Derry Township

2016 Inventory of Community Greenhouse Gas Emissions

Produced by the Derry Township Climate Change Advisory Committee
With Assistance from ICLEI - Local Governments for Sustainability USA

July 2020

Credits and Acknowledgements

This report was prepared by the Derry Township Climate Change Advisory Committee. The authors would like to acknowledge the following individuals for their assistance with this process.

Derry Township

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The Pennsylvania Department of Environmental Protections
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"The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people."

– Article 1, Section 27, Constitution of the Commonwealth of Pennsylvania

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Executive Summary

The Township of Derry recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. Furthermore, Derry Township has multiple opportunities to benefit by acting quickly to reduce community GHG emissions: reducing energy and transportation costs for residents and businesses, creating green jobs, improving health of residents, making the community a more attractive place to live and work.

Following the passage of Township Resolution 1555, Derry Township and the Climate Change Advisory Committee have begun the climate action planning process.This documents a progress report, providing estimates of greenhouse gas emissions resulting from activities in Derry Township as a whole in 2016.

Key Findings

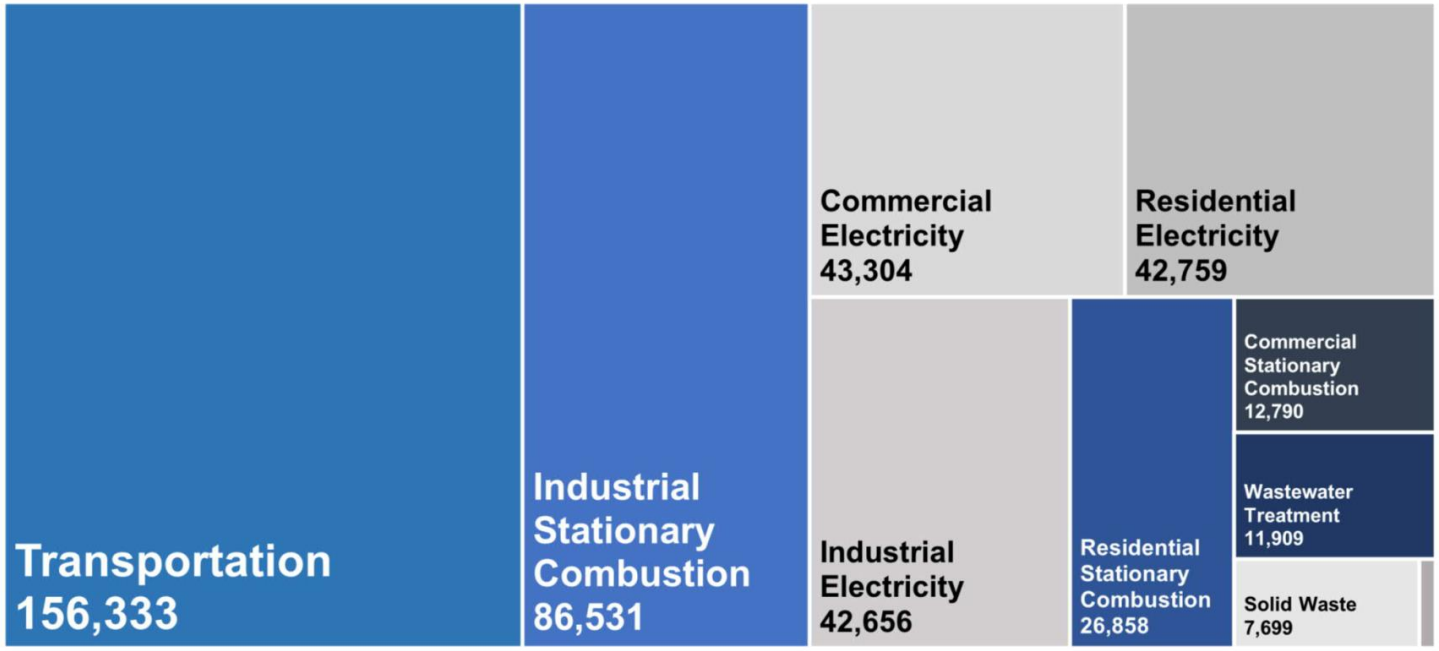

Figure 1: Community-wide emissions profile of Derry Township. Emissions values in metric tons of CO2 equivalent (mtCO2e). Dark boxes with white text represent sources of emissions and light boxes with black text represent activities contributing to the emissions profile. Categories are broken down in Table 2.

For the year 2016, the community-wide estimate for greenhouse gas emissions was 431,527 metric tons of CO2 equivalent (mtCO2e). There are a variety of emissions sources and activities included in the community-wide inventory. Figure 1 shows a breakdown of these emissions by sector and Table 2 details the sources and activities measured. The largest contributor is transportation within township boundaries with 36.2% of emissions. The next six biggest contributors come from the production of electricity and stationary combustion from the residential, commercial, and industrial sectors. Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Wastewater treatment and the production of solid waste within the township were responsible for the remainder of emissions.

