AECOM

Community and Municipal Greenhouse Gas Inventory Report

City of Newark, Delaware

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1.0 Introduction

AECOM developed community-wide and municipal operations greenhouse gas (GHG) inventories for the City of Newark, Delaware for the 2019 calendar year. This report summarizes the inventory results. It provides information on GHG inventory next steps, including communicating the results, establishing a reporting scheduling, and improving results in future inventories. It also includes a short section outlining the future climate action plan (CAP) development process, including plan development steps and preliminary GHG reduction strategies. The report concludes with technical descriptions of the GHG inventory methodologies and data collection sources.

The year 2019 was chosen out of concern that Covid-related disruptions in more recent years (i.e., 2020 or 2021) would have led to atypical or inaccurate results.

2.0 Community GHG Inventory Results

2.1 Protocol and Boundaries

The community-wide inventory follows the reporting guidance outlined in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) created by the World Resources Institute, C40 Cities, and ICLEI – Local Governments for Sustainability. The GPC is an international standard that ensures consistent and transparent measurement and reporting of GHGs between cities. C40 Cities created the City Inventory Reporting and Information System (CIRIS) Excel tool to support cities in reporting emissions according to requirements in the GPC. This tool has been used to manage and report Newark's community-wide GHG inventory data.

The GPC is designed to account for the seven GHGs covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3), which are reported in GHG inventories as CO_2 equivalents (CO_2e). The GPC groups emissions into three categories based on where they occur:

- Scope 1: GHG emissions from sources located within the city boundary
- Scope 2: GHG emissions occurring because of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary
- Scope 3: All other GHG emissions that occur outside the city boundary because of activities taking place within the city boundary

Newark's inventory includes GHGs occurring within the city's geographic boundary as well as specified emissions occurring outside of the city's boundary due to city-based activities during the 2019 calendar year. Further, the GPC defines two emissions reporting levels that demonstrate different levels of completeness regarding the emissions sources analyzed: BASIC and BASIC+. Newark's community-wide inventory follows the GPC BASIC reporting requirements, which covers Scope 1 and Scope 2 emissions from stationary energy and transportation and Scope 1 and Scope 3 emissions from waste. Additionally, BASIC reporting accounts for three of the seven Kyoto Protocol GHGs: CO_2, CH_4, and N_2O.

GHG emissions are typically estimated by multiplying activity data by an emission factor associated with the activity being measured. Activity data is a quantitative measure of an activity that results in GHG emissions generation during a given time period (e.g., kWh consumed, miles driven, tons of waste disposed over a calendar year). An emission factor is a measure of the mass of GHG emissions relative to a unit of activity (e.g., kg CO_2/kWh, g CH_4/mile). GHG emissions are then converted and reported as metric tonnes of CO_2e ($MTCO_2e$) by using specific global warming potentials[1] (GWPs) that reflect the global warming impact of different greenhouse gases.

2.2 Community Inventory Results Summary

In calendar year 2019, it is estimated that Newark generated 442,345 $MTCO_2e$ community-wide. **Table 1** shows the 2019 emissions sources; activity data; total

[1] The Newark GHG inventories use GWP values from the UN International Panel on Climate Change Fifth Assessment Report.

emissions; and if activity data was estimated, based on actual data (e.g., utility bills or metered data), or reported by another entity.

Table 1. 2019 Community-wide GHG Inventory Activity and Emissions

Emissions Source	2019 Activity Data	2019 Emissions ($MTCO_2e$)	% of Total Emissions	Activity Data Estimated or Actual?
STATIONARY ENERGY				
Scope 1				
Residential natural gas, fuel oil, and propane	584,262,295 CF natural gas 472,790 gal fuel oil 258,293 gal propane	38,522	9%	Estimated
Commercial and Institutional natural gas and fuel oil	599,005,360 CF natural gas 1,067,656 gal fuel oil	43,576	10%	Estimated
Industrial natural gas and fuel oil	429,573,072 CF natural gas 645,313 gal fuel oil	30,018	7%	Estimated
University of Delaware natural gas, fuel oil, and propane	712,932,000 CF natural gas 138,483 gal fuel oil 3,088 gal propane	40,288	9%	Reported
Fugitive emissions from natural gas distribution[2]	*NA*	2,337	1%	Estimated
Scope 2*				
Residential electricity	90,946,124 kWh	34,923	8%	Actual
Commercial and Institutional electricity	156,924,990 kWh	60,249	14%	Actual
Industrial electricity	11,731,043 kWh	4,505	1%	Actual
University of Delaware electricity	158,741,419 kWh	60,957	14%	Reported
Electricity Transmission and Distribution Line Loss	30,452,095 kWh	11,694	3%	Actual
TRANSPORTATION				
Scope 1				
On-road	158,673,749 VMT	84,028	19%	Estimated
Off-road**	*NA*	10,386	2%	Estimated
Scope 2				
Commuter rail	127,910 kWh	41	<1%	Estimated
WASTE				
Scope 3				
Landfilled solid waste – City-collected and University of Delaware	8,910 short tons	4,514	1%	Actual
Composted solid waste – City-collected and University of Delaware	1,497 short tons	239	<1%	Actual
Wastewater treatment	33,782 people	16,068	4%	Estimated
TOTAL	-	**442,345**	**100%+/-*** **	-

*Electricity emissions shown here were calculated using the market-based method.
**Some off-road sources are reported under the Stationary Energy sector per the GPC, but are aggregated here for clarity.
***Total does not sum to 100% due to rounding.

