34 | 1,359 | 528 | 1,498 | 280 | 59,022 | (298) | 58,724 |
| Doylestown Borough | 35,510 | 44,080 | 0 | 16,922 | 47,765 | <0.5 | 2,677 | 1,040 | 2,949 | 834 | 151,778 | (1,088) | 150,690 |
| Doylestown Township | 79,491 | 39,632 | 565 | N/A | 69,261 | 1,188 | 6,116 | 2,377 | 6,738 | 980 | 206,347 | (3,058) | 203,288 |
| Dublin Borough | 8,258 | 3,634 | 0 | 4,183 | 9,220 | 37 | 706 | 274 | 777 | 0 | 27,090 | 78 | 27,167 |
| Durham Township | 7,520 | 1,321 | 0 | N/A | 7,583 | 2,250 | 426 | 166 | 469 | - | 19,734 | 1,122 | 20,856 |
| East Rockhill Township | 19,530 | 8,492 | 0 | N/A | 21,273 | 1,204 | 1,853 | 720 | 2,041 | - | 55,113 | (1,571) | 53,541 |
| Falls Township | 125,018 | 105,958 | 49,339 | 97,904 | 126,752 | 192 | 11,080 | 4,306 | 12,206 | 2,369 | 535,124 | (3,990) | 531,134 |
| Haycock Township | 25,914 | 13,760 | 0 | N/A | 9,478 | 1,952 | 762 | 296 | 839 | - | 53,000 | 5,188 | 58,189 |
| Hilltown Township | 56,351 | 35,769 | 0 | N/A | 49,015 | 6,705 | 4,178 | 1,624 | 4,603 | 191 | 158,437 | 2,232 | 160,668 |
| Hulmeville Borough | 4,293 | 905 | 0 | 299 | 2,475 | 32 | 284 | 111 | 313 | 62 | 8,775 | 216 | 8,991 |
| Ivyland Borough | 3,868 | 5,248 | 0 | 1,560 | 6,699 | 21 | 274 | 107 | 302 | 84 | 18,164 | (59) | 18,106 |
| Langhorne Borough | 6,469 | 12,047 | 10,301 | 90,570 | 7,780 | 5 | 639 | 248 | 704 | 311 | 129,075 | (235) | 128,840 |
| Langhorne Manor Borough | 6,684 | 6,477 | 0 | 3,677 | 7,117 | - | 349 | 136 | 385 | 131 | 24,956 | (177) | 24,779 |
| Lower Makefield Township | 160,991 | 35,545 | N/A | N/A | 91,535 | 1,419 | 10,577 | 4,110 | 11,653 | 2,003 | 317,834 | (4,373) | 313,461 |
| Lower Southampton Township | 81,972 | 51,993 | 1,227 | 11,715 | 79,994 | 127 | 6,254 | 2,430 | 6,890 | 1,032 | 243,633 | (1,965) | 241,668 |
| Middletown Township | 177,398 | 107,066 | 3,124 | 15,457 | 190,432 | 506 | 15,376 | 5,975 | 16,940 | 2,370 | 534,645 | (6,022) | 528,623 |
| Milford Township | 39,669 | 20,032 | 0 | N/A | 38,007 | 7,139 | 3,080 | 1,197 | 3,393 | - | 112,516 | 9,045 | 121,562 |
| Morrisville Borough | 36,172 | 21,768 | 14,767 | 29,681 | 38,916 | <0.5 | 3,173 | 1,233 | 3,496 | 686 | 149,891 | (878) | 149,013 |
| New Britain Borough | 11,550 | 6,234 | 0 | N/A | 11,238 | 5 | 748 | 291 | 824 | 85 | 30,975 | (472) | 30,503 |
| New Britain Township | 52,911 | 26,184 | 2,955 | N/A | 40,490 | 2,343 | 3,526 | 1,370 | 3,884 | 422 | 134,084 | 643 | 134,728 |
| New Hope Borough | 12,353 | 17,278 | 0 | 346 | 38,856 | - | 741 | 288 | 816 | 224 | 70,901 | (45) | 70,856 |
| Newtown Borough | 12,391 | 11,172 | 0 | 1,068 | 13,500 | <0.5 | 729 | 283 | 803 | 195 | 40,142 | (309) | 39,833 |
| Newtown Township | 85,126 | 50,660 | 698 | 14,130 | 82,851 | 1,316 | 6,207 | 2,412 | 6,839 | 1,598 | 251,836 | (240) | 251,596 |
| Nockamixon Township | 16,541 | 2,970 | 0 | N/A | 19,073 | 3,605 | 1,195 | 464 | 1,316 | - | 45,164 | 9,408 | 54,572 |
| Northampton Township | 200,690 | 53,630 | 188 | 10,594 | 128,648 | 2,069 | 13,284 | 5,162 | 14,634 | 1,933 | 430,832 | (9,859) | 420,972 |
| Penndel Borough | 7,883 | 9,269 | 0 | 6,197 | 9,798 | <0.5 | 775 | 301 | 854 | 242 | 35,319 | (231) | 35,087 |
| Perkasie Borough | 28,325 | 2,605 | 0 | 0 | 31,429 | 60 | 2,824 | 1,097 | 3,111 | - | 69,452 | (865) | 68,587 |
| Plumstead Township | 59,527 | 32,761 | 2,689 | N/A | 47,303 | 6,594 | 3,862 | 1,501 | 4,255 | 532 | 159,023 | (1,734) | 157,289 |
| Quakertown Borough | 32,904 | 20,319 | 0 | N/A | 50,362 | 9 | 2,854 | 1,109 | 3,144 | - | 110,700 | (170) | 110,530 |
| Richland Township | 34,076 | 17,092 | 0 | N/A | 50,414 | 4,253 | 4,066 | 1,580 | 4,480 | - | 115,961 | 10,840 | 126,801 |
| Richlandtown Borough | 2,037 | 140 | 0 | N/A | 3,959 | 25 | 437 | 170 | 481 | - | 7,248 | (126) | 7,122 |
| Riegelsville Borough | 2,710 | 495 | 0 | N/A | 13,098 | 261 | 275 | 107 | 303 | - | 17,250 | (183) | 17,068 |
| Sellersville Borough | 5,815 | 3,513 | 0 | N/A | 22,475 | 1 | 1,457 | 566 | 1,605 | - | 35,432 | (445) | 34,988 |
| Silverdale Borough | 1,081 | 420 | 0 | 0 | 4,315 | 9 | 316 | 123 | 348 | - | 6,611 | (218) | 6,393 |
| Solebury Township | 53,644 | 12,301 | 614 | 1,524 | 35,362 | 5,005 | 2,873 | 1,116 | 3,165 | 380 | 115,983 | 8,157 | 124,140 |
| Springfield Township | 30,601 | 7,462 | 0 | N/A | 21,333 | 7,205 | 1,651 | 642 | 1,819 | - | 70,713 | 4,437 | 75,150 |
| Telford Borough | 4,808 | 3,683 | 0 | N/A | 8,453 | <0.5 | 706 | 274 | 778 | 87 | 18,790 | (240) | 18,550 |
| Tinicum Township | 18,442 | 3,381 | 0 | N/A | 21,631 | 5,835 | 1,382 | 537 | 1,523 | - | 52,731 | 4,969 | 57,700 |
| Trumbauersville Borough | 1,452 | 660 | 0 | N/A | 5,067 | 98 | 346 | 135 | 381 | - | 8,140 | (119) | 8,021 |