Next Steps

The next steps include setting an emissions reduction target, creating a formal climate action plan, and planning specific actions for emissions reduction. Surveys and focus groups will be conducted throughout the community to raise awareness and determine priorities and actionable steps. Actions that may be considered at different levels for Derry Township, community businesses, organizations, and individual community members will be explored.

Inventory Primer

Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fourth Assessment Report states that "warming of the climate system is unequivocal."[1] Furthermore, the report finds that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations."

Derry Township Resolution No. 1555

On August 28, 2018, the Derry Township Board of Supervisors unanimously adopted Resolution 1555. The resolution established the Climate Change Advisory Committee, a citizens group tasked with the inventory of greenhouse gas emissions emitted by the community and recommending strategies for reducing or offsetting current emission levels. This resolution is presented in full below.

[1] IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

RESOLUTION NO. 1555

A RESOLUTION OF THE BOARD OF SUPERVISORS OF THE TOWNSHIP OF DERRY, DAUPHIN COUNTY, PENNSYLVANIA, MAKING CLIMATE CHANGE AND THE MITIGATION OF GREENHOUSE GAS EMISSIONS AN ONGOING FOCUS OF THE TOWNSHIP

WHEREAS, the Township of Derry recognizes that climate change is one of the most critical sustainability issues threatening long-term human and environmental health, social well-being, and economic vitality of our community; and

WHEREAS, the Constitution of the Commonwealth of Pennsylvania, Article 1, Section 27, states that *"The people [of Pennsylvania] have a right to clean air, pure water, and to the natural, scenic, historic and aesthetic values of the environment"*[1], and in June 2017 the Supreme Court of the Commonwealth reaffirmed the critical role of the state government in protecting our natural environment[2]; and

WHEREAS, the Department of Conservation and Natural Resources of the Commonwealth of Pennsylvania reported that climate change has already begun to manifest itself in the Commonwealth in the form of higher temperatures and large storm events, decreased snow cover, and ecosystem destabilization[3]; and

WHEREAS, fine particulate matter (2.5 microns in diameter or less, $PM_{2.5}$) from air pollution is responsible for nearly 12,000 deaths annually statewide due to cancer and diseases of the lung and heart, ranking Pennsylvania fourth in the nation according to a study from the Massachusetts Institute of Technology [4]; and

WHEREAS, statewide costs due to premature infant and adult deaths, increased rates of illness, and reduced agricultural yields from energy production have been estimated to be in excess of $15 billion per year since 2002, ranking Pennsylvania among the top states for economic burden on its citizens according to a recent study from Carnegie Mellon University [5] with disproportionately heavy impacts likely among children and vulnerable populations[6]; and

WHEREAS, in addition to direct threats to human health and the environment, the productivity of Pennsylvania businesses will continue to be undermined by adverse weather events with damage to infrastructure, higher operating costs, and reduced production in our agricultural sector; and

WHEREAS, the General Assembly of the Commonwealth adopted the Pennsylvania Climate Change Act in 2008, which requires that the Department of Environmental Protection (hereinafter "DEP") report on "the potential climate change impact and economic opportunities for this Commonwealth"[7]; and

WHEREAS, the DEP, pursuant to Pennsylvania Climate Change Act, Section 7, was called upon to create a Climate Change Action Plan (hereinafter "CCAP") focused on the reduction and offset of greenhouse gas (hereinafter "GHG") emissions throughout the Commonwealth[8]; and

WHEREAS, the DEP submitted the CCAP in 2009 and the CCAP Update in 2015[9], finding that the plans created to reduce GHG emissions "have real potential to generate not only GHG reductions but also significant improvements in total employment, total income and real disposable personal income"; and

WHEREAS, an independent assessment of the Regional Greenhouse Gas Initiative (RGGI) in the northeastern United States has concluded that cumulative health and productivity benefits estimated at $5.7 billion have resulted over the first six years of implementation (2009 to 2014)[10]; and

WHEREAS, municipalities in the Commonwealth of Pennsylvania, including Philadelphia, Pittsburgh, Allentown, Bethlehem, Lancaster, State College, Easton, and Ferguson Township have already taken steps to address climate change by adopting climate change resolutions, CCAPs, and/or making a commitment to do so; and

WHEREAS, both public and private entities in the Township of Derry have already shown important commitments to climate change action including the enactment of the Stormwater Management Ordinance and the 2017 Zoning Ordinance incorporating Smart Growth principles[11], as well as installation of the Township solar array[12] and implementation of the TreeVitalize[13], community bike share, and community garden initiatives[14]; and

WHEREAS, the Penn State Health Milton S. Hershey Medical Center has reduced energy consumption by 25 percent since 2005 with accompanying GHG reductions[15], and The Hershey Company has adopted a set of "25 by 25" goals: 25 percent reduction in 2015 levels of water use, waste, and CO2 emissions by the year 2025[16]; and

WHEREAS, by adopting a Climate Action resolution, the Township of Derry will continue to serve as a model community in central Pennsylvania and beyond as we act

to protect the health and welfare of our citizens, conserve Township resources, and promote the viability of our businesses; and

WHEREAS, citizens of the Township of Derry have gathered together to bring forward this resolution and desire to create a Climate Change Advisory Committee that is composed of members of the community and whose goals will be to identify the sources of and trends in GHG emissions in the Township and to recommend to the Board of Supervisors cost effective strategies for reducing or offsetting GHG emissions.

