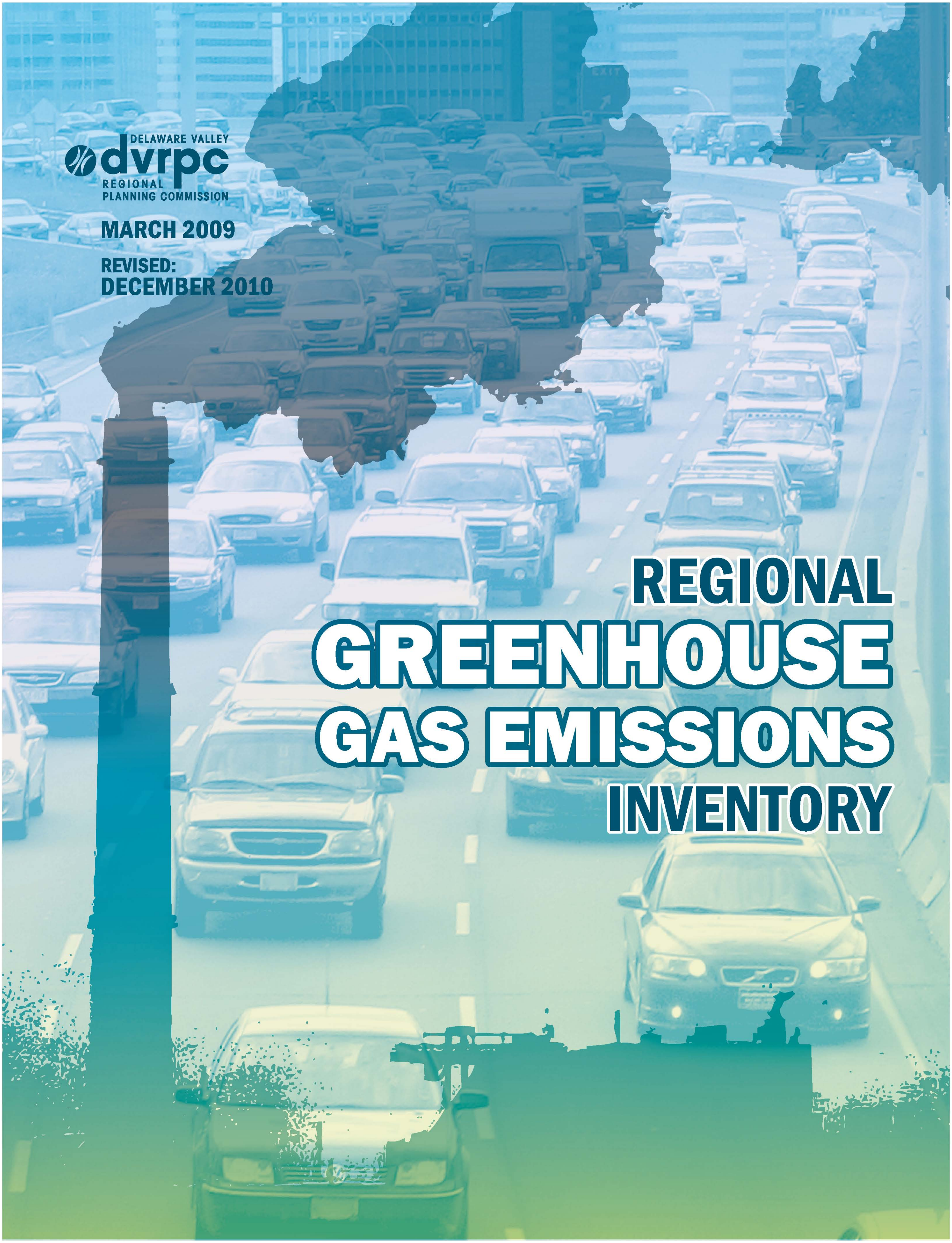
DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

MARCH 2009

REVISED:
DECEMBER 2010

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.

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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 *Regional Greenhouse Gas Emissions Inventory* was released in March 2009. This revsion incorporates a lower emissions factor for electricity, based on new guidance from US EPA. In addition, a small number of analytical errors have been corrected.[2] DVRPC has also created detailed estimates for each municipality's GHG emissions and energy use, to serve as a starting point for local action and analysis.[3]

Table 1 indicates the differences between the inventory as released in March 2009 and this revision. The total regional emissions are slightly lower in the revised inventory, almost exclusively due to the lower emissions factor used for electricity (see 2.1.2 below).

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 in the transportation sector, including on-road transportation, passenger and freight rail, aviation, marine transportation, and off-road vehicles. Non-energy-related emissions resulting from waste management (solid waste and wastewater), agriculture processes (both animal and plant related), 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 87.5 million metric tons of carbon dioxide equivalent ($MMTCO_2E$) in 2005. Almost 92 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 2.9 percent and 3.7 percent, respectively, of total emissions. Emissions from agricultural processes and fugitive emissions each account for less than 1 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 87.7 $MMTCO_2E$.[4]

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 indicate that municipalities with higher density tend to produce lower per capita emissions.

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

[2] Please contact DVRPC for details on these corrections.

[3] Please contact DVRPC to receive this information.

[4] 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.

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 summary results of the allocation by county and municipality and an appendix listing participants in the inventory advisory group and other stakeholders. Detailed allocations are available by contacting DVRPC.

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.

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 emissions 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.[5] 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.[6]

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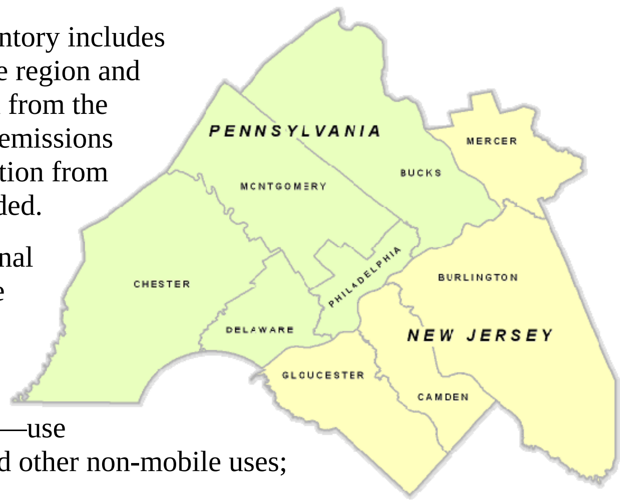
[5] For a detailed overview of greenhouse gas emissions inventory work, see: US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005*, April 2007. Available for download at: http://epa.gov/climatechange/emissions/usinventoryreport.html

[6] See: *Draft Regional Greenhouse Gas Inventory Guidance*, U.S. Environmental Protection Agency, State Climate and Energy Program, June 14, 2010.

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 comprised 98 percent of national emissions in 2005: 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.[7] Together, these six greenhouse gases accounted for 99.5 percent of national greenhouse gas emissions in 2005.[8]

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[7] 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 are best suited to 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, as well as 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 generation 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 from the outset in the development of the inventory. This engagement provided valuable input on establishing a baseline, provided data and information on data resources, built confidence in the methodologies used, provided input on key methodological and data questions, and built 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.[9]
- **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 serves as the basis for generating tradable carbon reduction certificates. Because the purpose of this inventory is to inform 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 (MTCO$_2$E) or million metric tons of carbon dioxide equivalent (MMTCO$_2$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 87.5 million metric tons of carbon dioxide equivalent (MMTCO$_2$E) in 2005. These emissions are summarized in Table 1, below. This table also indicates the differences between emissions as calculated in this revised inventory, and the inventory as released in March 2009. When the small amount of carbon emitted from the net loss of trees is included, net emissions were estimated to be 87.7 MMTCO$_2$E. Nearly 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

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.

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

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

management and industrial processes each accounted for an additional 2.9 percent and 3.7 percent, respectively, of total emissions, while agriculture, fugitive emissions from fuel systems, and emissions resulting from loss of forest land together contributed an additional 1.6 percent.

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

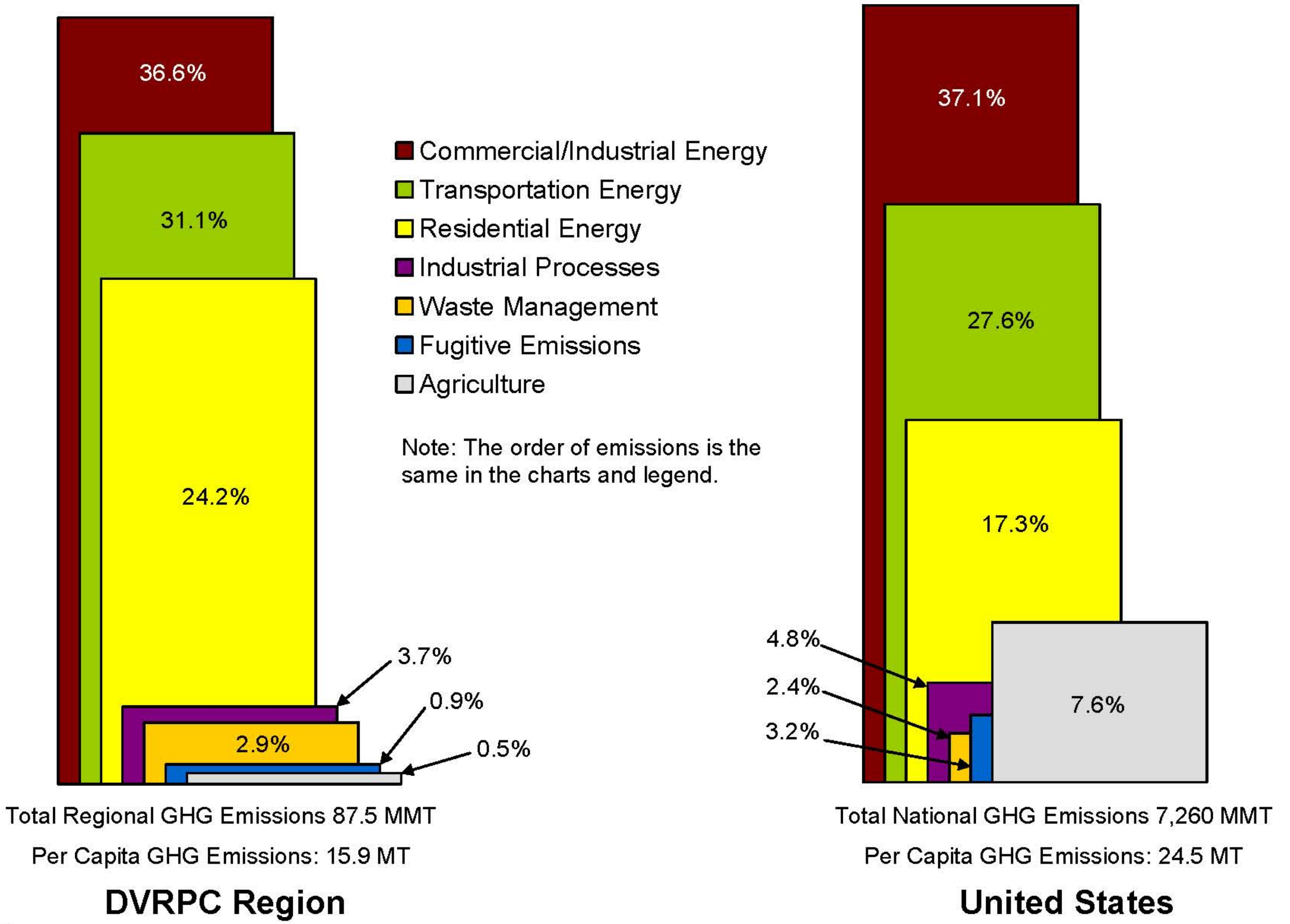
Emissions Source Category	Emissions ($MMTCO_2E$)	Percent of Total	Emissions Reported March 2009 ($MMTCO_2E$)
Stationary Energy Consumption—Residential	21.1	24.2%	21.9
Stationary Energy Consumption—Commercial & Industrial	32.1	36.6%	34.2
Mobile Energy Consumption	27.2	31.1%	27.1
Agriculture	0.5	0.5%	0.5
Waste Management	2.6	2.9%	2.6
Industrial Processes	3.2	3.7%	3.2
Fugitive Emissions from Fuel Systems	0.8	0.9%	0.8
Gross Emissions	**87.5**	**100%**	**90.3**
Land Use, Land Use Change, and Forestry[10]	0.2		0.2
Net Emissions	**87.7**		**90.4**

Source: DVRPC, 2010

In Figure 2 below, each bar on the graphs represents a single emissions source category. The height of the bar 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, such as agriculture, the relative share of emissions is quite different.