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **Residential** | **Commercial** | **Industrial Gas** | **Industrial Electricity** | **Mobile Energy** | **Agri-culture** | **Landfill** | **Waste water** | **Industrial Processes** | **Fugitive Methane** | **Gross Emissions** | **LULUCF** | **Net Emissions** |
| Tullytown Borough | 8,285 | 10,603 | 2,076 | 11,945 | 13,479 | - | 647 | 251 | 712 | 112 | 48,111 | (835) | 47,276 |
| Upper Makefield Township | 53,914 | 7,708 | 0 | 0 | 32,933 | 3,802 | 2,772 | 1,077 | 3,054 | 99 | 105,360 | 8,103 | 113,462 |
| Upper Southampton Township | 63,848 | 39,714 | 1,285 | 22,746 | 63,030 | 164 | 5,022 | 1,952 | 5,533 | 1,459 | 204,753 | (2,388) | 202,365 |
| Warminster Township | 120,703 | 85,613 | 7,905 | 74,762 | 115,734 | 151 | 10,781 | 4,190 | 11,878 | 3,207 | 434,922 | (4,043) | 430,879 |
| Warrington Township | 89,110 | 56,026 | 220 | N/A | 80,039 | 1,548 | 7,214 | 2,803 | 7,948 | 1,769 | 246,676 | 5,856 | 252,533 |
| Warwick Township | 63,485 | 19,149 | 0 | 4,906 | 41,788 | 1,412 | 4,763 | 1,851 | 5,248 | 1,071 | 142,672 | 652 | 143,324 |
| West Rockhill Township | 41,443 | 24,367 | 5,904 | N/A | 26,312 | 1,892 | 1,494 | 581 | 1,647 | 40 | 103,681 | (988) | 102,692 |
| Wrightstown Township | 16,720 | 7,656 | 2,450 | 4,635 | 11,921 | 2,063 | 905 | 352 | 997 | 90 | 47,790 | 1,608 | 49,398 |
| Yardley Borough | 11,909 | 12,496 | 0 | 7,726 | 14,635 | - | 824 | 320 | 908 | 238 | 49,055 | (607) | 48,449 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Chester County, PA – 2005 Greenhouse Gas Emissions Allocated to Municipality ($MTCO_2E$)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Atglen Borough | 2,193 | 672 | 15,564 | N/A | 9,744 | 68 | 437 | 170 | 481 | 58 | 29,387 | 260 | 29,648 |
| Avondale Borough | 4,049 | 4,326 | 468 | 12,192 | 7,445 | 23 | 355 | 138 | 390 | 57 | 29,441 | (166) | 29,275 |
| Birmingham Township | 24,409 | 8,173 | 185 | 2,145 | 14,661 | 448 | 1,381 | 536 | 1,519 | 335 | 53,790 | (1,621) | 52,169 |
| Caln Township | 56,281 | 30,806 | 720 | 24,173 | 56,521 | 199 | 3,973 | 1,541 | 4,370 | 693 | 179,276 | 5,958 | 185,235 |
| Charlestown Township | 27,174 | 14,751 | 6,298 | 6,984 | 23,752 | 1,039 | 1,886 | 732 | 2,074 | 269 | 84,959 | 7,123 | 92,082 |
| Coatesville City | 46,228 | 13,656 | 7,419 | 293,162 | 31,142 | - | 3,721 | 1,444 | 4,093 | 658 | 401,522 | 3,225 | 404,747 |
| Downingtown Borough | 26,266 | 27,283 | 3,591 | 46,037 | 43,713 | 31 | 2,544 | 987 | 2,798 | 630 | 153,878 | (358) | 153,520 |
| East Bradford Township | 47,714 | 6,590 | 0 | 3,537 | 30,146 | 1,173 | 3,293 | 1,278 | 3,623 | 520 | 97,874 | 3,408 | 101,282 |
| East Brandywine Township | 30,150 | 5,867 | 0 | 1,658 | 22,171 | 929 | 2,088 | 810 | 2,297 | 4 | 65,975 | 1,831 | 67,806 |
| East Caln Township | 17,517 | 21,291 | 0 | 5,850 | 24,814 | 26 | 1,338 | 519 | 1,471 | 428 | 73,254 | 8,461 | 81,715 |
| East Coventry Township | 26,037 | 6,342 | 0 | 2,337 | 19,976 | 1,379 | 1,844 | 716 | 2,029 | 136 | 60,797 | (1,122) | 59,675 |
| East Fallowfield Township | 31,194 | 3,621 | 2,956 | N/A | 22,205 | 1,790 | 2,172 | 843 | 2,389 | 232 | 67,402 | 1,658 | 69,061 |
| East Goshen Township | 88,894 | 40,327 | 0 | 12,771 | 75,901 | 207 | 5,777 | 2,242 | 6,355 | 1,070 | 233,544 | (1,031) | 232,514 |
| East Marlborough Township | 36,686 | 21,477 | 2,548 | 11,218 | 32,509 | 2,141 | 2,509 | 974 | 2,760 | 532 | 113,355 | 2,690 | 116,044 |
| East Nantmeal Township | 11,271 | 2,645 | 0 | N/A | 8,728 | 1,765 | 604 | 234 | 664 | 0 | 25,910 | 2,044 | 27,954 |