NOW, THEREFORE, BE IT RESOLVED that the Township of Derry Board of Supervisors is committed to making climate change and the mitigation of GHG emissions an ongoing focus of the Township of Derry, with the goal of reducing the adverse climate impact on the Township; and,

BE IT FURTHER RESOLVED that the Township will support and encourage the goals of the Climate Change Advisory Committee, making relevant information about Township operations available to the committee, as appropriate; and,

BE IT FURTHER RESOLVED that global warming mitigation and adaptation strategies will be integrated into key Township processes and planning, such as strategic plans, capital planning, budgeting, and training when possible or appropriate; and,

BE IT FURTHER RESOLVED that the Township of Derry will promote these efforts throughout Pennsylvania and the United States by example and will post this resolution on the Township's website to encourage other local governments to adopt a similar resolution.

DULY RESOLVED by the Board of Supervisors of the Township of Derry, Dauphin County, Pennsylvania this 27 day of August, 2018.

ATTEST:

Secretary

(Seal)

BOARD OF SUPERVISORS
TOWNSHIP OF DERRY
DAUPHIN COUNTY, PENNSYLVANIA

Chairman

RESOURCES

[1] Constitution of the Commonwealth of Pennsylvania, Article 1, Section 27. https://codes.findlaw.com/pa/constitution-of-the-commonwealth-of-pennsylvania/pa-const-art-1-sect-27.html

[2] Pennsylvania Environmental Defense Foundation v. Commonwealth of Pennsylvania.J-35-2016. Supreme Court of Pennsylvania Middle District; 2016.

[3] Pennsylvania Department of Conservation and Natural Resources. DCNR and Climate Change: Planning for the Future. (2015).

[4] Caiazzo F, Ashok A, Waitz IA, YimSHL, Barrett SRH. Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005.Atmospheric Environment 79: 198-208; 2013. https://doi.org/10.1016/j.atmosenv.2013.05.081

[5] Jaramillo P and Muller NZ. Air pollution emissions and damages from energy production in the U.S.: 2002–2011. Energy Policy. 2016; 90:202-211.

[6] Sheffield PE, Landrigan PJ. Global climate change and children's health: threats and strategies for prevention. Environ Health Perspect. 2011 Mar;119(3):291-8.

[7] Pennsylvania Climate Change Act. P.L. 935, No. 70, Cl 27; 2008.

[8] PA DEP, *Pennsylvania Climate Change Action Plan* (2009).

[9] PA DEP, *2015 Climate Change Action Plan Update* (2016)

[10] Abt Associates. Analysis of the Public Health Impacts of the Regional Greenhouse Gas Initiative, 2009-2014. http://abtassociates.com/RGGI;http://www.abtassociates.com/projects/the-regional-greenhouse-gas-initiative-rggi-analysis

[11] http://www.derrytownship.org/stormwater-management-ordinance; http://www.derrytownship.org/proposed-zoning-ordinance-update.

[12] Derry Township News, Spring 2017 http://www.derrytownship.org/wp-content/uploads/2017/02/2017Spring.pdf.

[13] PA DCNRTreeVitalize Program *http://www.dcnr.pa.gov/Communities/CommunityTreeManagement/*

[14] Zagster Bike Sharing - http://bike.zagster.com/hersheybikes/

[15] Penn State Health Milton S. Hershey Medical Center https://news.psu.edu/story/464082/2017/04/21/impact/initiatives-support-environmentally-conscious-growth-hershey-campus.

[16] The Hershey Company https://www.thehersheycompany.com/content/dam/corporate-us/documents/csr-reports/2016-hershey-csr-report.pdf#page=15

ICLEI Climate Mitigation Program

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

Figure 2: ICLEI Climate Mitigation Milestones

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones, also shown in Figure 2:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents the completion of ICLEI's Climate Mitigation Milestone One for the community as a whole and provides a foundation for future work to reduce greenhouse gas emissions in Derry Township. Derry Township has already implemented programs that have or will lead to ancillary benefits in the form of energy conservation and greenhouse gas reduction (see Resolution 1555). By continuing to work with ICLEI, the Township will be able to identify further actions that can impact the carbon footprint of our community.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from the Derry Township community as a whole.

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the Community Greenhouse Gas Emissions Protocol (Community Protocol)[2].