[10] 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.

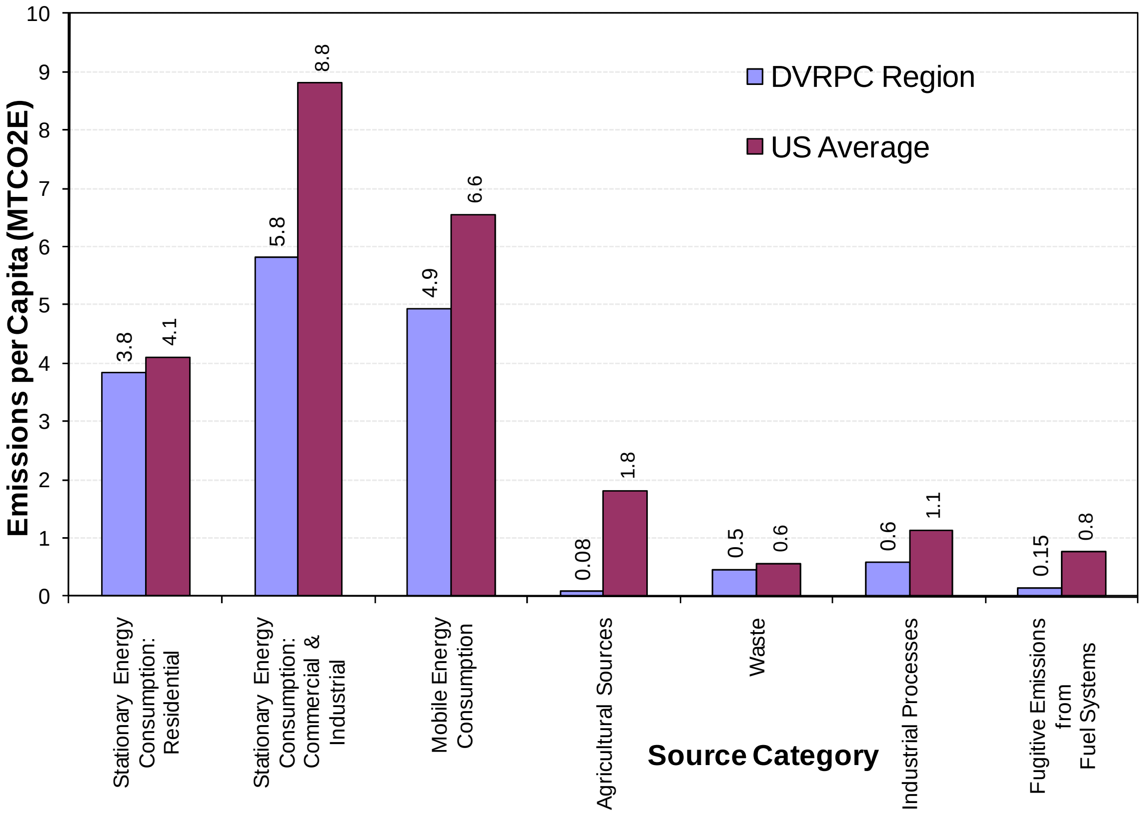
Figure 2. Relative Contribution of Emission Sources to Total DVRPC and National GHG Emissions by Source Category—2005



Source: DVRPC, 2010

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 15.9 $MTCO_2E$ per person are more than one-third lower than the national average of 24.5 $MTCO_2E$ per capita. This difference is driven in part by the region's lower per capita transportation, commercial/industrial, and agricultural emissions, as well as because the regional emissions exclude emissions associated with goods and services consumed in the DVRPC region but produced elsewhere (such as food imported from outside the region, and its associated transportation).

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



Source: DVRPC, 2010

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 (60.8%)

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 2005 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 slightly lower than the national values, at 36.6 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 $MMTCO_2E$
Direct Emissions	Natural Gas	6.6
	Coal	0.004
	Distillate Fuel Oil	2.9
	Kerosene	0.2
	LPG	0.3
Indirect Emissions	Purchased Electricity	11.1
Total		**21.1**
	Percent of region	24.2%
	Percent for nation	17.3%
Per capita ($MTCO_2E$/person)	Region	3.8
	U.S.	4.1

Source: DVRPC, 2010

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

Source	Fuel Type	Emissions $MMTCO_2E$
Direct Emissions	Natural Gas	7.6
	Coal	0.2
	Petroleum Coke	1.5
	Distillate Fuel Oil	1.9
	Residual Fuel	0.5
	Kerosene	0.2
	LPG	0.2
	Other fuels	1.0
Indirect Emissions	Purchased Electricity	19.0
Total		**32.1**
	Percent of region	36.6%
	Percent for nation	37.1%
Per capita ($MTCO_2E$/person)	Region	5.8
	U.S.	8.8

Source: DVRPC, 2010

1.5 Mobile Energy Consumption (31.1%)

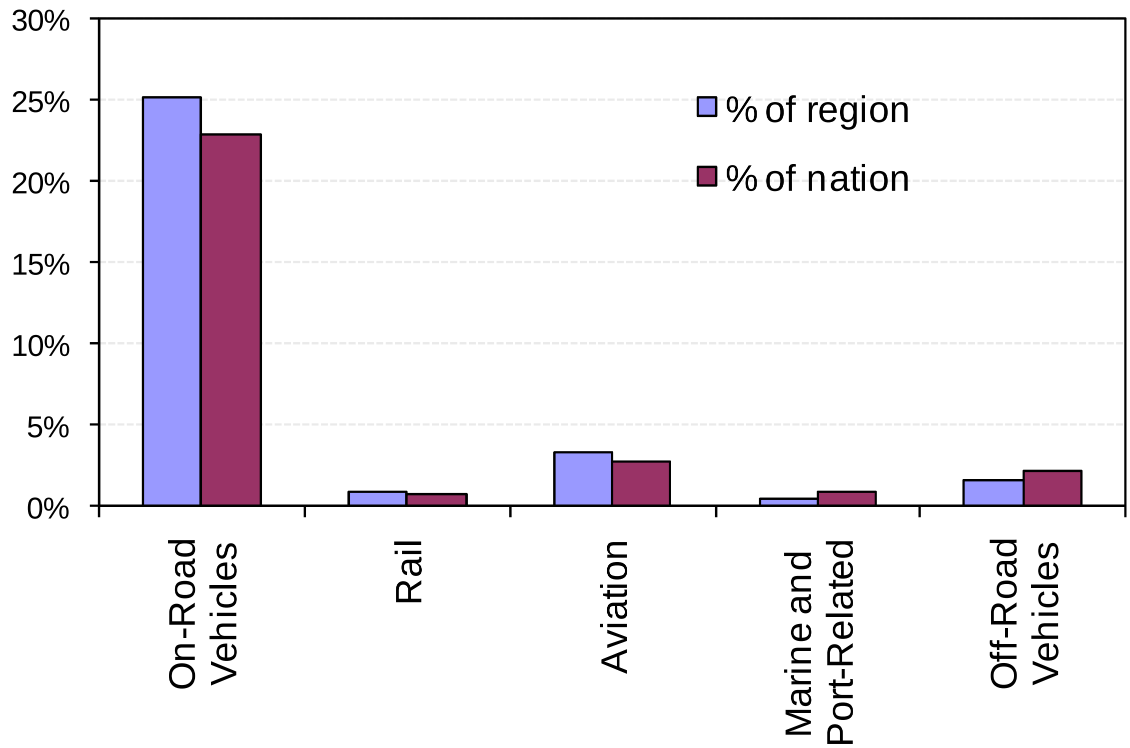
Fossil fuels used to power cars, trucks, mass transit, passenger and freight rail, aviation, and marine transport in the planning region resulted in emissions of approximately 27.2 $MMTCO_2E$ in 2005, representing 31.1 percent of total emissions. A summary of major mobile sources is presented in Table 4 below, while additional detail regarding on-road mobile sources is presented in Table 5 below. 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		21.9
Rail		0.7
Aviation		2.8
Marine & Port-Related		0.4
Off Road Vehicles		1.4
Total		**27.2**
	Percent of region	31.1%
	Percent for nation	27.6%
Per capita (MTCO$_2$E/person)	Region	4.9
	U.S.	6.6

Source: DVRPC, 2010

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



Source: DVRPC, 2010

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

Vehicle Type		Emissions $MMTCO_2E$
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		0.2
Total		**21.9**
	Percent of region	25.1%
	Percent for nation	22.8%
Per capita ($MTCO_2E$/person)	Region	4.0
	U.S.	6.6

Source: DVRPC, 2010

1.6 Agricultural Sources (0.5%)

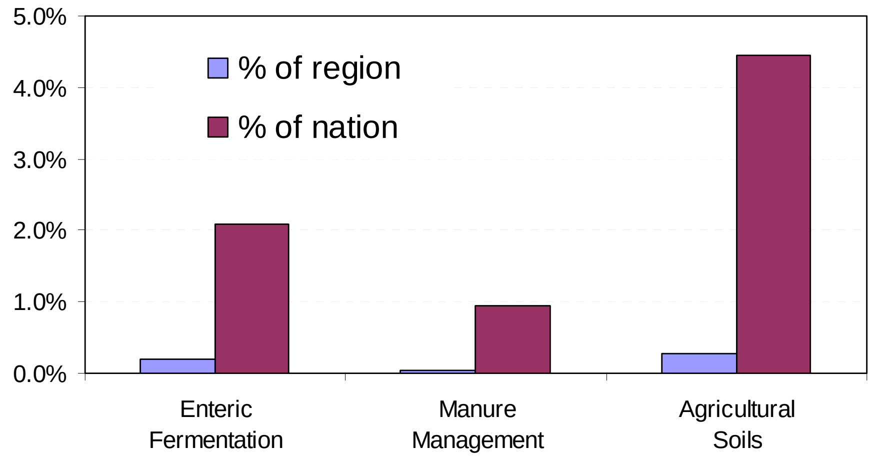
Sources of GHG emissions in the agricultural sector include enteric fermentation, manure management, and agricultural soils. Combined, these sources account for 0.45 $MMTCO_2E$, one-half percent of the region's total emissions. By contrast the agriculture sector represents 7.6 percent of total U.S. emissions.

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, 2010

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



Source: DVRPC, 2010

1.7 Waste Management (2.9%)

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 $MMTCO_2E$**
Landfill Methane		1.9
Wastewater		0.7
Total		**2.6**
	Percent of region	2.9%
	Percent for nation	2.4%
Per capita ($MTCO_2E$/person)	Region	0.5
	U.S.	0.6

Source: DVRPC, 2010

1.8 Industrial Processes (3.7%)

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	3.7%
	Percent for nation	4.7%
Per capita ($MTCO_2E$/person)	Region	0.6
	U.S.	1.1

Source: DVRPC, 2010

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, 2010

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 (60.8%)

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[11] (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).

[11] 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

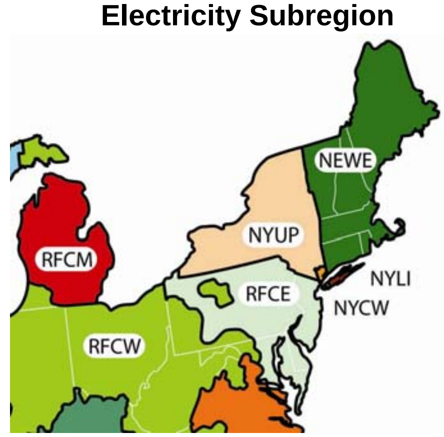
Note: The emission factors vary by year for some fuels (LPG, Natural Gas) and by year and by state for coal.