| East Nottingham Township | 28,342 | 6,473 | 0 | 3,712 | 30,246 | 3,321 | 2,574 | 999 | 2,832 | - | 78,500 | 3,813 | 82,312 |
| East Pikeland Township | 32,613 | 12,938 | 1,161 | 4,432 | 26,996 | 868 | 2,207 | 856 | 2,428 | 393 | 84,893 | 241 | 85,134 |
| Easttown Township | 59,344 | 24,909 | 885 | 1,807 | 45,293 | 192 | 3,366 | 1,306 | 3,703 | 1,069 | 141,875 | (2,709) | 139,165 |
| East Vincent Township | 28,101 | 7,574 | 0 | 0 | 22,965 | 1,749 | 2,086 | 810 | 2,295 | 175 | 65,756 | (1,550) | 64,206 |
| East Whiteland Township | 37,140 | 144,547 | 15,879 | 99,894 | 145,642 | 211 | 3,336 | 1,294 | 3,669 | 919 | 452,531 | 3,244 | 455,775 |
| Elk Township | 8,249 | 621 | 0 | 0 | 8,809 | 1,589 | 478 | 185 | 526 | 2 | 20,459 | 1,101 | 21,560 |
| Elverson Borough | 1,009 | 667 | 0 | N/A | 21,884 | 51 | 377 | 146 | 415 | - | 24,549 | (141) | 24,408 |
| Franklin Township | 20,126 | 1,820 | 0 | 2,625 | 16,733 | 1,641 | 1,384 | 537 | 1,523 | 40 | 46,431 | (577) | 45,854 |
| Highland Township | 7,327 | 1,623 | 0 | N/A | 6,792 | 3,781 | 387 | 150 | 426 | 4 | 20,491 | 1,921 | 22,411 |
| Honey Brook Borough | 2,063 | 1,015 | 332 | N/A | 7,875 | 28 | 449 | 174 | 494 | 51 | 12,481 | (221) | 12,260 |
| Honey Brook Township | 23,666 | 13,967 | 499 | N/A | 27,248 | 4,082 | 2,209 | 857 | 2,430 | 66 | 75,026 | 4,902 | 79,928 |
| Kennett Township | 39,932 | 33,375 | 2,292 | 19,531 | 35,118 | 1,419 | 2,341 | 908 | 2,575 | 367 | 137,857 | (544) | 137,313 |
| Kennett Square Borough | 19,495 | 17,602 | 1,125 | 22,058 | 27,390 | 15 | 1,713 | 665 | 1,884 | 337 | 92,283 | (391) | 91,892 |
| London Britain Township | 9,996 | 344 | 0 | 0 | 12,987 | 867 | 976 | 379 | 1,073 | - | 26,622 | 182 | 26,804 |
| Londonderry Township | 8,313 | 1,717 | 0 | 1,658 | 8,079 | 2,240 | 597 | 232 | 657 | 6 | 23,500 | 2,065 | 25,565 |
| London Grove Township | 29,364 | 13,761 | 0 | 3,190 | 23,019 | 2,530 | 2,022 | 785 | 2,225 | 370 | 77,265 | (1,035) | 76,230 |
| Lower Oxford Township | 3,627 | 1,032 | 0 | 0 | 20,200 | 3,246 | 1,589 | 616 | 1,748 | - | 32,057 | 1,233 | 33,289 |
| Malvern Borough | 13,230 | 12,651 | 2,594 | 13,506 | 19,484 | 6 | 1,003 | 389 | 1,104 | 319 | 64,286 | 177 | 64,464 |
| Modena Borough | 2,355 | 439 | 4,116 | 5,516 | 2,091 | 4 | 195 | 76 | 214 | 2 | 15,008 | (84) | 14,924 |
| New Garden Township | 45,736 | 80,558 | 4,763 | 28,343 | 50,106 | 1,713 | 3,568 | 1,384 | 3,925 | 742 | 220,839 | 4,312 | 225,151 |
| Newlin Township | 4,558 | 204 | 0 | 0 | 5,258 | 1,684 | 401 | 156 | 441 | - | 12,702 | 2,350 | 15,053 |
| New London Township | 23,853 | 4,180 | 0 | 281 | 20,489 | 1,468 | 1,774 | 688 | 1,952 | 8 | 54,693 | 1,732 | 56,426 |
| North Coventry Township | 35,264 | 17,488 | 0 | 11,725 | 52,063 | 970 | 2,465 | 957 | 2,712 | 318 | 123,963 | 2,236 | 126,200 |
| Oxford Borough | 10,920 | 6,696 | 0 | 6,661 | 19,479 | 160 | 1,516 | 588 | 1,667 | 0 | 47,687 | (685) | 47,003 |
| Parkesburg Borough | 13,737 | 3,950 | 0 | N/A | 14,362 | 52 | 1,115 | 433 | 1,227 | 113 | 34,988 | (484) | 34,504 |
| Penn Township | 20,762 | 14,270 | 863 | 5,834 | 19,045 | 1,405 | 1,492 | 579 | 1,641 | 317 | 66,208 | (579) | 65,629 |
| Pennsbury Township | 19,315 | 4,410 | 0 | 3,899 | 17,220 | 901 | 1,251 | 485 | 1,375 | 153 | 49,009 | 1,059 | 50,068 |
| Phoenixville Borough | 61,682 | 33,689 | 2,394 | 19,739 | 52,072 | 27 | 4,991 | 1,936 | 5,490 | 1,122 | 183,143 | 1,830 | 184,972 |
| Pocopson Township | 15,761 | 5,361 | 3,784 | 4,632 | 11,882 | 1,071 | 1,091 | 423 | 1,201 | 128 | 45,334 | 44 | 45,378 |
| Sadsbury Township | 15,023 | 9,004 | 0 | N/A | 13,138 | 841 | 1,048 | 407 | 1,153 | 232 | 40,845 | 502 | 41,348 |