Community Emissions Protocol

The Community Protocol, released by ICLEI in October 2012, represents a national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

Quantifying Greenhouse Gas Emissions

Sources and Activities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory: 1) GHG emissions that are produced by "sources" located within the community boundary, and 2) GHG emissions produced as a consequence of community "activities".

[2] http://www.icleiusa.org/tools/ghg-protocol/community-protocol

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere	**The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions.**

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. The division of emissions into sources and activities replaces the scopes framework that is used in government operations inventories, but that does not have a clear definition for application to community inventories.

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Derry Township's community greenhouse gas emissions inventory utilizes 2016 as its base year. This year was chosen to ensure data availability at the time of compiling the report.

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.

- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions.*

Most emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel

consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see appendices for a detailed listing of the activity data used in composing this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity).

For this inventory, calculations were made using the ClearPath software, and the results were reviewed and approved by ICLEI staff.

Community Emissions Inventory Results

Community Profile

To put emissions inventory data in context, it is helpful to have some basic information about community such as population and number of households. This information is provided in Table 1.

Table 1: Derry Township Community Indicators

Population (2010 Census)	24,679
Households (2010 Census)	9,637

Community-Wide Activities Frame

Derry Township has chosen to look at emissions through the community-wide activities frame. This frame includes emissions that result from the use of energy, materials, and services by all members of the community, regardless of whether the township has significant influence over those emissions. These emissions may be occurring within or outside of the community boundary. This frame includes the required five Basic Emissions Generating Activities: electricity use in the community, stationary combustion in residential, commercial, and industrial facilities, on-road passenger and freight motor vehicle travel, energy used to treat and distribute water and wastewater used in the community, and generation of solid waste by the community. When used for comparison across communities, this framework is helpful in illustrating relative urban efficiencies. Table 2 summarizes emissions from community-wide activities.

Table 2: Community-Wide GHG Emissions by Type of Activity

*conversion factors less than 1e-5 MT CO2 omitted from table for clarity. mt = metric ton, Wh = Watt-hour, MMBtu = one million British Thermal Units, scf = standard cubic foot, BOD5 = biochemical oxygen demand over five days.

Source or Activity	Activity Data Quantity and Unit	Emissions Factor	Emissions (MT CO2e)
Electricity			
Residential Use of Electricity	46,040,258 kWh (Met-Ed) 78,294,148 kWh (PPL)	0.1 mtCO2/MMBtu (2016 eGRID)	42,759
Commercial Use of Electricity	19,188,808 kWh (Met-Ed) 106,729,773 kWh (PPL)		43,304
Industrial Use of Electricity	17,303,062 kWh (Met-Ed) 106,729,773 kWh (PPL)		42,656
Stationary Combustion			

Residential Natural Gas Combustion	2,889,438 therms	53.02 kg CO2/MMBut 0.005 kg CH4/MMBtu 0.0001 kg NO2/MMBtu	15,365
Commercial Natural Gas Combustion	2,405,205 therms		12,790
Industrial Natural Gas Combustion	16,303,638 therms		86,531
Residential Propane Consumption	22449 MMBtu	61.46 kg CO2/MMBtu 0.011 kg CH4/MMBtu 0.001 kg NO2/MMBtu	1,393
Residential Fuel Oil Consumption	136,868 MMBtu	72.93 kg CO2/MMBtu 0.011 kg CH4/MMBtu 0.0007 kg NO2/MMBtu	10,048
Residential Wood Consumption	5793 MMBtu	93.8 kg Biogenic CO2/MMBtu 0.316 kg CH4/MMBtu 0.0042 kg NO2/MMBtu	53
Transportation			
On-road Vehicle Travel (Gasoline)	292,840,620 vehicle miles 0.61% Motorcycle 78.42% Passenger Vehicle 7.52% Light Truck 1.39% Heavy Truck	0.07 mtCO2/MMBtu 0.068 mtBiogenic CO2/MMBtu	103,992
On-road Vehicle Travel (Diesel)	292,840,620 vehicle miles 0.89% Passenger Vehicle 0.43% Light Truck 10.19% Heavy Truck	0.074 mtCO2/MMBtu 0.074 mtBiogenic CO2/MMBtu	50,630
On-road Vehicle Travel (E85)	292,840,620 vehicle miles 0.3% Passenger Vehicle 0.04% Light Truck	0.070 mtCO2/MMBtu 0.068 mtBiogenic CO2/MMBtu	387
Freight Railway (Diesel)	17738 MMBtu	0.074 mtO2/MMBtu	1,324
Water/Wastewater			
Wastewater treatment digester gas	150,000 scf/day	65% CH4 52.07 kg Biogenic CO2/MMBtu	10
Nitrogen discharge from wastewater treatment facility	95 kg N/day	0.005 kg N2O/kg N	81
Digester flaring	150,000 scf/day	65% CH4 99% Destruction efficiency	167
Process Emissions	4067 kg BOD5/day	35% BOD5 removed in primary treatment 0.175 mtCH4/daily kg BOD5	11,587
Nitrification/denitrification	24679 residents served	7 g N2O/person	64
Use of Electricity in Potable Water Treatment and Distribution	2,000,000 kWh	0.1 mtCO2/MMBtu	688
Solid Waste			
Landfilled solid waste (Mainly construction materials)	1217 tons		418
Combustion of Solid Waste	20981 tons	Calculation methods SW.2.2a in ICLEI	7,281
Total Community-Wide Activity Emissions			**431,527**