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:

Figure 6: The RFC East Electricity Subregion



Source: US EPA, 2007

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 RFC East (RFCE) subregion of the electrical grid, shown in Figure 6.[12] As shown in Table 11 below, coal—the most CO_2-intensive fuel—accounts for the

[12] RFCE is a US EPA-defined subregion of the larger PJM Interconnection LLC (PJM), 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. The DVRPC region falls entirely within the RFCE subregion. Based on recommendations contained in *The Value of eGRID and*

largest portion of generation in the RFCE subregion (45.1 percent), while nuclear power, which does not result in GHG emissions, is the second most common fuel, providing 38.3 percent of generation. In 2005, the average CO_2 emission rate for the RFCE subregion was 1,139 lbs CO_2/MWh. The average emissions rate for methane was 30.3 lbs CH_4/GWh and the average emissions rate for nitrous oxide was 18.7 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. According to US EPA, the transmission and distribution losses for the RFCE subregion average 6.409 percent.[13] Thus, this analysis increased the electricity GHG emission rates by 6.409 percent to account for these losses. Together these factors result in a net emissions factor of 1,219 lbs CO_2E/MWh.

Table 11: RFC East Electricity Generation Resource Mix—2005

Fuel	Percent of Generation
Coal	45.1%
Nuclear	38.3%
Gas	9.6%
Oil	4.0%
Biomass/wood	1.1%
Hydro	0.9%
Other fossil combustion	0.9%
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 or treated differently by different electrical distribution companies. While the data was available to estimate portions of these sectors separately, for the regional totals 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.[14]

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

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eGRIDweb to GHG Inventories (Dec 2009, EPA & Pechan & Associates), we have used emissions factors from the Emissions & Generation Resource Integrated Database (eGRID) for the RFCE subregion. Electricity for all consumers in the DVRPC region is drawn from this portion of the grid, thus the average emissions for generation for this subregion are appropriate to use.

[13] *The Value of eGRID and eGRIDweb to GHG Inventories*, Dec 2009, EPA & Pechan & Associates

[14] 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.

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 small number of New Jersey households that report heating with coal are 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.[15] 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.

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.[16] 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.[17]

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.

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

[16] Coal ranges in heat value from under 6,000 Btu/lb to close to 14,000 Btu/lb depending on source and type.

[17] 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 (31.1%)

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,[18] 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.

[18] 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).[19]

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

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

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.[20] 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-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

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

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		1.6%
% for nation		2.2%
Per capita ($MTCO_2E$/person)	Region	0.25
	U.S.	0.52

Source: DVRPC, 2010

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 (2.9%)

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[21], 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[22], fraction of wastewater treated anaerobically, and annual protein consumption.[23] 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 (3.7%)

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).

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

[22] 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.

[23] 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).

2.5.2 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).

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).[24]

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.

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[24] 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.

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 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 7 shows how the municipalities in the region differ from each other in density of population and employment. Figure 8 and Figure 9 illustrate the results of the municipality level greenhouse gas emissions allocation and their relationship to density in two different views.[25]

Figure 8 shows greenhouse gas emissions per acre by municipality for the DVRPC region.[26] 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 9 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.

[25] 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.

[26] 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 7:
Population + Employment per Acre by Municipality (2005)

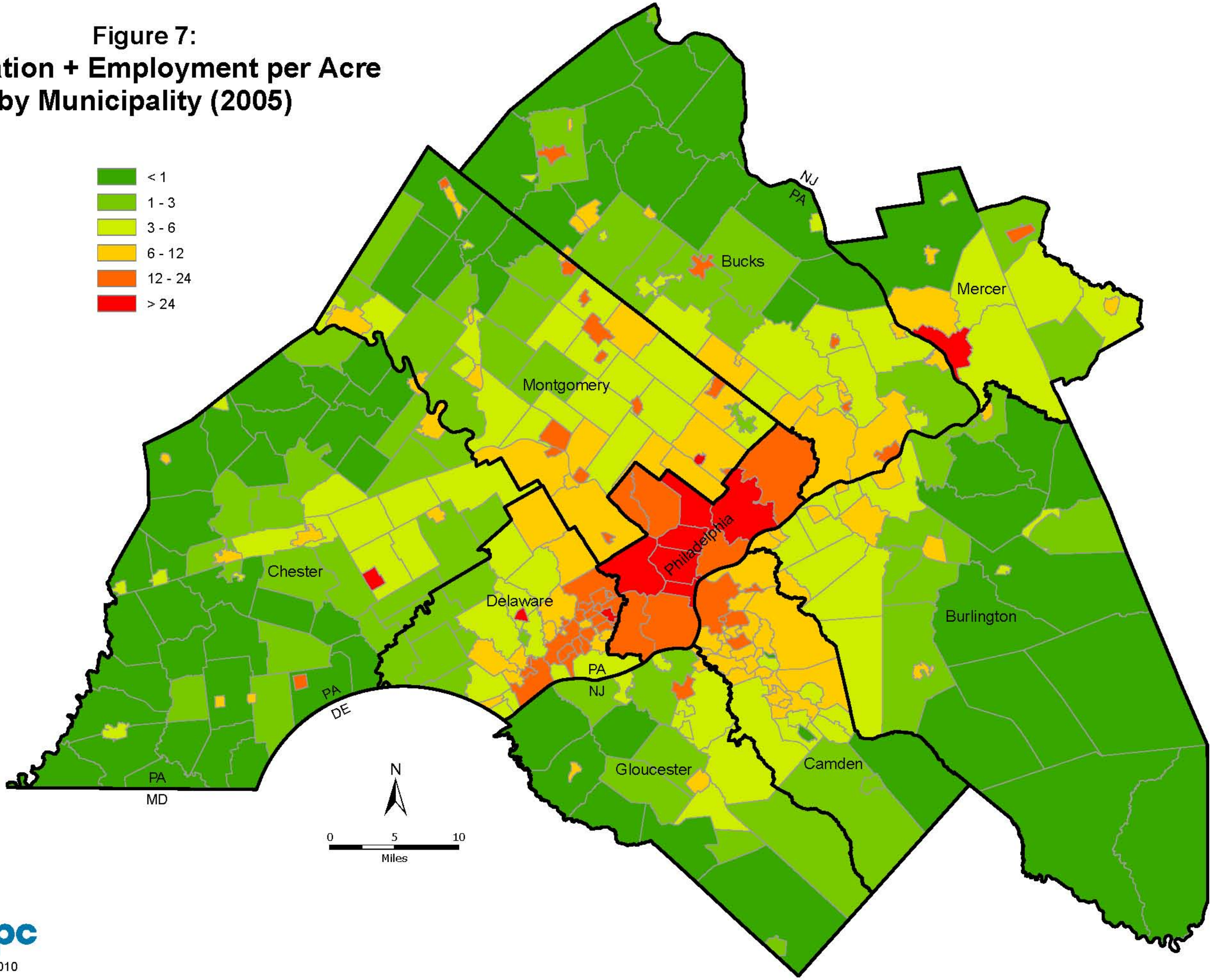

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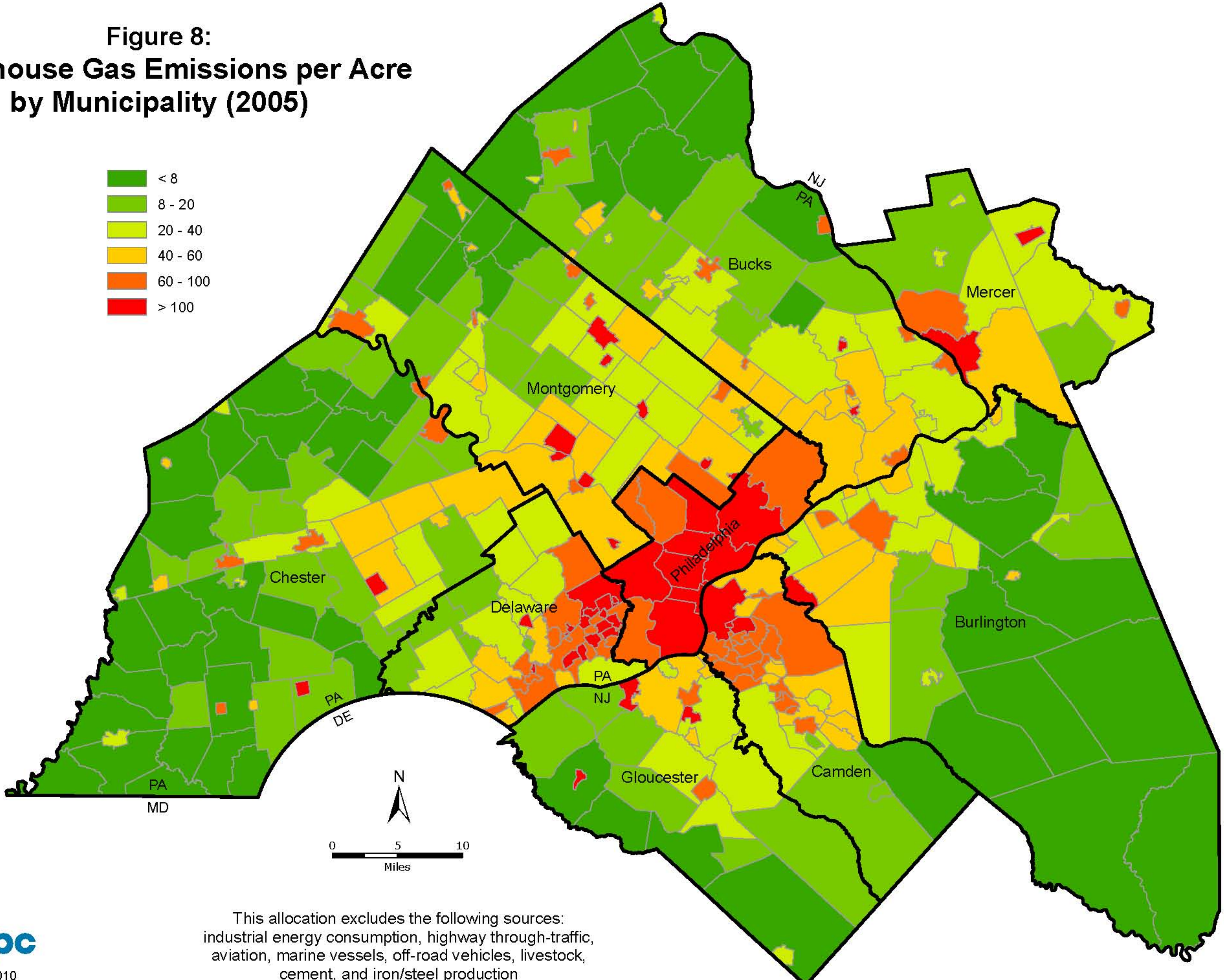
Figure 8:
Greenhouse Gas Emissions per Acre by Municipality (2005)