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Schuylkill Township | 41,743 | 16,954 | 6,376 | 49,935 | 31,406 | 294 | 2,473 | 960 | 2,720 | 716 | 153,577 | 328 | 153,904 |
| South Coatesville Borough | 5,314 | 2,226 | 0 | 58,959 | 4,955 | 40 | 344 | 133 | 378 | 63 | 72,412 | 604 | 73,016 |
| South Coventry Township | 11,644 | 4,847 | 0 | 3,027 | 11,644 | 719 | 772 | 299 | 849 | 56 | 33,857 | 1,074 | 34,931 |
| Spring City Borough | 14,440 | 9,730 | 422 | 7,323 | 12,746 | 19 | 1,063 | 412 | 1,169 | 265 | 47,591 | (159) | 47,432 |
| Thornbury Township | 15,081 | 4,186 | 5,156 | 8,329 | 13,187 | 196 | 949 | 368 | 1,044 | 242 | 48,738 | (1,019) | 47,719 |
| Tredyffrin Township | 143,984 | 158,286 | 13,683 | 145,191 | 225,145 | 165 | 9,413 | 3,652 | 10,355 | 2,551 | 712,425 | (2,619) | 709,806 |
| Upper Oxford Township | 8,042 | 331 | 0 | 0 | 11,417 | 3,386 | 767 | 298 | 844 | - | 25,086 | 1,722 | 26,808 |
| Upper Uwchlan Township | 49,435 | 14,426 | 0 | 1,967 | 31,115 | 592 | 2,606 | 1,011 | 2,867 | 552 | 104,573 | 10,377 | 114,950 |
| Uwchlan Township | 78,886 | 77,709 | 3,525 | 35,866 | 71,540 | 371 | 5,929 | 2,300 | 6,522 | 1,297 | 283,944 | 1,945 | 285,890 |
| Valley Township | 27,659 | 11,717 | 1,344 | 3,661 | 21,344 | 317 | 1,956 | 759 | 2,152 | 283 | 71,192 | 4,699 | 75,891 |
| Wallace Township | 4,012 | 762 | 0 | N/A | 13,369 | 868 | 1,101 | 427 | 1,211 | - | 21,750 | 1,526 | 23,277 |
| Warwick Township | 9,183 | 1,997 | 0 | N/A | 15,203 | 1,628 | 872 | 338 | 959 | - | 30,180 | 3,653 | 33,834 |
| West Bradford Township | 55,947 | 7,880 | 0 | 3,940 | 35,121 | 1,561 | 3,785 | 1,468 | 4,163 | 165 | 114,030 | 5,716 | 119,746 |
| West Brandywine Township | 32,361 | 8,612 | 226 | N/A | 27,844 | 1,238 | 2,472 | 959 | 2,720 | 145 | 76,577 | 1,163 | 77,739 |
| West Caln Township | 39,756 | 6,374 | 0 | N/A | 32,412 | 2,033 | 2,528 | 981 | 2,781 | 79 | 86,943 | 10,973 | 97,916 |
| West Chester Borough | 53,182 | 58,389 | 862 | 50,189 | 66,102 | - | 5,841 | 2,266 | 6,425 | 1,546 | 244,801 | (913) | 243,888 |
| West Fallowfield Township | 13,780 | 4,693 | 330 | N/A | 13,459 | 3,795 | 839 | 326 | 923 | 7 | 38,152 | 517 | 38,669 |
| West Goshen Township | 86,659 | 101,878 | 12,399 | 94,977 | 123,666 | 99 | 6,854 | 2,659 | 7,539 | 2,095 | 438,825 | (827) | 437,998 |
| West Grove Borough | 9,653 | 5,943 | 0 | 2,604 | 10,878 | 10 | 854 | 332 | 940 | 133 | 31,347 | (251) | 31,096 |
| West Marlborough Township | 3,535 | 350 | 0 | 0 | 5,035 | 3,842 | 281 | 109 | 309 | - | 13,462 | 307 | 13,769 |
| West Nantmeal Township | 8,142 | 2,814 | 0 | N/A | 11,297 | 1,988 | 710 | 275 | 781 | - | 26,008 | 5,503 | 31,511 |
| West Nottingham Township | 17,264 | 5,196 | 0 | 17,880 | 18,136 | 1,535 | 892 | 346 | 981 | 0 | 62,231 | 2,106 | 64,337 |
| West Pikeland Township | 23,921 | 2,093 | 0 | 0 | 15,027 | 900 | 1,291 | 501 | 1,420 | 101 | 45,253 | 2,713 | 47,966 |
| West Sadsbury Township | 8,498 | 6,748 | 0 | N/A | 14,446 | 1,807 | 809 | 314 | 890 | 114 | 33,626 | 1,399 | 35,025 |
| Westtown Township | 48,827 | 16,150 | 190 | 3,657 | 40,346 | 430 | 3,434 | 1,332 | 3,777 | 451 | 118,595 | (1,132) | 117,464 |
| West Vincent Township | 21,548 | 3,985 | 0 | 0 | 14,900 | 2,217 | 1,258 | 488 | 1,384 | 54 | 45,833 | 6,313 | 52,146 |
| West Whiteland Township | 82,944 | 102,810 | 282 | 41,657 | 144,735 | 455 | 5,938 | 2,304 | 6,531 | 1,838 | 389,493 | 1,174 | 390,667 |
| Willistown Township | 59,226 | 22,575 | 2,823 | 11,472 | 57,347 | 1,575 | 3,477 | 1,349 | 3,825 | 512 | 164,181 | 4,985 | 169,165 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Delaware County, PA – 2005 Greenhouse Gas Emissions Allocated to Municipality (MTCO$_2$E)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Aldan Borough | 17,554 | 2,064 | 0 | 2,406 | 9,665 | - | 1,389 | 539 | 1,528 | 367 | 35,511 | (331) | 35,181 |
| Aston Township | 69,991 | 30,336 | 1,530 | 25,119 | 65,756 | 16 | 5,440 | 2,111 | 5,984 | 1,148 | 207,430 | 3,757 | 211,187 |
| Bethel Township | 37,937 | 4,696 | 0 | 14,809 | 80,222 | 66 | 2,947 | 1,143 | 3,242 | 523 | 145,587 | 5,859 | 151,446 |
| Brookhaven Borough | 34,571 | 10,048 | 160 | 4,037 | 28,692 | 530 | 2,539 | 985 | 2,793 | 622 | 84,978 | 1,845 | 86,824 |
| Chadds Ford Township | 25,286 | 23,642 | 0 | 5,644 | 44,873 | - | 1,038 | 403 | 1,142 | 359 | 102,385 | (722) | 101,663 |
| Chester City | 113,027 | 54,787 | 122,907 | 90,413 | 100,401 | - | 11,989 | 4,652 | 13,188 | 2,960 | 514,323 | (2,115) | 512,208 |
| Chester Township | 16,186 | 13,591 | 12,650 | 8,706 | 16,198 | - | 1,457 | 565 | 1,603 | 440 | 71,397 | 16,015 | 87,411 |