Looking at the community-wide activities frame shows that transportation and energy generation are important ways in which the Derry Township community contributes to emissions. Households and businesses in Derry Township may want to consider these activities as they think about how to reduce their own emissions.

Several municipalities throughout the state of Pennsylvania have undergone similar emissions assessments in the past decade. Derry Township generates emissions that are on par with other jurisdiction of similar size (Figure 3), though on a per capita basis, Derry Township is at the top of the range of surveyed municipalities (Figure 4).

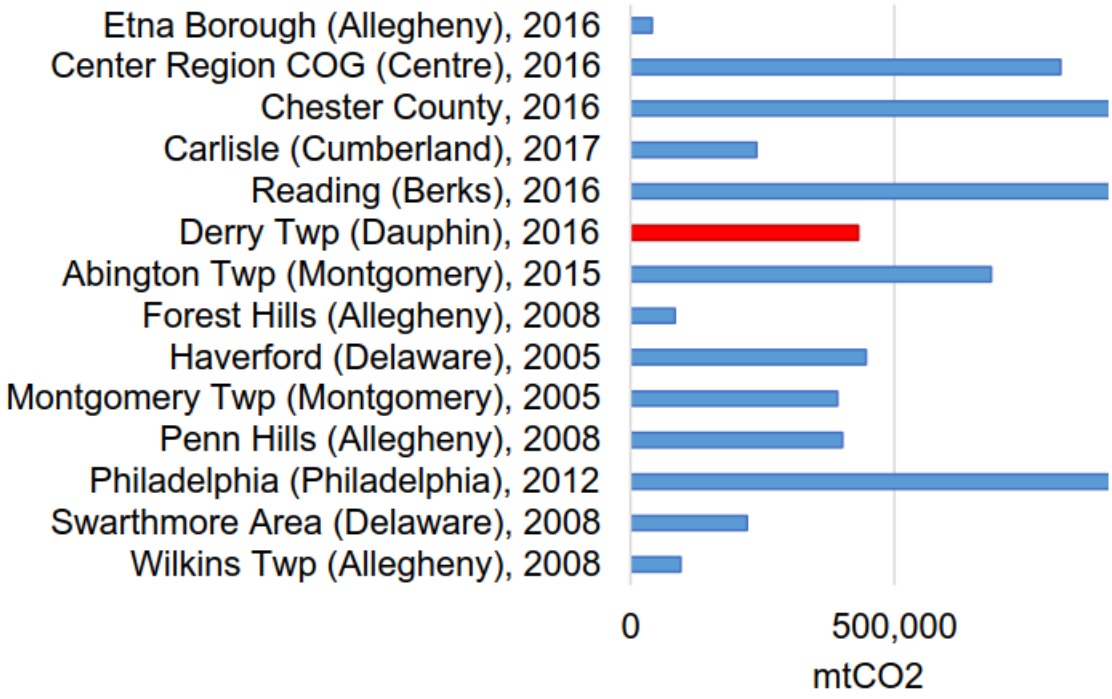

Figure 3: Comparison of Derry Township emissions with other locations in Pennsylvania. Community greenhouse gas inventories for other cities, counties, or regional groups are reported, along with the inventory year. Note: the values for Reading (1.3 million mtCO2), Chester County (6.95 million mtCO2), and Philadelphia (20.9 million $mtCO_2$) extend past the chart boundary.