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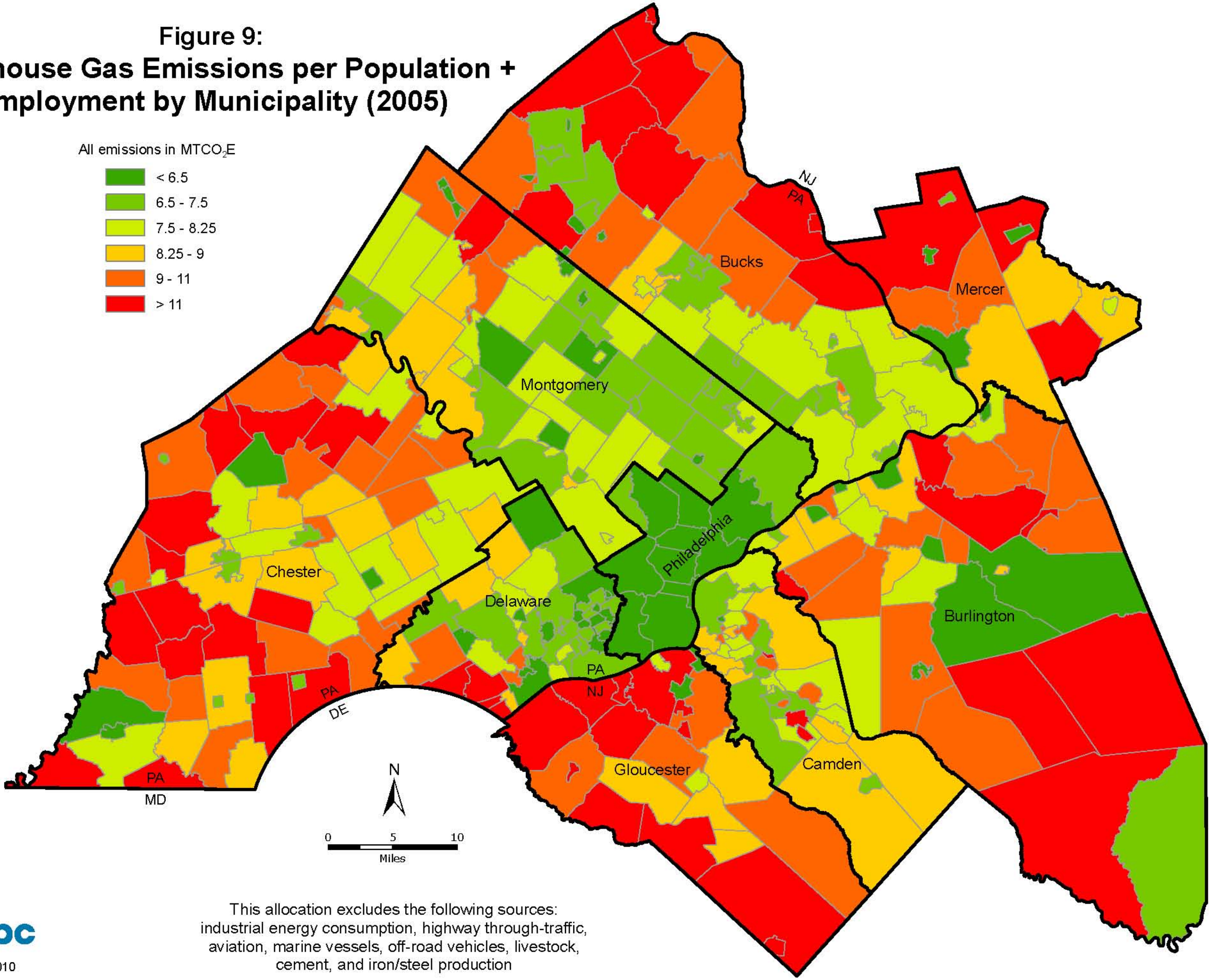
This allocation excludes the following sources: industrial energy consumption, highway through-traffic, aviation, marine vessels, off-road vehicles, livestock, cement, and iron/steel production

Figure 9:
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

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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	0.0037	x	x			x
Distillate Fuel Oil	2.91	x	x			x
Kerosene	0.21	x	x			x
LPG	0.27	x	x			x
Purchased Electricity	11.10	x	x			x
Stationary Energy— Commercial						
Fuel Type						
Natural Gas	5.61	x	x			x
Coal	0.04	x	x		x	
Distillate	1.05	x	x		x	
Kerosene	0.08	x	x		x	
LPG	0.05	x	x		x	
Residual Fuel	0.13	x	x	x		
Motor Gasoline	0.02	x	x	x		
Purchased Electricity	8.75	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	10.20	x	some MCDs			x
Mobile Energy						
Highway (ex. thru & airport traffic)	20.46	x	x			x
Public transit (buses and rail)	0.45	x	x			x
Highway through & airport traffic	1.29					
Freight Rail	0.28					
Intercity Rail (electric)	0.18					
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 ($MMTCO_2E$)	**87.66** **100%**	**78.5** **90%**	**73.5** **84%**	**2.8** **3.6%**	**4.0** **5%**	**71.7** **91.3%**

Source: DVRPC, 2010

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 industrial 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).[27]

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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[27] 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.[28] The CO_2 emissions per TAZ were rolled up into municipality totals using a correspondence table that matched TAZs with municipalities.[29] 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.

[28] 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.

[29] 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.

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APPENDIX A: 2005 ALLOCATED INVENTORY

Please contact DVRPC for more detailed allocation data, including energy use.

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[30]	Net Emissions
	Residential	Commercial	Industrial			Landfill	Waste water					
Burlington	1,771	1,672	529	2,049	23	170	56	159	68	**6,497**	138	**6,635**
Camden	1,913	1,679	470	1,848	0	196	65	183	66	**6,421**	(28)	**6,393**
Gloucester	1,158	1,372	520	1,209	16	104	34	98	61	**4,572**	71	**4,643**
Mercer	1,344	1,651	321	1,654	70	139	46	130	58	**5,414**	28	**5,441**
Bucks	2,664	1,406	1,194	2,649	108	202	78	222	33	**8,556**	21	**8,577**
Chester	2,060	1,281	1,568	2,508	180	153	60	169	26	**8,004**	118	**8,122**
Delaware	2,108	911	1,647	2,243	3	180	70	198	49	**7,408**	(12)	**7,396**
Montgomery	3,234	2,127	2,900	3,841	51	253	98	278	69	**12,850**	(154)	**12,697**
Philadelphia	4,805	3,238	4,182	3,822	0	480	187	528	213	**17,456**	(37)	**17,419**

Source: DVRPC, 2010

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.

[30] 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$_2$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
Bass River Township	7,355	2,796	0	#N/A	5,021	139	590	195	552	0	16,647	(660)	15,987
Beverly City	6,390	3,038	#N/A	#N/A	8,173	-	1,008	333	943	178	20,061	96	20,157
Bordentown City	5,047	3,788	#N/A	#N/A	18,735	-	1,505	497	1,409	110	31,091	125	31,216
Bordentown Township	28,075	24,828	#N/A	#N/A	55,601	86	3,893	1,285	3,642	1,137	118,546	9,814	128,360
Burlington City	23,774	24,326	#N/A	#N/A	43,044	0	3,695	1,219	3,457	714	100,230	(1,277)	98,952
Burlington Township	81,701	91,589	#N/A	#N/A	101,064	125	8,270	2,729	7,738	2,957	296,173	9,377	305,551
Chesterfield Township	33,439	18,505	#N/A	#N/A	13,660	1,368	2,357	778	2,205	1,095	73,407	4,301	77,708
Cinnaminson Township	70,459	50,389	#N/A	#N/A	61,896	25	5,717	1,887	5,349	2,406	198,126	969	199,094
Delanco Township	25,911	17,316	#N/A	#N/A	18,874	36	1,496	494	1,400	800	66,327	3,897	70,225
Delran Township	70,747	48,159	#N/A	#N/A	62,296	52	6,572	2,169	6,149	2,149	198,293	8,309	206,603
Eastampton Township	28,617	26,722	#N/A	#N/A	22,302	175	2,539	838	2,376	906	84,475	520	84,995
Edgewater Park Township	27,759	14,349	#N/A	#N/A	23,934	30	3,026	999	2,831	924	73,852	2,719	76,571
Evesham Township	185,297	137,028	#N/A	#N/A	200,160	239	17,723	5,849	16,581	5,179	568,056	2,583	570,639
Fieldsboro Borough	1,653	1,004	#N/A	#N/A	2,394	-	220	72	206	36	5,585	653	6,238
Florence Township	68,349	63,074	#N/A	#N/A	43,214	270	4,316	1,424	4,038	2,451	187,137	12,270	199,408
Hainesport Township	23,489	15,483	#N/A	#N/A	34,185	116	2,232	737	2,088	530	78,859	7,850	86,709
Lumberton Township	32,186	35,417	#N/A	#N/A	43,250	543	4,689	1,547	4,387	1,194	123,211	(1,232)	121,980
Mansfield Township	34,866	20,669	#N/A	#N/A	29,357	1,135	2,890	954	2,704	1,049	93,623	3,602	97,225
Maple Shade Township	66,041	222,449	#N/A	#N/A	70,667	1	7,360	2,429	6,886	11,317	387,151	(335)	386,815
Medford Township	129,467	81,416	#N/A	#N/A	106,196	700	8,913	2,942	8,339	4,429	342,402	16,405	358,806
Medford Lakes Borough	7,594	3,172	#N/A	#N/A	13,569	-	1,579	521	1,478	144	28,058	(582)	27,476
Moorestown Township	115,633	143,120	#N/A	#N/A	123,907	212	7,552	2,492	7,066	4,372	404,353	1,033	405,387
Mount Holly Township	17,904	17,466	#N/A	#N/A	49,946	1	4,025	1,328	3,766	445	94,884	(814)	94,069
Mount Laurel Township	177,023	220,155	#N/A	#N/A	212,011	221	15,336	5,061	14,348	5,138	649,293	(1,436)	647,857
New Hanover Township	8,561	102,974	#N/A	#N/A	43,902	137	3,637	1,195	3,387	3,974	167,768	(535)	167,233
North Hanover Township	23,264	13,721	#N/A	#N/A	40,812	923	2,869	947	2,684	727	85,947	3,826	89,773
Palmyra Borough	30,442	14,247	#N/A	#N/A	26,189	-	2,883	952	2,698	868	78,280	572	78,852
Pemberton Borough	3,757	2,936	#N/A	#N/A	7,727	2	499	165	467	14	15,568	3,012	18,580
Pemberton Township	47,723	36,278	#N/A	#N/A	114,512	1,372	10,904	3,599	10,202	2,543	227,133	1,351	228,485
Riverside Township	20,391	11,513	#N/A	#N/A	24,789	-	3,015	995	2,821	495	64,019	(750)	63,269
Riverton Borough	8,224	4,921	#N/A	#N/A	9,805	-	1,033	341	967	208	25,500	(347)	25,153
Shamong Township	34,310	6,948	#N/A	#N/A	26,015	559	2,591	855	2,424	188	73,891	7,434	81,325
Southampton Township	19,187	5,174	#N/A	#N/A	48,414	1,705	4,125	1,361	3,860	182	84,008	5,782	89,790
Springfield Township	41,903	34,554	#N/A	#N/A	15,807	1,969	1,343	443	1,257	1,442	98,717	2,182	100,898
Tabernacle Township	43,160	11,331	#N/A	#N/A	26,829	666	2,775	916	2,596	168	88,442	30,412	118,854
Washington Township	11,986	3,432	0	#N/A	3,213	426	244	80	228	170	19,780	2,019	21,799
Westampton Township	52,977	52,099	#N/A	#N/A	46,319	384	3,268	1,079	3,058	1,760	160,944	(1,560)	159,384
Willingboro Township	137,120	54,372	#N/A	#N/A	91,316	3	12,616	4,163	11,804	4,463	315,857	(3,445)	312,413
Woodland Township	15,541	7,371	#N/A	#N/A	11,397	508	517	171	484	309	36,297	8,391	44,688
Wrightstown Borough	3,347	23,778	#N/A	#N/A	15,671	4	281	98	279	546	44,004	1,392	45,396