| Chester Heights Borough | 12,092 | 5,439 | 0 | 1,344 | 14,172 | 50 | 802 | 311 | 882 | 107 | 35,199 | (12,816) | 22,383 |
| Clifton Heights Borough | 25,068 | 7,861 | 0 | 1,477 | 17,573 | - | 2,144 | 832 | 2,358 | 516 | 57,829 | (364) | 57,465 |
| Collingdale Borough | 29,740 | 10,552 | 0 | 262 | 14,977 | - | 2,750 | 1,067 | 3,026 | 715 | 63,089 | (478) | 62,611 |
| Colwyn Borough | 7,749 | 1,578 | 0 | 0 | 4,421 | - | 774 | 300 | 852 | 200 | 15,875 | (135) | 15,740 |
| Concord Township | 61,246 | 57,724 | 4,450 | 27,237 | 87,091 | 346 | 4,924 | 1,911 | 5,416 | 1,251 | 251,596 | 4,582 | 256,178 |
| Darby Borough | 30,968 | 10,217 | 3,591 | 11,841 | 18,726 | - | 3,250 | 1,261 | 3,575 | 789 | 84,218 | (32) | 84,186 |
| Darby Township | 30,480 | 10,329 | 0 | 9,609 | 21,550 | - | 3,122 | 1,211 | 3,434 | 741 | 80,479 | (309) | 80,170 |
| East Lansdowne Borough | 9,464 | 2,102 | 0 | 0 | 4,047 | - | 814 | 316 | 896 | 219 | 17,857 | (118) | 17,739 |
| Eddystone Borough | 8,949 | 16,165 | 10,232 | 16,629 | 13,203 | - | 770 | 299 | 847 | 332 | 67,426 | (329) | 67,098 |
| Edgmont Township | 19,174 | 13,349 | 0 | 678 | 19,901 | 348 | 1,343 | 521 | 1,477 | 96 | 56,888 | 1,159 | 58,047 |
| Folcroft Borough | 21,269 | 16,408 | 235 | 3,832 | 20,700 | - | 2,234 | 867 | 2,458 | 650 | 68,653 | (499) | 68,155 |
| Glenolden Borough | 24,009 | 14,407 | 1,422 | 10,245 | 21,036 | - | 2,365 | 917 | 2,601 | 684 | 77,685 | (454) | 77,231 |
| Haverford Township | 199,482 | 56,063 | 684 | 17,064 | 133,828 | 15 | 15,777 | 6,121 | 17,354 | 4,769 | 451,157 | (4,629) | 446,528 |
| Lansdowne Borough | 40,120 | 13,747 | 508 | 12,428 | 27,067 | - | 3,490 | 1,354 | 3,839 | 1,085 | 103,639 | (668) | 102,971 |
| Lower Chichester Township | 12,793 | 6,943 | 0 | 3,311 | 33,731 | - | 1,131 | 439 | 1,244 | 236 | 59,828 | (475) | 59,354 |
| Marcus Hook Borough | 8,742 | 10,374 | 0 | 399,247 | 32,198 | - | 733 | 284 | 806 | 175 | 452,559 | (617) | 451,942 |
| Marple Township | 99,171 | 56,262 | 646 | 22,196 | 93,520 | 27 | 7,625 | 2,959 | 8,388 | 2,267 | 293,060 | (1,566) | 291,494 |
| Media Borough | 21,558 | 34,174 | 2,703 | 15,650 | 36,732 | - | 1,764 | 684 | 1,940 | 614 | 115,818 | (369) | 115,449 |
| Middletown Township | 59,030 | 29,534 | 6,154 | 72,520 | 83,134 | 327 | 5,215 | 2,023 | 5,736 | 735 | 264,407 | (1,087) | 263,320 |
| Millbourne Borough | 2,235 | 1,145 | 0 | 0 | 1,866 | - | 297 | 115 | 327 | 68 | 6,053 | (152) | 5,901 |
| Morton Borough | 10,220 | 7,292 | 0 | 775 | 10,111 | - | 862 | 335 | 948 | 248 | 30,792 | (207) | 30,585 |
| Nether Providence Township | 62,321 | 10,961 | 261 | 3,492 | 41,883 | 5 | 4,303 | 1,670 | 4,734 | 951 | 130,581 | (1,408) | 129,173 |
| Newtown Township | 59,391 | 42,617 | 6,553 | 37,584 | 64,274 | 321 | 3,834 | 1,488 | 4,218 | 900 | 221,177 | 3,572 | 224,750 |
| Norwood Borough | 21,928 | 4,908 | 0 | 0 | 13,644 | - | 1,893 | 735 | 2,082 | 449 | 45,639 | (357) | 45,283 |
| Parkside Borough | 8,779 | 1,357 | 0 | 0 | 6,286 | - | 716 | 278 | 787 | 139 | 18,342 | (108) | 18,234 |
| Prospect Park Borough | 22,650 | 11,167 | 3 | 0 | 18,695 | - | 2,086 | 810 | 2,295 | 537 | 58,242 | (379) | 57,863 |
| Radnor Township | 129,485 | (18,807) | 16,562 | 109,501 | 155,744 | 271 | 10,029 | 3,891 | 11,032 | 3,603 | 421,311 | (6,251) | 415,060 |
| Ridley Township | 111,885 | 46,156 | 465 | 73,337 | 100,261 | - | 9,780 | 3,794 | 10,757 | 2,450 | 358,887 | (7,324) | 351,563 |
| Ridley Park Borough | 27,532 | 10,351 | 1,215 | 6,191 | 22,823 | - | 2,285 | 886 | 2,513 | 614 | 74,410 | 5,217 | 79,627 |
| Rose Valley Borough | 5,489 | (143) | 0 | 0 | 2,709 | - | 300 | 116 | 330 | 53 | 8,854 | (292) | 8,562 |
| Rutledge Borough | 3,435 | 233 | 0 | 0 | 1,777 | - | 271 | 105 | 298 | 57 | 6,176 | (89) | 6,087 |
| Sharon Hill Borough | 19,298 | 15,162 | 0 | 1,466 | 14,749 | - | 1,733 | 672 | 1,906 | 591 | 55,579 | (379) | 55,201 |
| Springfield Township | 97,803 | 50,451 | 3,689 | 32,053 | 93,716 | - | 7,471 | 2,899 | 8,218 | 2,558 | 298,855 | (2,020) | 296,835 |
| Swarthmore Borough | 21,850 | 8,457 | 0 | 11,572 | 24,840 | - | 1,988 | 771 | 2,187 | 562 | 72,228 | (176) | 72,051 |
| Thornbury Township | 29,704 | 4,452 | 0 | 0 | 24,613 | 342 | 2,229 | 865 | 2,452 | 344 | 65,001 | 105 | 65,105 |
| Tinicum Township | 17,339 | 34,232 | 3,284 | 25,834 | 86,958 | 16 | 1,376 | 534 | 1,514 | 604 | 171,692 | (2,834) | 168,858 |
| Trainer Borough | 7,532 | 4,850 | 13,979 | 279,945 | 10,773 | - | 602 | 234 | 662 | 108 | 318,686 | (296) | 318,390 |
| Upland Borough | 10,932 | 6,245 | 0 | 21,093 | 15,834 | - | 942 | 365 | 1,036 | 226 | 56,673 | (257) | 56,416 |