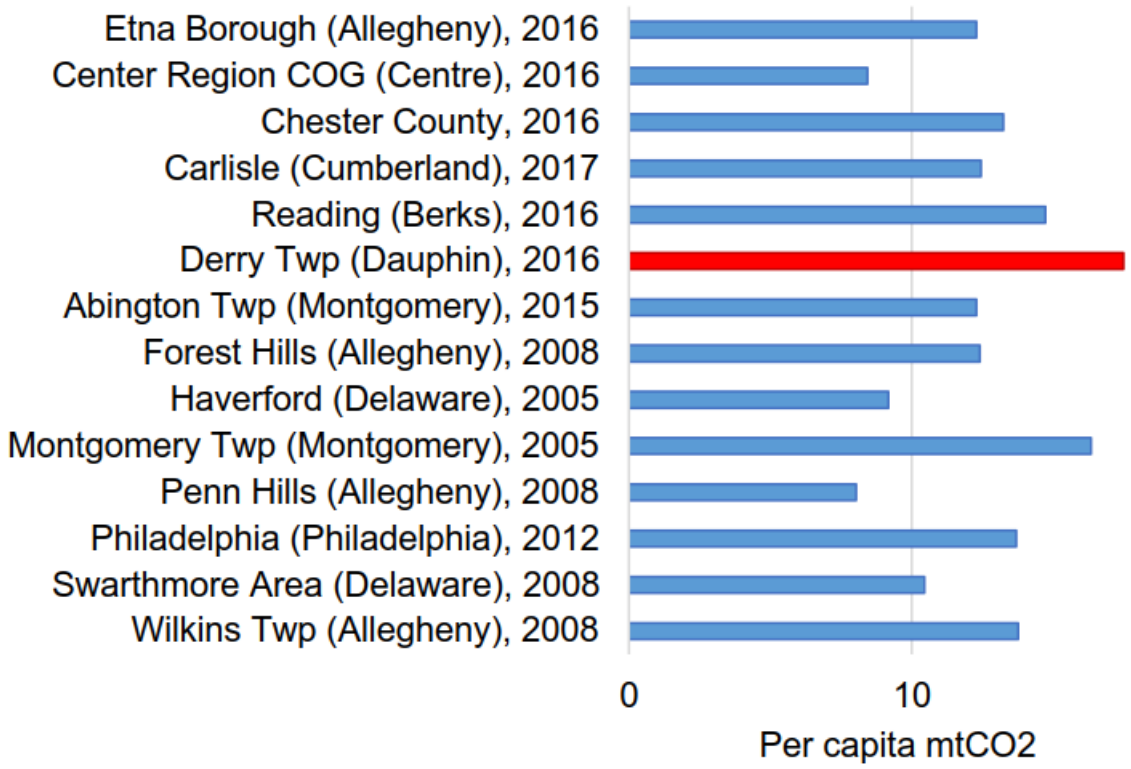

Figure 4: Comparison of Derry Township per capita emissions with other locations in Pennsylvania. Community greenhouse gas inventories for other cities, counties, or regional groups are reported, along with the inventory year.

Conclusion

This inventory marks the completion of Milestone One of the Five Milestones for Climate Mitigation. The next steps are to set an emissions reduction target, and to develop a climate action plan that identifies specific quantified strategies that can cumulatively meet that target. In addition, Derry Township should continue to track key energy use and emissions indicators on an on-going basis. ICLEI recommends completing a re-inventory at least every five years to measure emissions reduction progress.

Emissions reduction strategies to consider for the climate action plan include energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, and waste reduction among others. This inventory shows that transportation will be particularly important to focus on. Through these efforts and others, the Township of Derry can achieve additional benefits beyond reducing emissions, including saving money and improving Derry Township's economic vitality and its quality of life.

Appendix A: Community Inventory Details

Table A-1 provides a summary of the emissions sources and activities that are included in the community inventory, as well as those potential sources that are excluded. Table A-2 provides details on calculation methods and data sources for each included activity and source.

Table A-1: Summary of Included and Excluded Community Emissions. SI - Local Government Significant Influence, CA - Community-Wide Activities, HC - Household Consumption, IE – Included Elsewhere, NA – not applicable, NO – not occurring, NE – not estimated

Emissions Type		Source or Activity?	Required Activities	Included under reporting frameworks: SI	CA	HC	Excluded (IE, NA, NO, or NE)	Explanatory Notes	Emissions ($MTCO_2e$)
Built Environment									
Use of fuel in residential and commercial stationary combustion equipment		Source AND Activity			X				39,649
Industrial stationary combustion sources		Source			X				86,531
Electricity	Power generation in the community	Source					NE		
	Use of electricity by the community	Activity			X				128,719
District Heating/ Cooling	District heating/cooling facilities in the community	Source					NO		
	Use of district heating/cooling by the community	Activity					NO		
Industrial process emissions in the community		Source					NE		
Refrigerant leakage in the community		Source					NE		
Transportation and Other Mobile Sources									
On-road Vehicles (Gasoline)	On-road vehicles operating within the community boundary	Source			X				103,992
	On-road vehicle travel associated with community land uses	Activity					NE		
On-road vehicles (Diesel)	On-road vehicles operating within the community boundary	Source			X				50,630
	On-road vehicle travel associated with community land uses	Activity					NE		
On-road Vehicles (E85)	On-road vehicles operating within the community boundary	Source			X				387
	On-road vehicle travel associated with community land uses	Activity					NE		
Transit Rail	Transit rail vehicles operating within the community boundary	Source					NO		
	Use of transit rail travel by the community	Activity					NE		
Inter-city passenger rail vehicles operating within the community boundary		Source					NO		