Source: DVRPC, 2010

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	36,693	20,946	#N/A	#N/A	28,691	-	3,460	1,142	3,238	1,048	95,218	(798)	93,372
Audubon Park Borough	3,524	2,145	#N/A	#N/A	3,075	-	408	135	382	119	9,789	(80)	9,589
Barrington Borough	25,484	12,195	#N/A	#N/A	21,466	0	2,667	880	2,495	766	65,953	(931)	64,256
Bellmawr Borough	41,269	43,399	#N/A	#N/A	46,260	0	4,259	1,406	3,985	1,698	142,277	(1,492)	139,087
Berlin Borough	29,134	37,122	#N/A	3,489	36,807	0	2,815	929	2,634	386	113,316	639	113,569
Berlin Township	23,080	27,332	#N/A	#N/A	32,091	0	2,042	674	1,911	1,014	88,144	(37)	87,093
Brooklawn Borough	9,046	7,263	#N/A	#N/A	9,640	-	876	289	820	241	28,174	(243)	27,690
Camden City	223,674	315,848	#N/A	#N/A	180,590	-	30,343	10,014	28,391	10,696	799,556	(6,686)	782,173
Cherry Hill Township	302,739	346,999	#N/A	#N/A	316,466	0	27,206	8,979	25,456	11,943	1,039,788	(9,373)	1,018,472
Chesilhurst Borough	5,644	1,441	#N/A	10	5,352	0	667	220	624	23	13,983	(117)	13,843
Clementon Borough	37,202	22,608	0	#N/A	16,902	-	1,870	617	1,750	731	81,681	(503)	80,447
Collingswood Borough	50,118	48,551	#N/A	#N/A	41,624	-	5,327	1,758	4,984	1,578	153,940	(1,057)	151,305
Gibbsboro Borough	11,303	15,512	#N/A	#N/A	14,428	0	934	308	874	377	43,736	501	43,859
Gloucester Township	201,226	120,023	#N/A	#N/A	192,452	0	25,132	8,295	23,515	8,191	578,834	977	571,620
Gloucester City City	46,399	34,613	#N/A	#N/A	32,421	-	4,381	1,446	4,099	1,181	124,539	(1,010)	122,347
Haddon Township	61,863	53,426	#N/A	#N/A	48,080	-	5,513	1,820	5,159	1,988	177,848	(1,021)	174,840
Haddonfield Borough	52,804	22,097	#N/A	#N/A	46,307	-	4,385	1,447	4,103	1,524	132,667	(1,283)	129,860
Haddon Heights Borough	34,652	13,992	#N/A	#N/A	26,028	-	2,810	927	2,629	956	81,994	(789)	80,249
Hi-Nella Borough	3,687	1,703	#N/A	#N/A	2,806	-	384	127	359	112	9,178	(96)	8,970
Laurel Springs Borough	10,000	9,020	0	12	6,296	-	734	242	686	171	27,161	(247)	26,743
Lawnside Borough	11,903	17,010	#N/A	#N/A	16,385	-	1,051	347	983	509	48,188	599	48,279
Lindenwold Borough	53,798	26,562	#N/A	#N/A	47,375	-	6,531	2,155	6,111	1,455	143,989	(1,136)	141,398
Magnolia Borough	14,677	5,115	#N/A	#N/A	12,665	-	1,660	548	1,554	433	36,653	(390)	35,830
Merchantville Borough	10,583	7,598	#N/A	#N/A	12,019	-	1,445	477	1,352	307	33,780	(347)	33,127
Mount Ephraim Borough	15,445	7,723	#N/A	#N/A	14,308	-	1,690	558	1,581	451	41,756	(103)	41,202
Oaklyn Borough	18,564	8,516	#N/A	#N/A	13,297	-	1,557	514	1,457	523	44,428	(350)	43,555
Pennsauken Township	119,439	166,256	#N/A	#N/A	145,799	-	13,439	4,436	12,575	4,997	466,941	(4,202)	457,742
Pine Hill Borough	39,291	17,747	#N/A	#N/A	27,584	-	4,277	1,411	4,001	1,273	95,585	(1,163)	93,148
Pine Valley Borough	4,209	4,538	#N/A	2	375	-	8	3	8	359	9,501	(46)	9,096
Runnemede Borough	32,983	27,588	#N/A	#N/A	28,553	-	3,223	1,064	3,016	1,205	97,631	(955)	95,471
Somerdale Borough	21,083	10,585	#N/A	#N/A	16,568	-	1,950	644	1,825	667	53,320	(592)	52,061
Stratford Borough	24,585	19,456	#N/A	#N/A	26,287	-	2,727	900	2,551	485	76,990	(765)	75,740
Tavistock Borough	5,647	2,098	#N/A	#N/A	-	-	9	3	-	149	7,906	(59)	7,698
Voorhees Township	121,237	117,368	#N/A	#N/A	130,453	0	10,983	3,625	10,276	3,548	397,490	(2,119)	391,823
Waterford Township	48,000	18,085	#N/A	#N/A	40,017	0	4,052	1,337	3,792	1,068	116,351	(1,371)	113,912
Winslow Township	155,196	63,848	#N/A	60,501	116,038	0	14,188	4,683	13,275	3,680	431,409	8,966	436,694
Woodlynne Borough	7,068	2,661	#N/A	#N/A	4,698	-	1,038	343	972	161	16,939	(114)	16,665

Source: DVRPC, 2010

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	29,555	18,937	#N/A	10,254	29,184	105	2,769	914	2,591	1,158	95,466	(2,839)	92,627
Deptford Township	128,373	112,517	#N/A	#N/A	130,316	122	11,213	3,701	10,491	4,656	401,389	(1,629)	399,759
East Greenwich Township	32,336	36,354	#N/A	#N/A	23,111	636	2,362	780	2,210	2,019	99,809	(674)	99,135
Elk Township	19,160	23,982	#N/A	304	16,520	929	1,429	472	1,337	1,692	65,826	4,868	70,693
Franklin Township	73,377	57,864	#N/A	284	74,479	1,370	6,280	2,073	5,876	3,213	224,816	16,411	241,227
Glassboro Borough	54,032	80,409	#N/A	12,871	74,558	79	7,272	2,400	6,804	3,008	241,432	2,716	244,147
Greenwich Township	24,543	38,777	#N/A	#N/A	27,879	110	1,877	620	1,757	1,786	97,349	8,727	106,076
Harrison Township	49,788	16,509	#N/A	2,156	39,375	838	4,298	1,418	4,021	619	119,023	455	119,478
Logan Township	19,838	105,903	#N/A	46,057	54,011	685	2,340	772	2,189	2,471	234,266	32,490	266,756
Mantua Township	99,067	36,118	#N/A	#N/A	59,105	445	5,721	1,888	5,352	2,713	210,409	3,972	214,382
Monroe Township	140,279	97,861	#N/A	8,872	108,408	603	11,860	3,914	11,096	5,320	388,214	15,154	403,368
National Park Borough	12,859	2,539	#N/A	#N/A	9,131	-	1,215	401	1,137	207	27,489	(436)	27,053
Newfield Borough	9,517	7,525	#N/A	2,439	18,566	30	626	207	586	177	39,673	68	39,741
Paulsboro Borough	27,551	125,381	#N/A	#N/A	24,999	-	2,298	758	2,150	5,818	188,956	(1,102)	187,854
Pitman Borough	36,150	20,195	#N/A	24,764	30,737	5	3,488	1,151	3,263	1,061	120,813	(650)	120,163
South Harrison Township	13,459	4,793	#N/A	11	12,822	890	1,088	359	1,018	565	35,006	2,246	37,252
Swedesboro Borough	19,233	28,392	#N/A	6,061	17,393	6	773	255	723	44	72,881	(106)	72,775
Washington Township	183,913	148,598	#N/A	#N/A	164,354	190	19,108	6,306	17,879	5,316	545,664	(2,877)	542,787
Wenonah Borough	22,561	5,052	0	#N/A	8,445	0	879	290	823	329	38,380	(438)	37,942
West Deptford Township	83,049	288,835	#N/A	#N/A	88,458	165	7,883	2,602	7,376	13,788	492,156	(2,786)	489,369
Westville Borough	9,780	5,980	#N/A	#N/A	18,773	-	1,684	556	1,575	183	38,530	(609)	37,921
Woodbury City	28,323	28,910	#N/A	#N/A	53,918	-	3,934	1,298	3,681	707	120,770	(411)	120,359
Woodbury Heights Borough	13,988	51,248	#N/A	#N/A	12,331	-	1,139	376	1,066	2,716	82,866	(543)	82,322
Woolwich Township	27,035	29,264	#N/A	2,013	27,696	1,075	2,851	941	2,668	1,236	94,778	(1,476)	93,302

Source: DVRPC, 2010

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	42,105	83,022	#N/A	#N/A	158,975	602	10,159	3,353	9,505	4,746	312,466	9,454	321,920
Ewing Township	160,855	267,821	#N/A	#N/A	163,757	131	14,130	4,663	13,220	8,995	633,571	(235)	633,337
Hamilton Township	357,010	307,649	#N/A	#N/A	325,878	633	34,110	11,257	31,913	13,455	1,081,905	13,893	1,095,798
Hightstown Borough	17,147	16,896	#N/A	#N/A	30,609	3	2,008	663	1,879	346	69,552	727	70,278
Hopewell Borough	3,281	2,791	0	#N/A	9,541	13	773	255	723	19	17,395	(864)	16,531
Hopewell Township	120,062	119,795	#N/A	#N/A	81,360	2,285	6,732	2,222	6,299	3,726	342,481	198	342,680
Lawrence Township	147,417	209,715	#N/A	#N/A	154,287	433	11,915	3,932	11,148	5,964	544,812	1,176	545,988
Pennington Borough	6,252	2,681	0	#N/A	10,977	0	1,023	338	957	87	22,314	(1,069)	21,244
Princeton Borough	19,901	55,503	#N/A	#N/A	44,660	-	5,159	1,702	4,827	964	132,716	(1,699)	131,016
Princeton Township	89,383	157,904	#N/A	#N/A	72,127	154	6,544	2,160	6,123	4,029	338,424	(7,999)	330,426
Trenton City	210,242	278,423	#N/A	#N/A	216,379	-	32,155	10,612	30,085	8,246	786,142	(2,689)	783,453
Washington Township	57,440	58,993	#N/A	#N/A	53,658	936	4,409	1,455	4,125	2,923	183,939	8,103	192,041
West Windsor Township	113,214	90,238	#N/A	#N/A	194,853	618	9,860	3,254	9,225	4,058	425,321	8,671	433,992

Source: DVRPC, 2010

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 ($MTCO_2E$)