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

| Municipality | Stationary Energy: Residential | Stationary Energy: Commercial | Stationary Energy: Industrial Gas | Stationary Energy: Industrial Electricity | Mobile Energy | Agri-culture | Waste: Landfill | Waste: Waste-water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Chichester Township | 70,308 | 37,450 | 447 | 20,722 | 128,502 | 19 | 5,622 | 2,181 | 6,184 | 1,258 | 272,693 | 2,361 | 275,054 |
| Upper Darby Township | 268,157 | 115,572 | 12,885 | 47,566 | 192,474 | - | 25,985 | 10,082 | 28,584 | 7,538 | 708,844 | (3,681) | 705,163 |
| Upper Providence Township | 49,764 | 15,339 | 702 | 1,234 | 38,367 | 5 | 3,608 | 1,400 | 3,968 | 776 | 115,162 | (1,324) | 113,838 |
| Yeadon Borough | 40,111 | 20,477 | 2,435 | 6,692 | 28,018 | - | 3,722 | 1,444 | 4,095 | 1,282 | 108,276 | (843) | 107,433 |

Source: DVRPC, 2009

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

## Montgomery County, PA – 2005 Greenhouse Gas Emissions Allocated to Municipality ($MTCO_2E$)

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Abington Township | 245,121 | 84,324 | 18,923 | 85,885 | 200,775 | 179 | 18,066 | 7,010 | 19,872 | 5,996 | 686,149 | (9,664) | 676,485 |
| Ambler Borough | 25,784 | 11,228 | 636 | 20,847 | 21,338 | - | 2,088 | 810 | 2,297 | 560 | 85,588 | (339) | 85,248 |
| Bridgeport Borough | 18,542 | 12,125 | 0 | 38,761 | 16,176 | - | 1,434 | 556 | 1,577 | 429 | 89,601 | (982) | 88,619 |
| Bryn Athyn Borough | 5,138 | 4,919 | 1,707 | 3,336 | 5,800 | 143 | 441 | 171 | 485 | 78 | 22,218 | (712) | 21,506 |
| Cheltenham Township | 151,560 | 57,774 | 3,149 | 52,939 | 122,001 | 2 | 11,834 | 4,592 | 13,017 | 4,269 | 421,137 | (2,774) | 418,363 |
| Collegeville Borough | 19,114 | 12,990 | 0 | 8,756 | 21,688 | 35 | 1,538 | 597 | 1,692 | 463 | 66,872 | (72) | 66,799 |
| Conshohocken Borough | 31,733 | 40,634 | 7,848 | 13,431 | 34,471 | - | 2,671 | 1,036 | 2,938 | 909 | 135,672 | (900) | 134,772 |
| Douglass Township | 31,067 | 2,579 | 0 | 0 | 50,679 | 3,091 | 3,328 | 1,291 | 3,661 | - | 95,696 | (761) | 94,935 |
| East Greenville Borough | 4,418 | 1,877 | 0 | 0 | 13,403 | 10 | 1,005 | 390 | 1,106 | 88 | 22,297 | (132) | 22,165 |
| East Norriton Township | 55,176 | 46,738 | 1,480 | 15,906 | 58,745 | 246 | 4,401 | 1,708 | 4,842 | 1,087 | 190,330 | (581) | 189,749 |
| Franconia Township | 46,096 | 34,039 | 18,292 | N/A | 48,944 | 2,451 | 3,950 | 1,533 | 4,345 | 237 | 159,886 | (4,101) | 155,785 |
| Green Lane Borough | 2,339 | 1,888 | 0 | 972 | 3,668 | 3 | 191 | 74 | 210 | 33 | 9,378 | (16) | 9,363 |
| Hatboro Borough | 26,498 | 18,726 | 365 | 4,082 | 31,990 | - | 2,374 | 921 | 2,611 | 524 | 88,092 | (613) | 87,479 |
| Hatfield Borough | 7,365 | 6,414 | 7,664 | N/A | 12,898 | 10 | 935 | 363 | 1,029 | 182 | 36,860 | (526) | 36,333 |
| Hatfield Township | 65,917 | 70,253 | 9,815 | N/A | 84,351 | 732 | 5,691 | 2,208 | 6,260 | 974 | 246,201 | (5,557) | 240,644 |
| Horsham Township | 106,518 | 138,886 | 7,158 | N/A | 146,876 | 837 | 8,166 | 3,169 | 8,983 | 2,378 | 422,971 | (7,178) | 415,793 |
| Jenkintown Borough | 16,445 | 25,729 | 2,408 | 25,786 | 24,000 | - | 1,434 | 557 | 1,578 | 647 | 98,583 | (391) | 98,192 |
| Lansdale Borough | 68,294 | 23,367 | 9,311 | N/A | 58,444 | 4 | 5,183 | 2,011 | 5,701 | 1,243 | 173,559 | (2,397) | 171,162 |
| Limerick Township | 72,811 | 47,511 | 1,376 | 31,343 | 72,452 | 2,695 | 5,344 | 2,074 | 5,879 | 1,353 | 242,838 | (1,019) | 241,819 |