Emissions Type		Source or Activity?	Required Activities	Included under reporting frameworks: SI	CA	HC	Excluded	Notes	Emissions (MTCO2e)
Freight rail vehicles operating within the community boundary		Source			X				1,324
Marine	Marine vessels operating within the community boundary	Source					NA	Non-significant	
	Use of ferries by the community	Activity					NA		
Off-road surface vehicles and other mobile equipment operating within the community boundary		Source					NE		
Use of air travel by the community		Activity					NE		
Solid Waste									
Solid Waste	Operation of solid waste disposal facilities in the community	Source					NO		
	Generation and disposal of solid waste by the community	Activity			X				7,281
Water and Wastewater									
Potable Water - Energy Use	Operation of water delivery facilities in the community	Source					NO		
	Use of energy associated with use of potable water by the community	Activity			X				688
Use of energy associated with generation of wastewater by the community		Activity					IE	Included in industrial electricity	
Centralized Wastewater Systems - Process Emissions	Process emissions from operation of wastewater treatment facilities located in the community	Source			X				11,909
	Process emissions associated with generation of wastewater by the community	Activity					IE	All wastewater treated in boundary	
Use of septic systems in the community		Source AND activity					NE	Use of septic systems not determined	
Agriculture									
Domesticated animal production		Source					NE		
Manure decomposition and treatment		Source					NE		
Upstream Impacts of Community-Wide Activities									
Upstream impacts of fuels used in stationary applications by the community		Activity					NE		
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community		Activity					NE		
Upstream impacts of fuels used for transportation in trips associated with the community		Activity					NE		
Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary		Activity					NE		
Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community		Activity					NE		

Emissions Type	Source or Activity?		Included under reporting frameworks: SI	CA	HC	Excluded	Notes	Emissions (MTCO2e)
Independent Consumption-Based Acccounting								
Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)	Activity					NE		
Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)	Activity					NE		
Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community)	Activity					NE		

Table A-2: Community Inventory Calculation Method and Data Source Details

Residential use of electricity	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	124,334,407	kWh	0.1	mtCO2/MMBtu	eGRID 2016	BE.2.1
Method and data source notes: 78,294,148 kWh from PPL. PPL provided the total residential electricity usage for zipcodes 17033, 17036, and 17078 (187,504,316 kWh). This total was multiplied by the fraction (41.8%) of the total population of those three zipcodes (16972 +21913+20218 = 59103) that were Derry residents (24679). **46,040,258 kWh from Met-Edison.** Met-Ed provided the total residential energy for the same three zipcodes (110,260,444 kWh), and the fraction attributable to Derry was calculated.						

Commercial use of electricity	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	125,918,581	kWh	0.1	mtCO2/MMBtu	eGrid 2016	BE.2.1
Method and data source notes: 106,729,773 kWh from PPL. PPL provided total non-residential electricity usage for zipcodes 17033, 17036, and 17078 (511,207,892 kWh). This value was multiplied by the fraction of Derry residents making up those three zipcodes, then further divided equally between commercial and industrial sources. **19,188,808 kWh from Met-Edison.** Met-Ed provided the total commercial electricity use for the same three zipcodes (45,954,706 kWh), and the fraction attributable to Derry was calculated.						

Industrial use of electricity	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	124,033,055	kWh	0.1	mtCO2/MMBtu	eGrid 2016	BE.2.1
Method and data source notes: 106,729,773 kWh from PPL. See method of calculation from "Commercial use of electricity" methods. **17,303,062 kWh from Met-Edison.** Met-Ed provided the total						

industrial electricity use for the same three zipcodes (41,438,588 kWh), and the fraction attributable to Derry was calculated.

	Activity data		Emissions factor			Method
Residential, Commercial, and Industrial use of Natural Gas	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	21,598,281	**therms**	**53.02** **0.005** **0.0001**	**kg CO2/MMBtu** **kg CH4/MMBtu** **kg NO2/MMBtu**		**BE.1.1**
Method and data source notes: Data provided by UGI. 16,303,638 industrial therms over 22 accounts. 2,405,205 commercial therms over 479 accounts. 2,889,438 residential therms over 4,046 accounts.						

	Activity data		Emissions factor			Method
Residential use of non-utility fuels	**Value**	**Unit**	**Value**	**Unit**	**Source**	
--Propane	**22,449**	**MMBtu**	**61.46** **0.011** **0.001**	**kg CO2/MMBtu** **kg CH4/MMBtu** **kg NO2/MMBtu**	**ICLEI**	
--Fuel Oil	**136,868**	**MMBtu**	**72.93** **0.011** **0.0007**	**kg CO2/MMBtu** **kg CH4/MMBtu** **kg NO2/MMBtu**		
--Wood	**5,793**	**MMBtu**	**93.8** **0.316** **0.0042**	**kg Bio CO2/MMBtu** **kg CH4/MMBtu** **kg NO2/MMBtu**		
Method and data source notes: Non-utility fuel estimation was allocated based on natural gas usage. Percent of housing units using specific fuel types was obtained through US CENSUS data (http://factfinder.census.gov) by entering and searching "Derry Township, Dauphin County, PA" into the Community Facts. The percent of housing units utilizing utility gas, propane, fuel oil, and wood was 39.9%, 3.1%, 18.9% and 0.8%, respectively. The total occupied housing units (9,786) times each percent estimated the number of houses using each fuel type. The MMBtu/household was 74.						