	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
Bedminster Township	45,681	14,879	304	#N/A	22,461	10,514	1,608	625	1,771	31	97,874	382	98,256
Bensalem Township	227,718	182,673	14,949	106,645	274,277	140	19,036	7,398	20,973	3,832	857,639	(4,695)	852,945
Bridgeton Township	6,158	1,254	0	#N/A	7,964	232	463	180	510	-	16,761	1,127	17,888
Bristol Borough	41,889	26,385	872	16,409	41,698	-	3,181	1,236	3,505	867	136,041	(905)	135,137
Bristol Township	234,041	121,144	16,038	117,091	178,537	15	17,666	6,865	19,464	2,404	713,264	(1,992)	711,272
Buckingham Township	99,835	27,262	1,653	4,742	67,354	7,853	6,043	2,348	6,658	1,243	224,991	1,951	226,942
Chalfont Borough	21,324	9,771	7,845	#N/A	15,669	34	1,359	528	1,498	280	58,308	(298)	58,010
Doylestown Borough	35,821	42,918	0	15,073	47,810	0	2,677	1,040	2,949	834	149,123	(1,088)	148,035
Doylestown Township	79,079	38,701	565	#N/A	69,327	1,188	6,116	2,377	6,738	980	205,071	(3,058)	202,013
Dublin Borough	7,976	3,346	0	3,726	9,229	37	706	274	777	0	26,071	78	26,148
Durham Township	7,584	1,312	0	#N/A	7,585	2,250	426	166	469	-	19,791	1,122	20,914
East Rockhill Township	19,353	8,015	0	#N/A	21,278	1,204	1,853	720	2,041	-	54,464	(1,571)	52,893
Falls Township	127,458	101,684	49,339	87,206	126,989	192	11,080	4,306	12,206	2,369	522,830	(3,990)	518,840
Haycock Township	24,348	12,287	0	#N/A	9,487	1,952	762	296	839	-	49,970	5,188	55,159
Hilltown Township	55,688	33,569	0	#N/A	49,052	6,705	4,178	1,624	4,603	191	155,610	2,232	157,842
Hulmeville Borough	4,283	865	0	267	2,479	32	284	111	313	62	8,697	216	8,913
Ivyland Borough	3,889	5,133	0	1,390	6,701	21	274	107	302	84	17,901	(59)	17,843
Langhorne Borough	6,604	11,521	10,301	80,673	7,793	5	639	248	704	311	118,799	(235)	118,565
Langhorne Manor Borough	6,522	6,342	0	3,275	7,127	-	349	136	385	131	24,267	(177)	24,090
Lower Makefield Township	154,587	33,361	#N/A	#N/A	92,095	1,419	10,577	4,110	11,653	2,003	309,806	(4,373)	305,433
Lower Southampton Township	82,906	50,939	1,227	10,435	80,152	127	6,254	2,430	6,890	1,032	242,392	(1,965)	240,427
Middletown Township	177,355	103,576	3,124	13,768	190,730	506	15,376	5,975	16,940	2,370	529,721	(6,022)	523,698
Milford Township	39,024	18,482	0	#N/A	38,008	7,139	3,080	1,197	3,393	-	110,323	9,045	119,368
Morrisville Borough	37,222	21,334	14,767	26,437	39,004	0	3,173	1,233	3,496	686	147,351	(878)	146,473
New Britain Borough	11,462	5,905	0	#N/A	11,254	5	748	291	824	85	30,574	(472)	30,102
New Britain Township	52,278	24,914	2,955	#N/A	40,542	2,343	3,526	1,370	3,884	422	132,234	643	132,877
New Hope Borough	11,981	15,983	0	309	38,881	-	741	288	816	224	69,222	(45)	69,176
Newtown Borough	12,585	11,400	0	951	13,522	0	729	283	803	195	40,470	(309)	40,161
Newtown Township	80,592	46,833	698	12,586	83,061	1,316	6,207	2,412	6,839	1,598	242,142	(240)	241,902
Nockamixon Township	17,145	3,064	0	#N/A	19,085	3,605	1,195	464	1,316	-	45,874	9,408	55,282
Northampton Township	191,973	50,628	188	9,436	128,960	2,069	13,284	5,162	14,634	1,933	418,268	(9,859)	408,408
Penndel Borough	8,063	8,906	0	5,520	9,816	0	775	301	854	242	34,478	(231)	34,246
Perkasie Borough	28,082	13,816	0	0	31,447	60	2,824	1,097	3,111	-	80,439	(865)	79,574
Plumstead Township	58,331	30,759	2,689	#N/A	47,352	6,594	3,862	1,501	4,255	532	155,874	(1,734)	154,140
Quakertown Borough	32,723	20,062	0	#N/A	50,375	9	2,854	1,109	3,144	-	110,275	(170)	110,105
Richland Township	34,346	16,483	0	#N/A	50,427	4,253	4,066	1,580	4,480	-	115,634	10,840	126,474
Richlandtown Borough	2,243	169	0	#N/A	3,959	25	437	170	481	-	7,483	(126)	7,357
Riegelsville Borough	3,155	550	0	#N/A	13,098	261	275	107	303	-	17,750	(183)	17,567
Sellersville Borough	6,674	3,900	0	#N/A	22,482	1	1,457	566	1,605	-	36,684	(445)	36,240
Silverdale Borough	1,203	432	0	0	4,317	9	316	123	348	-	6,747	(218)	6,529
Solebury Township	52,941	11,484	614	1,357	35,407	5,005	2,873	1,116	3,165	380	114,342	8,157	122,499
Springfield Township	30,216	6,872	0	#N/A	21,344	7,205	1,651	642	1,819	-	69,749	4,437	74,186
Telford Borough	4,967	3,632	0	#N/A	8,465	0	706	274	778	87	18,911	(240)	18,671
Tinicum Township	19,499	3,508	0	#N/A	21,654	5,835	1,382	537	1,523	-	53,937	4,969	58,906
Trumbauersville Borough	1,720	727	0	#N/A	5,067	98	346	135	381	-	8,475	(119)	8,356

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	8,865	10,659	2,076	10,640	13,486	-	647	251	712	112	47,449	(835)	46,614
Upper Makefield Township	52,528	7,345	0	0	32,988	3,802	2,772	1,077	3,054	99	103,665	8,103	111,768
Upper Southampton Township	62,375	37,821	1,285	20,260	63,171	164	5,022	1,952	5,533	1,459	199,042	(2,388)	196,654
Warminster Township	117,962	80,896	7,905	66,592	115,938	151	10,781	4,190	11,878	3,207	419,500	(4,043)	415,457
Warrington Township	85,977	52,384	220	#N/A	80,157	1,548	7,214	2,803	7,948	1,769	240,020	5,856	245,877
Warwick Township	59,398	17,707	0	4,369	41,876	1,412	4,763	1,851	5,248	1,071	137,696	652	138,348
West Rockhill Township	39,253	22,909	5,904	#N/A	26,326	1,892	1,494	581	1,647	40	100,046	(988)	99,058
Wrightstown Township	16,744	7,440	2,450	4,129	11,933	2,063	905	352	997	90	47,102	1,608	48,710
Yardley Borough	12,023	11,932	0	6,882	14,661	-	824	320	908	238	47,787	(607)	47,181

Source: DVRPC, 2010

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	2,429	710	15,564	#N/A	9,745	68	437	170	481	58	29,662	260	29,922
Avondale Borough	4,075	4,197	468	10,859	7,445	23	355	138	390	57	28,006	(166)	27,840
Birmingham Township	23,040	7,409	185	1,910	14,684	448	1,381	536	1,519	335	51,447	(1,621)	49,826
Caln Township	54,812	29,216	720	21,531	56,614	199	3,973	1,541	4,370	693	173,669	5,958	179,627
Charlestown Township	26,402	13,751	6,298	6,221	23,785	1,039	1,886	732	2,074	269	82,457	7,123	89,580
Coatesville City	46,719	12,923	7,419	261,128	31,260	-	3,721	1,444	4,093	658	369,363	3,225	372,589
Downingtown Borough	26,052	26,204	3,591	41,006	43,774	31	2,544	987	2,798	630	147,616	(358)	147,258
East Bradford Township	45,368	6,273	0	3,150	30,195	1,173	3,293	1,278	3,623	520	94,873	3,408	98,281
East Brandywine Township	29,716	5,536	0	1,477	22,196	929	2,088	810	2,297	4	65,053	1,831	66,883
East Caln Township	16,804	19,777	0	5,211	24,831	26	1,338	519	1,471	428	70,404	8,461	78,865
East Coventry Township	26,476	6,073	0	2,082	19,987	1,379	1,844	716	2,029	136	60,721	(1,122)	59,599
East Fallowfield Township	31,243	3,470	2,956	#N/A	22,212	1,790	2,172	843	2,389	232	67,307	1,658	68,965
East Goshen Township	83,674	37,720	0	11,376	76,052	207	5,777	2,242	6,355	1,070	224,473	(1,031)	223,443
East Marlborough Township	35,693	20,393	2,548	9,992	32,513	2,141	2,509	974	2,760	532	110,055	2,690	112,745
East Nantmeal Township	10,967	2,495	0	#N/A	8,732	1,765	604	234	664	0	25,462	2,044	27,505
East Nottingham Township	27,460	6,128	0	3,306	30,253	3,321	2,574	999	2,832	-	76,874	3,813	80,687
East Pikeland Township	32,526	12,265	1,161	3,948	27,024	868	2,207	856	2,428	393	83,677	241	83,918
Easttown Township	57,454	23,725	885	1,610	45,508	192	3,366	1,306	3,703	1,069	138,817	(2,709)	136,108
East Vincent Township	28,038	7,319	0	0	22,969	1,749	2,086	810	2,295	175	65,442	(1,550)	63,893
East Whiteland Township	37,725	137,371	15,879	88,978	145,701	211	3,336	1,294	3,669	919	435,084	3,244	438,328
Elk Township	8,157	596	0	0	8,810	1,589	478	185	526	2	20,343	1,101	21,444
Elverson Borough	1,168	803	0	#N/A	21,889	51	377	146	415	-	24,849	(141)	24,708
Franklin Township	19,855	1,751	0	2,338	16,740	1,641	1,384	537	1,523	40	45,809	(577)	45,232
Highland Township	7,302	1,580	0	#N/A	6,795	3,781	387	150	426	4	20,426	1,921	22,346
Honey Brook Borough	2,436	1,085	332	#N/A	7,875	28	449	174	494	51	12,925	(221)	12,703
Honey Brook Township	24,034	13,153	499	#N/A	27,259	4,082	2,209	857	2,430	66	74,590	4,902	79,492
Kennett Township	38,971	30,717	2,292	17,397	35,123	1,419	2,341	908	2,575	367	132,108	(544)	131,565
Kennett Square Borough	19,905	17,481	1,125	19,648	27,393	15	1,713	665	1,884	337	90,166	(391)	89,775
London Britain Township	10,411	1,388	0	0	12,994	867	976	379	1,073	-	28,088	182	28,270
Londonderry Township	8,304	1,661	0	1,477	8,080	2,240	597	232	657	6	23,255	2,065	25,320
London Grove Township	28,790	12,995	0	2,842	23,022	2,530	2,022	785	2,225	370	75,580	(1,035)	74,544
Lower Oxford Township	4,457	1,257	0	0	20,204	3,246	1,589	616	1,748	-	33,117	1,233	34,349
Malvern Borough	13,115	12,194	2,594	12,030	19,531	6	1,003	389	1,104	319	62,284	177	62,462
Modena Borough	2,526	460	4,116	4,914	2,095	4	195	76	214	2	14,601	(84)	14,517
New Garden Township	44,445	73,475	4,763	25,246	50,110	1,713	3,568	1,384	3,925	742	209,371	4,312	213,683
Newlin Township	4,820	817	0	0	5,262	1,684	401	156	441	-	13,581	2,350	15,932
New London Township	23,380	3,952	0	250	20,495	1,468	1,774	688	1,952	8	53,967	1,732	55,699
North Coventry Township	36,355	17,024	0	10,444	52,081	970	2,465	957	2,712	318	123,327	2,236	125,563
Oxford Borough	10,074	6,087	0	5,933	19,479	160	1,516	588	1,667	0	45,504	(685)	44,819
Parkesburg Borough	13,902	3,907	0	#N/A	14,371	52	1,115	433	1,227	113	35,120	(484)	34,636
Penn Township	20,208	13,194	863	5,196	19,051	1,405	1,492	579	1,641	317	63,946	(579)	63,368
Pennsbury Township	18,815	4,218	0	3,473	17,224	901	1,251	485	1,375	153	47,895	1,059	48,955
Phoenixville Borough	61,945	32,113	2,394	17,582	52,183	27	4,991	1,936	5,490	1,122	179,783	1,830	181,613
Pocopson Township	15,334	5,366	3,784	4,126	11,882	1,071	1,091	423	1,201	128	44,407	44	44,451
Sadsbury Township	15,309	8,454	0	#N/A	13,141	841	1,048	407	1,153	232	40,585	502	41,088