| Lower Frederick Township | 19,739 | 5,887 | 0 | 1,225 | 18,057 | 823 | 1,591 | 617 | 1,750 | 81 | 49,771 | (1,201) | 48,570 |
| Lower Gwynedd Township | 60,529 | 28,544 | 18,882 | 61,003 | 56,721 | 252 | 3,578 | 1,388 | 3,935 | 1,371 | 236,202 | (5,730) | 230,472 |
| Lower Merion Township | 323,102 | 161,097 | 21,626 | 172,482 | 267,051 | 35 | 18,963 | 7,358 | 20,859 | 8,740 | 1,001,313 | (18,375) | 982,938 |
| Lower Moreland Township | 61,850 | 26,688 | 2,310 | 10,689 | 44,545 | 175 | 3,815 | 1,480 | 4,196 | 1,352 | 157,099 | (1,658) | 155,441 |
| Lower Pottsgrove Township | 38,373 | 20,732 | 0 | 7,142 | 47,294 | 328 | 3,924 | 1,522 | 4,316 | 453 | 124,085 | (663) | 123,422 |
| Lower Providence Township | 95,307 | 61,814 | 4,170 | 57,142 | 90,325 | 580 | 8,062 | 3,128 | 8,868 | 1,536 | 330,931 | (4,671) | 326,260 |
| Lower Salford Township | 63,879 | 30,730 | 559 | N/A | 59,471 | 1,721 | 4,630 | 1,797 | 5,093 | 616 | 168,496 | (2,696) | 165,800 |
| Marlborough Township | 21,447 | 6,440 | 0 | 0 | 12,872 | 914 | 1,065 | 413 | 1,172 | 33 | 44,356 | (35) | 44,321 |
| Montgomery Township | 103,394 | 94,212 | 3,638 | N/A | 127,479 | 301 | 7,887 | 3,060 | 8,675 | 2,300 | 350,944 | (6,770) | 344,174 |
| Narberth Borough | 17,937 | 8,915 | 848 | 474 | 15,378 | - | 1,353 | 525 | 1,488 | 491 | 47,409 | (301) | 47,108 |
| New Hanover Township | 26,709 | 1,342 | 0 | 0 | 33,418 | 2,830 | 2,914 | 1,131 | 3,205 | - | 71,548 | 4,033 | 75,582 |
| Norristown Borough | 107,276 | 62,192 | 3,919 | 48,158 | 97,722 | 34 | 10,100 | 4,004 | 11,352 | 2,882 | 347,637 | (2,537) | 345,100 |
| North Wales Borough | 14,814 | 7,670 | 2,060 | 0 | 13,401 | - | 1,075 | 417 | 1,182 | 203 | 40,822 | (377) | 40,445 |
| Pennsburg Borough | 4,715 | 3,389 | 0 | 0 | 14,886 | 22 | 1,098 | 426 | 1,208 | 126 | 25,870 | 51 | 25,921 |
| Perkiomen Township | 33,381 | 8,854 | 0 | 2,659 | 30,209 | 360 | 2,701 | 1,048 | 2,971 | 468 | 82,651 | 33 | 82,684 |
| Plymouth Township | 61,686 | 108,932 | 82,168 | 134,108 | 136,076 | 172 | 5,291 | 2,053 | 5,820 | 1,818 | 538,123 | (6,693) | 531,430 |
| Pottstown Borough | 90,768 | 71,279 | 11,565 | 51,778 | 108,256 | - | 7,020 | 2,724 | 7,721 | 1,320 | 352,431 | (1,453) | 350,978 |
| Red Hill Borough | 7,185 | 1,347 | 0 | 0 | 9,658 | 36 | 768 | 298 | 844 | 66 | 20,202 | (254) | 19,948 |
| Rockledge Borough | 9,725 | 3,801 | 0 | 0 | 9,342 | <0.5 | 827 | 321 | 909 | 246 | 25,170 | (85) | 25,085 |
| Royersford Borough | 17,387 | 13,903 | 533 | 4,331 | 18,141 | - | 1,410 | 547 | 1,551 | 290 | 58,094 | (301) | 57,793 |
| Salford Township | 21,226 | 6,106 | 0 | N/A | 9,196 | 855 | 831 | 323 | 915 | 22 | 39,475 | (6,876) | 32,598 |
| Schwenksville Borough | 5,956 | 6,363 | 0 | 17,796 | 7,644 | 6 | 443 | 172 | 488 | 66 | 38,933 | 133 | 39,066 |
| Skippack Township | 42,279 | 14,653 | 1,782 | 10,393 | 37,755 | 2,002 | 4,020 | 1,560 | 4,422 | 457 | 119,322 | 844 | 120,166 |
| Souderton Borough | 15,035 | 9,467 | 0 | N/A | 25,923 | 5 | 2,179 | 846 | 2,397 | 289 | 56,141 | (710) | 55,432 |
| Springfield Township | 86,601 | 38,875 | 4,487 | 24,204 | 70,970 | 140 | 6,285 | 2,439 | 6,914 | 2,892 | 243,807 | (2,616) | 241,191 |
| Telford Borough | 1,580 | 852 | 0 | N/A | 9,420 | <0.5 | 797 | 309 | 877 | 61 | 13,896 | (287) | 13,609 |

See Table 22 for information on emissions included in and excluded from municipality level inventory allocation.