	Activity data		Emissions factor			Method
On-road vehicle travel (gasoline)	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	257,524,041	**VMT**	**0.07** **0.068**	**mtCO2/MMBtu** **mtBiogenic CO2/MMBtu**	**National Default Vehicle Fuel Efficiency & Emissions Factors**	**TR.1.B**
Method and data source notes: The Tri-County Regional Planning Authority provided the 2016 Annual Vehicle Miles Traveled (VMT) Distribution by Fuel Type and by MOVES Vehicle Type for Derry Township (in-boundary). The township VMT total was 292,840,620 miles, which were driven by the following **gasoline-powered** vehicles: motorcycles (0.61% total VMT), passenger cars (48.10%), passenger trucks (30.32%), light trucks (7.52%) and heavy trucks (1.39%).						

	Activity data		Emissions factor			Method
On-road vehicle travel (diesel)	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	33,705,955	**VMT**	**0.074** **0.074**	**mtCO2/MMBtu** **mtBiogenic CO2/MMBtu**	**National Default Vehicle Fuel Efficiency & Emissions Factors**	**TR.1.B**
Method and data source notes: The township VMT total was 292,840,620 miles, which were driven by the following **diesel-powered** vehicles: passenger cars (0.37%), passenger trucks (0.52%), light trucks (0.43%) and heavy trucks (10.19%).						

On-road vehicle travel (E85)	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	995,658	VMT	0.07 0.068	mtCO2/MMBtu mtBiogenic CO2/MMBtu	National Default Vehicle Fuel Efficiency & Emissions Factors	TR.1.B
Method and data source notes: The township VMT total was 292,840,620 miles, which were driven by the following **E85-powered** vehicles: passenger cars (0.12%), passenger trucks (0.18%), and light trucks (0.04%).						

Freight Railway	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	17,738	MMBtu	0.074	mtCO2/MMBtu		TR.5
Method and data source notes: Data for freight rail was obtained by measuring the length of Norfolk Southern railway present in Derry Township using Google Earth (5.52 miles). The total diesel fuel use by Norfolk Southern was obtained from their 2016 Sustainability Report 2016 Annual Report (426 million gallons of diesel consumed / 19,979 miles of rail operated). This results in a per-mile diesel consumption of 23,124 gallons; 127,646 gallons within the township boundary. A conversion factor of 7.2e-6 gallons diesel/MMBtu is used.						

Landfilling of solid waste by the community	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	1738	tons	0.0326 0.058	mtCO2/MMBtu mtBioCO2/MMBtu		SW.2.2a
Method and data source notes: Data on waste tonnage was received from the Susquehanna Resource Management Complex. Construction/Demolition tonnage (1,738) is sent to be landfilled by the Lancaster County Solid Waste Authority.						

Combustion of solid waste by the community	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	20981	tons	0.0326 0.058	mtCO2/MMBtu mtBioCO2/MMBtu		SW.2.2a
Method and data source notes: Data on waste tonnage was received from the Susquehanna Resource Management Complex. Refuse tonnage (20,020) and residual tonnage (961) are both sent to the incinerator facility to be processed.						

Use of energy associated with use of potable water	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	2,000,000	kWh	0.1	mtCO2/MMBtu	eGrid 2016	WW.14
Method and data source notes: Data received from PA American water for the electricity associated with processing and delivery of water to the community (2,000,000 kWh).						

Process emissions of wastewater	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	2644	Kg BOD5/day	0.175	mtCH4/kg BOD5/day		WW.6
Method and data source notes: Data received from the Derry Township Municipal Authority (4067 kg						

BOD5/day), 35% of which is removed in primary treatment.

Nitrification/Denitrification process NO2 emissions	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	24679	people	7	g N2O/person		WW.7
Method and data source notes: Input the population of Derry Township to calculate N2O emissions.						

Wastewater treatment digester gas	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	150,000	scf/day				WW.1.a WW.2.a WW.3
Method and data source notes: Data received from the Derry Township Municipal Authority (150,000 scf/day), 65% of which is CH4.						

Nitrogen Discharge from wastewater treatment facility	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	95	kg N/day	0.005	kg N2O/kg N effluent		WW.12
Method and data source notes: Data received from the Derry Township Municipal Authority (95 kg N released to environment per day).						

Digester Flaring	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	150,000	scf/day	1.222e-7	mtCH4/scf	ICLEI	
Method and data source notes: Data received from the Derry Township Municipal Authority (150,000 scf/day), 65% of which is CH4. Flaring has a 99% destruction efficiency.						