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	41,038	16,138	6,376	44,478	31,465	294	2,473	960	2,720	716	146,658	328	146,986
South Coatesville Borough	5,379	2,360	0	52,516	4,964	40	344	133	378	63	66,177	604	66,781
South Coventry Township	11,787	4,630	0	2,697	11,650	719	772	299	849	56	33,458	1,074	34,532
Spring City Borough	15,440	9,481	422	6,523	12,759	19	1,063	412	1,169	265	47,554	(159)	47,396
Thornbury Township	14,750	4,023	5,156	7,419	13,210	196	949	368	1,044	242	47,357	(1,019)	46,338
Tredyffrin Township	140,757	150,915	13,683	129,325	225,758	165	9,413	3,652	10,355	2,551	686,576	(2,619)	683,957
Upper Oxford Township	8,405	1,347	0	0	11,426	3,386	767	298	844	-	26,473	1,722	28,196
Upper Uwchlan Township	46,951	13,483	0	1,752	31,163	592	2,606	1,011	2,867	552	100,979	10,377	111,356
Uwchlan Township	75,088	72,035	3,525	31,947	71,670	371	5,929	2,300	6,522	1,297	270,682	1,945	272,628
Valley Township	27,712	11,292	1,344	3,261	21,350	317	1,956	759	2,152	283	70,426	4,699	75,125
Wallace Township	5,059	899	0	#N/A	13,377	868	1,101	427	1,211	-	22,943	1,526	24,469
Warwick Township	9,867	1,981	0	#N/A	15,210	1,628	872	338	959	-	30,855	3,653	34,508
West Bradford Township	54,702	7,530	0	3,509	35,171	1,561	3,785	1,468	4,163	165	112,054	5,716	117,770
West Brandywine Township	32,247	8,550	226	#N/A	27,844	1,238	2,472	959	2,720	145	76,400	1,163	77,563
West Caln Township	39,121	5,974	0	#N/A	32,436	2,033	2,528	981	2,781	79	85,931	10,973	96,904
West Chester Borough	53,515	56,808	862	44,704	66,232	-	5,841	2,266	6,425	1,546	238,198	(913)	237,284
West Fallowfield Township	13,620	4,508	330	#N/A	13,459	3,795	839	326	923	7	37,806	517	38,323
West Goshen Township	86,228	98,157	12,399	84,599	123,773	99	6,854	2,659	7,539	2,095	424,403	(827)	423,576
West Grove Borough	9,724	5,687	0	2,320	10,881	10	854	332	940	133	30,881	(251)	30,630
West Marlborough Township	3,765	1,398	0	0	5,036	3,842	281	109	309	-	14,742	307	15,049
West Nantmeal Township	8,311	2,653	0	#N/A	11,300	1,988	710	275	781	-	26,019	5,503	31,522
West Nottingham Township	16,987	4,937	0	15,927	18,136	1,535	892	346	981	0	59,741	2,106	61,847
West Pikeland Township	22,915	2,097	0	0	15,042	900	1,291	501	1,420	101	44,268	2,713	46,981
West Sadsbury Township	8,737	6,563	0	#N/A	14,451	1,807	809	314	890	114	33,684	1,399	35,083
Westtown Township	47,701	15,438	190	3,258	40,413	430	3,434	1,332	3,777	451	116,423	(1,132)	115,291
West Vincent Township	21,212	3,775	0	0	14,919	2,217	1,258	488	1,384	54	45,307	6,313	51,620
West Whiteland Township	79,974	96,874	282	37,105	144,926	455	5,938	2,304	6,531	1,838	376,227	1,174	377,401
Willistown Township	58,054	22,771	2,823	10,218	57,426	1,575	3,477	1,349	3,825	512	162,031	4,985	167,016

Source: DVRPC, 2010

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 ($MTCO_2E$)

	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
Aldan Borough	17,524	1,936	0	2,143	9,751	-	1,389	539	1,528	367	35,177	(331)	34,846
Aston Township	70,331	28,798	1,530	22,374	65,816	16	5,440	2,111	5,984	1,148	203,547	3,757	207,304
Bethel Township	36,658	4,401	0	13,191	80,242	66	2,947	1,143	3,242	523	142,414	5,859	148,273
Brookhaven Borough	33,735	9,279	160	3,596	28,740	530	2,539	985	2,793	622	82,979	1,845	84,825
Chadds Ford Township	24,196	22,350	0	5,027	44,890	-	1,038	403	1,142	359	99,404	(722)	98,682
Chester City	115,213	52,366	122,907	80,533	101,431	-	11,989	4,652	13,188	2,960	505,239	(2,115)	503,124
Chester Township	15,890	12,442	12,650	7,755	16,247	-	1,457	565	1,603	440	69,050	16,015	85,064
Chester Heights Borough	11,830	5,144	0	1,197	14,192	50	802	311	882	107	34,516	(12,816)	21,699
Clifton Heights Borough	25,143	7,366	0	1,316	17,721	-	2,144	832	2,358	516	57,396	(364)	57,032
Collingdale Borough	29,716	10,044	0	233	15,124	-	2,750	1,067	3,026	715	62,675	(478)	62,198
Colwyn Borough	7,614	1,501	0	0	4,507	-	774	300	852	200	15,750	(135)	15,615
Concord Township	59,347	53,820	4,450	24,261	87,132	346	4,924	1,911	5,416	1,251	242,858	4,582	247,439
Darby Borough	30,516	9,746	3,591	10,547	19,144	-	3,250	1,261	3,575	789	82,421	(32)	82,389
Darby Township	28,802	9,594	0	8,559	21,727	-	3,122	1,211	3,434	741	77,193	(309)	76,884
East Lansdowne Borough	9,592	2,004	0	0	4,096	-	814	316	896	219	17,937	(118)	17,819
Eddystone Borough	9,399	15,690	10,232	14,812	13,224	-	770	299	847	332	65,606	(329)	65,277
Edgmont Township	18,398	12,405	0	604	19,910	348	1,343	521	1,477	96	55,102	1,159	56,261
Folcroft Borough	20,388	15,353	235	3,414	20,778	-	2,234	867	2,458	650	66,377	(499)	65,878
Glenolden Borough	24,002	13,730	1,422	9,125	21,165	-	2,365	917	2,601	684	76,012	(454)	75,558
Haverford Township	196,370	53,406	684	15,199	134,562	15	15,777	6,121	17,354	4,769	444,258	(4,629)	439,629
Lansdowne Borough	40,092	13,202	508	11,070	27,441	-	3,490	1,354	3,839	1,085	102,082	(668)	101,413
Lower Chichester Township	12,906	6,532	0	2,949	33,757	-	1,131	439	1,244	236	59,195	(475)	58,720
Marcus Hook Borough	9,010	9,891	0	355,621	32,215	-	733	284	806	175	408,736	(617)	408,119
Marple Township	97,171	53,463	646	19,771	93,694	27	7,625	2,959	8,388	2,267	286,010	(1,566)	284,444
Media Borough	21,988	33,183	2,703	13,940	36,859	-	1,764	684	1,940	614	113,674	(369)	113,305
Middletown Township	59,526	30,114	6,154	64,596	83,253	327	5,215	2,023	5,736	735	257,678	(1,087)	256,591
Millbourne Borough	2,213	1,067	0	0	1,930	-	297	115	327	68	6,016	(152)	5,864
Morton Borough	10,036	6,901	0	690	10,163	-	862	335	948	248	30,183	(207)	29,977
Nether Providence Township	61,363	10,754	261	3,111	42,102	5	4,303	1,670	4,734	951	129,253	(1,408)	127,845
Newtown Township	59,302	41,256	6,553	33,477	64,372	321	3,834	1,488	4,218	900	215,719	3,572	219,291
Norwood Borough	21,624	4,628	0	0	13,705	-	1,893	735	2,082	449	45,117	(357)	44,760
Parkside Borough	8,797	1,292	0	0	6,297	-	716	278	787	139	18,305	(108)	18,197
Prospect Park Borough	22,452	10,583	3	0	18,768	-	2,086	810	2,295	537	57,534	(379)	57,154
Radnor Township	125,662	(9,778)	16,562	97,536	156,329	271	10,029	3,891	11,032	3,603	415,136	(6,251)	408,885
Ridley Township	110,254	44,126	465	65,323	100,730	-	9,780	3,794	10,757	2,450	347,681	(7,324)	340,357
Ridley Park Borough	27,529	9,987	1,215	5,515	22,939	-	2,285	886	2,513	614	73,483	5,217	78,700
Rose Valley Borough	5,458	500	0	0	2,728	-	300	116	330	89	9,521	(292)	9,229
Rutledge Borough	3,517	245	0	0	1,781	-	271	105	298	57	6,274	(89)	6,185
Sharon Hill Borough	19,111	14,307	0	1,306	14,880	-	1,733	672	1,906	591	54,507	(379)	54,129
Springfield Township	95,166	47,923	3,689	28,550	93,978	-	7,471	2,899	8,218	2,558	290,451	(2,020)	288,431
Swarthmore Borough	21,945	8,631	0	10,308	24,988	-	1,988	771	2,187	562	71,380	(176)	71,204
Thornbury Township	28,927	4,606	0	0	24,636	342	2,229	865	2,452	344	64,402	105	64,506
Tinicum Township	17,738	35,780	3,284	23,011	86,985	16	1,376	534	1,514	604	170,842	(2,834)	168,008
Trainer Borough	7,853	4,764	13,979	249,355	10,794	-	602	234	662	108	288,352	(296)	288,056
Upland Borough	10,807	6,386	0	18,788	15,870	-	942	365	1,036	226	54,420	(257)	54,164

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
Upper Chichester Township	70,302	35,740	447	18,457	128,596	19	5,622	2,181	6,184	1,258	268,808	2,361	271,169
Upper Darby Township	264,653	109,799	12,885	42,368	194,857	-	25,985	10,082	28,584	7,538	696,752	(3,681)	693,070
Upper Providence Township	49,308	14,803	702	1,100	38,465	5	3,608	1,400	3,968	776	114,134	(1,324)	112,810
Yeadon Borough	38,760	19,179	2,435	5,961	28,581	-	3,722	1,444	4,095	1,282	105,459	(843)	104,616