| | Stationary Energy | | | | | | Waste | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Municipality | Residential | Commercial | Industrial Gas | Industrial Electricity | Mobile Energy | Agri-culture | Landfill | Waste water | Industrial Processes | Fugitive Methane | Gross Emissions | LULUCF | Net Emissions |
| Towamencin Township | 70,191 | 39,999 | 373 | N/A | 60,301 | 634 | 5,856 | 2,272 | 6,441 | 1,153 | 187,221 | (4,187) | 183,034 |
| Trappe Borough | 16,079 | 7,021 | 949 | 9,272 | 15,954 | 229 | 1,115 | 433 | 1,226 | 206 | 52,484 | (195) | 52,289 |
| Upper Dublin Township | 120,774 | 64,594 | 3,567 | 67,307 | 126,460 | 193 | 8,451 | 3,279 | 9,296 | 2,672 | 406,593 | (7,509) | 399,084 |
| Upper Frederick Township | 15,430 | 1,981 | 0 | 0 | 13,735 | 1,689 | 1,197 | 465 | 1,317 | 11 | 35,825 | (1,140) | 34,685 |
| Upper Gwynedd Township | 62,137 | 41,031 | 227,942 | 159,390 | 71,081 | 348 | 4,754 | 1,844 | 5,229 | 1,275 | 575,032 | (8,235) | 566,797 |
| Upper Hanover Township | 41,007 | 15,983 | 17,588 | 0 | 37,299 | 3,479 | 1,818 | 706 | 2,000 | 17 | 119,896 | (1,844) | 118,053 |
| Upper Merion Township | 103,212 | 198,967 | 51,915 | 350,413 | 277,676 | 10 | 8,871 | 3,442 | 9,759 | 3,511 | 1,007,778 | (18,141) | 989,637 |
| Upper Moreland Township | 91,530 | 89,817 | 4,846 | 47,703 | 104,475 | 75 | 8,065 | 3,129 | 8,871 | 2,618 | 361,130 | (4,797) | 356,333 |
| Upper Pottsgrove Township | 13,614 | 4,241 | 133 | 1,460 | 18,615 | 437 | 1,605 | 623 | 1,765 | 185 | 42,677 | 1,425 | 44,102 |
| Upper Providence Township | 83,808 | 54,223 | 31,402 | 122,152 | 83,839 | 1,694 | 5,955 | 2,310 | 6,550 | 1,553 | 393,486 | 2,007 | 395,493 |
| Upper Salford Township | 16,412 | 4,662 | 0 | N/A | 12,729 | 1,457 | 1,014 | 394 | 1,116 | 6 | 37,790 | (2,708) | 35,082 |
| West Conshohocken Borough | 6,744 | 16,435 | 312 | 10,693 | 19,055 | - | 492 | 191 | 542 | 219 | 54,683 | (1,545) | 53,138 |
| West Norriton Township | 64,505 | 35,834 | 9,563 | 20,915 | 64,008 | 154 | 5,002 | 1,856 | 5,261 | 1,433 | 208,529 | (1,594) | 206,935 |
| West Pottsgrove Township | 15,238 | 9,449 | 1,093 | 3,736 | 20,506 | 32 | 1,248 | 484 | 1,373 | 122 | 53,281 | (373) | 52,909 |
| Whitemarsh Township | 82,050 | 72,130 | 11,206 | 62,717 | 99,822 | 747 | 5,588 | 2,168 | 6,147 | 2,121 | 344,696 | 6,694 | 351,390 |
| Whitpain Township | 94,416 | 60,283 | 2,025 | 31,110 | 119,242 | 473 | 6,123 | 2,376 | 6,735 | 1,824 | 324,606 | (9,042) | 315,564 |
| Worcester Township | 46,652 | 20,663 | 2,203 | 30,668 | 38,037 | 2,525 | 2,865 | 1,112 | 3,152 | 591 | 148,467 | (4,429) | 144,038 |

Source: DVRPC, 2009

# APPENDIX B: INVENTORY ADVISORY GROUP AND OTHER STAKEHOLDERS

## APPENDIX B: INVENTORY ADVISORY GROUP AND OTHER STAKEHOLDERS

The individuals listed below participated in one or more meetings of the Greenhouse Gas Emissions Inventory Advisory Group or otherwise provided or facilitated feedback and guidance as the inventory was being prepared.

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Calvin M. Davenger
Philadelphia International Airport

Liz Deruchie
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Andrea Denny
US EPA Office of Air and Radiation

David Director
Nether Providence Township, PA

Dan Dobromilsky
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Michael Dunn
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**Title of Report**: *Regional Greenhouse Gas Emissions Inventory*

**Publication No.:** 09038

**Date Published:** March 2009

**Geographic Area Covered:** DVRPC's nine member counties (Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey).

**Key Words:** Greenhouse gas; climate change; energy; emissions; inventory.

**Abstract:** The *Regional Greenhouse Gas Emissions Inventory* provides an accounting of greenhouse gas emissions for the nine-county DVRPC region for 2005. This inventory was carried out in close consultation with the US EPA to assure the protocol used conforms where possible to the agency's current thinking on MPO-level inventories. DVRPC also consulted with both the Commonwealth of Pennsylvania and the State of New Jersey, as well as with ICLEI—Local Governments for Sustainability. The protocol used drew on the state inventories developed using the state inventory tool, as well as local data where available. This work was carried out with the consulting support of ICF International.

The inventory allocates emissions to the each of the nine counties and 352 municipalities in the region. This sub-regional allocation excludes several emissions categories which were not feasible to allocate with available data, including emissions from aircraft, through highway traffic, some industrial fuel use, and livestock. Nonetheless, 90 percent of all emissions for the region are allocated to the county level, and 84 percent to the municipal level.

Electricity and natural gas use information was collected at either the municipal or ZIP code level by customer class (residential, commercial, industrial) from each of the dozen or so utilities that serve the region. Vehicle miles traveled (VMT) in the region was allocated to municipalities by assigning half of each trip to the municipality of origin and half to the destination municipality.

The results clearly demonstrate that municipalities with higher density tend to produce lower per capita emissions.

DVRPC will use this inventory in its work to develop policies and programs for the region to reduce greenhouse gas emissions. DVRPC will also use this inventory to support inventory efforts at the county and municipality level, as well as to support regional analysis of where investments in energy conservation and efficiency might be most productively made.

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