Source: DVRPC, 2010

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	239,548	79,835	18,923	76,500	201,681	179	18,066	7,010	19,872	5,996	667,608	(9,664)	657,944
Ambler Borough	25,796	10,664	636	18,569	21,435	-	2,088	810	2,297	560	82,856	(339)	82,517
Bridgeport Borough	18,910	11,440	0	34,526	16,226	-	1,434	556	1,577	429	85,098	(982)	84,116
Bryn Athyn Borough	5,140	4,617	1,707	2,971	5,804	143	441	171	485	78	21,557	(712)	20,845
Cheltenham Township	148,627	54,147	3,149	47,154	123,123	2	11,834	4,592	13,017	4,269	409,914	(2,774)	407,140
Collegeville Borough	18,856	12,734	0	7,799	21,703	35	1,538	597	1,692	463	65,416	(72)	65,344
Conshohocken Borough	31,708	38,059	7,848	11,963	34,558	-	2,671	1,036	2,938	909	131,691	(900)	130,791
Douglass Township	31,679	14,685	0	0	50,679	3,091	3,328	1,291	3,661	-	108,414	(761)	107,653
East Greenville Borough	5,326	2,047	0	0	13,403	10	1,005	390	1,106	88	23,373	(132)	23,242
East Norriton Township	54,548	44,069	1,480	14,168	58,810	246	4,401	1,708	4,842	1,087	185,359	(581)	184,779
Franconia Township	45,268	31,692	18,292	#N/A	48,969	2,451	3,950	1,533	4,345	237	156,736	(4,101)	152,635
Green Lane Borough	2,448	1,871	0	866	3,668	3	191	74	210	33	9,364	(16)	9,349
Hatboro Borough	26,699	18,112	365	3,636	32,067	-	2,374	921	2,611	524	87,310	(613)	86,697
Hatfield Borough	8,104	6,481	7,664	#N/A	12,902	10	935	363	1,029	182	37,670	(526)	37,144
Hatfield Township	64,964	66,731	9,815	#N/A	84,446	732	5,691	2,208	6,260	974	241,821	(5,557)	236,264
Horsham Township	103,041	130,993	7,158	#N/A	147,041	837	8,166	3,169	8,983	2,378	411,765	(7,178)	404,588
Jenkintown Borough	16,292	24,364	2,408	22,968	24,136	-	1,434	557	1,578	647	94,384	(391)	93,993
Lansdale Borough	68,755	57,445	9,311	#N/A	58,561	4	5,183	2,011	5,701	1,243	208,215	(2,397)	205,818
Limerick Township	70,627	44,402	1,376	27,918	72,468	2,695	5,344	2,074	5,879	1,353	234,136	(1,019)	233,117
Lower Frederick Township	19,420	5,424	0	1,091	18,060	823	1,591	617	1,750	81	48,858	(1,201)	47,657
Lower Gwynedd Township	58,464	27,824	18,882	54,337	56,793	252	3,578	1,388	3,935	1,371	226,823	(5,730)	221,093
Lower Merion Township	313,298	155,329	21,626	153,635	268,378	35	18,963	7,358	20,859	8,740	968,221	(18,375)	949,846
Lower Moreland Township	59,558	25,158	2,310	9,521	44,693	175	3,815	1,480	4,196	1,352	152,258	(1,658)	150,600
Lower Pottsgrove Township	39,360	19,937	0	6,361	47,311	328	3,924	1,522	4,316	453	123,513	(663)	122,850
Lower Providence Township	95,268	59,236	4,170	50,898	90,396	580	8,062	3,128	8,868	1,536	322,141	(4,671)	317,469
Lower Salford Township	61,130	29,097	559	#N/A	59,529	1,721	4,630	1,797	5,093	616	164,171	(2,696)	161,475
Marlborough Township	20,916	5,951	0	0	12,878	914	1,065	413	1,172	33	43,341	(35)	43,306
Montgomery Township	98,351	87,826	3,638	#N/A	127,675	301	7,887	3,060	8,675	2,300	339,712	(6,770)	332,942
Narberth Borough	18,051	8,523	848	422	15,513	-	1,353	525	1,488	491	47,215	(301)	46,914
New Hanover Township	27,013	6,242	0	0	33,418	2,830	2,914	1,131	3,205	-	76,753	4,033	80,787
Norristown Borough	106,832	60,006	3,919	42,895	98,334	34	10,100	4,004	11,352	2,882	340,358	(2,537)	337,821
North Wales Borough	15,424	7,613	2,060	0	13,428	-	1,075	417	1,182	203	41,401	(377)	41,024
Pennsburg Borough	5,594	3,626	0	0	14,888	22	1,098	426	1,208	126	26,988	51	27,039
Perkiomen Township	32,230	8,371	0	2,368	30,230	360	2,701	1,048	2,971	468	80,746	33	80,779
Plymouth Township	60,078	101,738	82,168	119,453	136,164	172	5,291	2,053	5,820	1,818	514,755	(6,693)	508,062
Pottstown Borough	95,411	69,832	11,565	46,120	108,376	-	7,020	2,724	7,721	1,320	350,089	(1,453)	348,636
Red Hill Borough	7,473	1,485	0	0	9,658	36	768	298	844	66	20,628	(254)	20,374
Rockledge Borough	9,592	3,596	0	0	9,397	0	827	321	909	246	24,888	(85)	24,803
Royersford Borough	18,001	13,184	533	3,858	18,147	-	1,410	547	1,551	290	57,521	(301)	57,221
Salford Township	20,333	5,563	0	#N/A	9,204	855	831	323	915	22	38,046	(6,876)	31,169
Schwenksville Borough	6,056	5,913	0	15,851	7,646	6	443	172	488	66	36,640	133	36,773
Skippack Township	40,942	14,320	1,782	9,257	37,793	2,002	4,020	1,560	4,422	457	116,555	844	117,399
Souderton Borough	17,249	9,649	0	#N/A	25,945	5	2,179	846	2,397	289	58,559	(710)	57,849
Springfield Township	83,913	37,511	4,487	21,560	71,265	140	6,285	2,439	6,914	2,892	237,405	(2,616)	234,789
Telford Borough	1,488	813	0	#N/A	9,420	0	797	309	877	61	13,765	(287)	13,478

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	66,967	37,230	373	#N/A	60,390	634	5,856	2,272	6,441	1,153	181,317	(4,187)	177,130
Trappe Borough	15,549	6,704	949	8,259	15,957	229	1,115	433	1,226	206	50,626	(195)	50,431
Upper Dublin Township	116,242	62,022	3,567	59,952	126,914	193	8,451	3,279	9,296	2,672	392,588	(7,509)	385,079
Upper Frederick Township	15,168	1,968	0	0	13,735	1,689	1,197	465	1,317	11	35,549	(1,140)	34,409
Upper Gwynedd Township	60,311	39,956	227,942	141,973	71,214	348	4,754	1,844	5,229	1,275	554,847	(8,235)	546,612
Upper Hanover Township	39,159	15,684	17,588	0	37,299	3,479	1,818	706	2,000	17	117,750	(1,844)	115,906
Upper Merion Township	100,474	187,372	51,915	312,123	277,940	10	8,871	3,442	9,759	3,511	955,417	(18,141)	937,276
Upper Moreland Township	89,628	84,577	4,846	42,490	104,673	75	8,065	3,129	8,871	2,618	348,974	(4,797)	344,177
Upper Pottsgrove Township	14,350	4,139	133	1,301	18,621	437	1,605	623	1,765	185	43,159	1,425	44,584
Upper Providence Township	80,630	50,707	31,402	108,804	83,899	1,694	5,955	2,310	6,550	1,553	373,503	2,007	375,511
Upper Salford Township	16,602	4,472	0	#N/A	12,729	1,457	1,014	394	1,116	6	37,790	(2,708)	35,082
West Conshohocken Borough	6,662	15,380	312	9,525	19,073	-	492	191	542	219	52,395	(1,545)	50,851
West Norriton Township	62,637	33,924	9,563	18,629	64,131	154	5,002	1,856	5,261	1,433	202,589	(1,594)	200,996
West Pottsgrove Township	16,090	9,097	1,093	3,327	20,519	32	1,248	484	1,373	122	53,388	(373)	53,015
Whitemarsh Township	78,629	67,655	11,206	55,864	100,057	747	5,588	2,168	6,147	2,121	330,181	6,694	336,875
Whitpain Township	90,795	57,745	2,025	27,710	119,392	473	6,123	2,376	6,735	1,824	315,198	(9,042)	306,156
Worcester Township	45,945	19,950	2,203	27,317	38,093	2,525	2,865	1,112	3,152	591	143,752	(4,429)	139,323

Source: DVRPC, 2010

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.

John Ackler
Lower Makefield Township, PA

Suzanne Adams
Weston Solutions/Chester County GHG Reduction Task Force

Mary Ameen
North Jersey Transportation Planning Authority

Mike Aucott
New Jersey Department of Environmental Protection

Richard M. Balgowan
Hamilton Township, NJ

Robert Benjamin
Hamilton Township, NJ

Joy Bergey
PennFuture

John Butler
Marple Township, PA

Adriana Caldarelli
New Jersey Department of Environmental Protection

Andrew Carten
City of Trenton, NJ

Shea Christilaw
Nether Providence Township, PA

Marion Coker
SEPTA

Jay Corbalis
New Jersey Future

James Cowhey
Lancaster County Planning Commission

Stefano Crema
Sierra Club, NJ Cool Cities Program

Fred Cummings
Philadelphia International Airport

Calvin M. Davenger
Philadelphia International Airport

Liz Deruchie
North Jersey Transportation Planning Authority

Andrea Denny
US EPA Office of Air and Radiation

David Director
Nether Providence Township, PA

Dan Dobromilsky
West Windsor Township, NJ

Michael Dunn
US EPA, Region 3

Phil Eastman
PECO

State Senator Edwin B. Erickson
Pennsylvania Senate District 26

Patti Esler
PSEG

Carr Everbach
Nether Providence Township, PA

Jeff Featherstone
Temple University

Spencer Finch
Pennsylvania Environmental Council

Bradley Flamm
Temple University

Rob Fleming
Philadelphia University

Alex Flemming
SEPTA

Jeanne Fox
New Jersey Board of Public Utilities

Steve Fromnick
Chester County Planning

Kathryn Garza
Nether Providence Township, PA

Katie Goodrum
Philadelphia City Planning Commission

Virginia Gregory
Office of Chris Ross, Pennsylania 158th Legislative District

John Haak
Philadelphia City Planning Commission

Lori Hanlon-Widdop
Haverford Township, PA

Dianne Herrin
West Chester Borough, PA

Nicole Hostettler
Cherry Hill Township, NJ

Bill Jones
US EPA, Region 3

Michael N. Kaiser
Lehigh Valley Planning Commission

Peter Kasabach
New Jersey Future

Jonathan Knauer
ICLEI-Local Governments for Sustainability

Ginny Kreitler
Keystone Conservation Trust

Dave Kuhn
New Jersey Department of Transportation

Paul Leonard
Upper Dublin Township, PA

Andrew Levecchia
Camden County, NJ

Lynn Mandarano
Temple University

David Mandelbaum
Ballard Spahr Andrews & Ingersoll, LLP

Robin Mann
Radnor Township, PA

Courtney Marm
West Chester Borough, PA

Shawn McCaney
The William Penn Foundation

Mike McCartney
Philadelphia International Airport

Sveta McShane
Narberth Greens

Marv Meyer
Radnor Township, PA

Lance Miller
New Jersey Board of Public Utilities

Joseph Otis Minott
Clean Air Council

Mona Lee Mosser
New Jersey Board of Public Utilities

Steve Nelson
Montgomery County, PA, Commissioners Office

Howard M. Neukrug, P.E
City of Philadelphia Water Department

Adam Nichols
Nether Providence Township, PA

Margaret O'Sullivan
Clinton Climate Initiative

Bharat Patel
New Jersey Board of Public Utilities

Stephanie Piech
Lower Makefield Township, PA

Cara Purcell
Lehigh Valley Planning Commission

James Requa
New Jersey Department of Community Affairs Office of Smart Growth

Alison Riley
City of Philadelphia Air Management Services

Emilee Ritchie
Weston Solutions/Chester County Task Force

Jim Ritzman
Pennsylvania Department of Transporation

Liz Robinson
Energy Coordinating Agency

Carlos Rodrigues
Regional Plan Association

Marty Rosen
New Jersey Department of Environmental Protection

Rebecca Ross
Delaware County, PA

State Representative Chris Ross
Pennsylvania 158th Legislative District

Athena Sarafides
New Jersey Department of Environmental Protection

Mark Scorsolini
PSEG

Kassahun Sellassie
City of Philadelphia Air Management Services

Elizabeth Semple
New Jersey Department of Environmental Protection

Jennifer Senick
Rutgers University

Maureen Sharkey
PECO

Drew Shaw
Montgomery County, PA

Joe Sherrick
Pennsylvania Department of Environmental Protection

Christina Simeone
Pennsylvania Department of Environmental Protection

Jim Smith
US EPA, Region 3

Gerrett Snediker
Nether Providence Township, PA

Randall Solomon
NJ Sustainable State Institute
Rutgers University

Patrick Starr
Pennsylvania Environmental Council

Melissa Stults
ICLEI-Local Governments for Sustainability

William Swiatek
WILMAPCO

Matt Thomas
Narberth (PA) Greens

Charles Thomas
Hamilton Township, NJ

Jeff Tiell
Philadelphia City Planning Commission

Alicia Tillett
South Jersey Transportation Planning Organization

Bill Toffey
City of Philadelphia Municipal Energy Office

Craig Totaro
Lansdowne Borough, PA

Glenn Unterberger
Ballard Spahr Andrews & Ingersoll, LLP

Don Verdiani
Sunoco, Inc.; Chester County GHG Reduction Task Force

State Representative Greg Vitali
Pennsylvania 166th Legislative District

Roland Wall
Academy of Natural Sciences

Nick Walsh
Philadelphia Regional Port Authority

Nathan Willcox
PennEnvironment

Dennis Winters
Sierra Club

Gregor Wojslaw
Sierra Club

Wesley Wolf P.E.
Upper Dublin Township, PA

Title of Report: *Regional Greenhouse Gas Emissions Inventory*

Publication No.: 09038A

Date Published: March 2009, revised December 2010

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 revision incorporates a lower emissions factor for electricity, based on new guidance from US EPA. In addition, a small number of analytical errors have been corrected. DVRPC has also created detailed estimates for each municipality's GHG emissions and energy use, to serve as a starting point for local action and analysis.

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.

Delaware Valley Regional Planning Commission

190 N. Independence Mall West, 8th Floor
Philadelphia, PA 19106-2582

Telephone:	215-592-1800
Fax:	215-592-9125
Internet:	www.dvrpc.org
Staff contact:	Robert Graff Manager, Office of Energy and Climate Change Initiatives rgraff@dvrpc.org

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

190 N INDEPENDENCE MALL WEST
8TH FLOOR
PHILADELPHIA, PA 19106
215.592.1800
WWW.DVRPC.ORG