[2] Fugitive emissions were estimated using a calculator within the CIRIS tool based on total natural gas consumption for each end user category (e.g., residential).

Biogenic CO_2 emissions (CO_2(b)) from combusting materials of biogenic origin (e.g., biofuels, landfill gas, etc.) are reported separately from the other GHGs and are not counted in emissions totals. This is because the carbon in biomass is of a biogenic origin—meaning that it was recently contained in living organic matter—while the carbon in fossil fuels has been trapped in geologic formations for millennia. Table 2 shows total CO_2(b) emissions from landfilled waste.

Table 2. Biogenic CO_2(b) Emissions

Emissions Source	2019 Activity Data	2019 Biogenic CO_2(b) Emissions ($MTCO_2e$)	Activity Data Estimated or Actual?
WASTE			
Waste sent to landfill (City-collected and University of Delaware)	8,910 short tons	2,513	Actual

The largest contributor to total community-wide emissions is electricity, which generates 39% of total emissions (see Figure1). Stationary fuels, including natural gas, fuel oil, and propane, are the second largest source, generating 35% of total emissions. On-road transportation fuels generate 19% of total emissions, and waste and off-road vehicles contribute the remaining 7%.

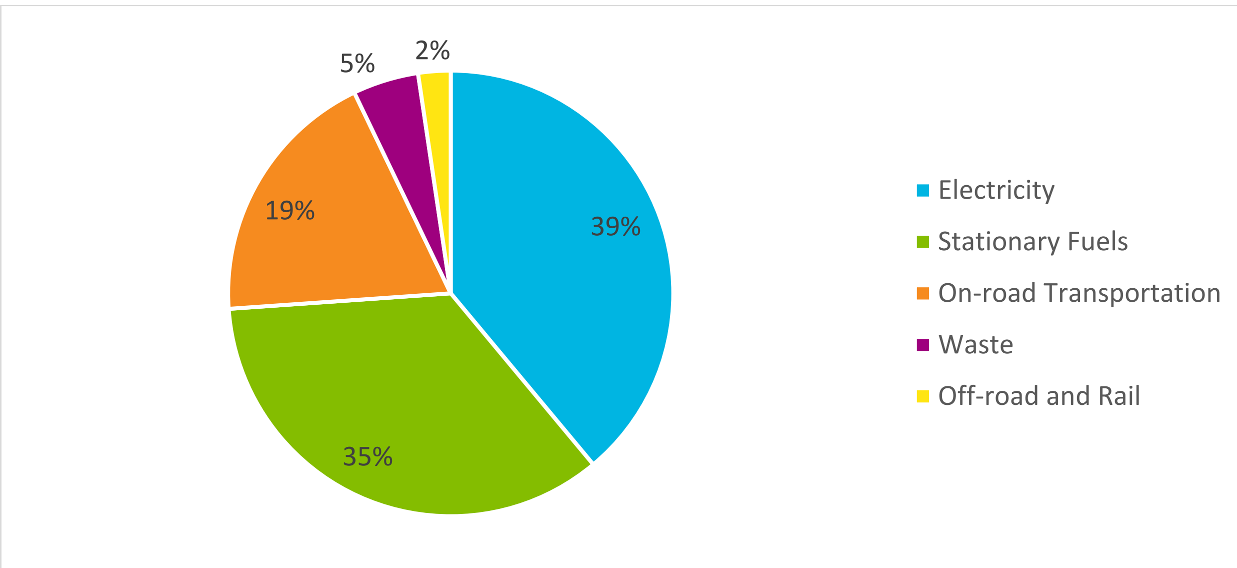

Figure 1. 2019 Community-wide GHG Emissions by Source

Figure 2 shows GHG emissions by sector. Stationary energy (including electricity, natural gas, fuel oil, and propane) in the commercial and institutional sector generates the largest amount of emissions (24% of total emissions) and is closely followed by the University of Delaware stationary energy consumption (23%), on-road transportation (19%), and residential stationary energy (17%). The remaining emissions are generated by industrial stationary energy (8%), waste (5%), electricity line-loss (3%), and off-road activities (2%).

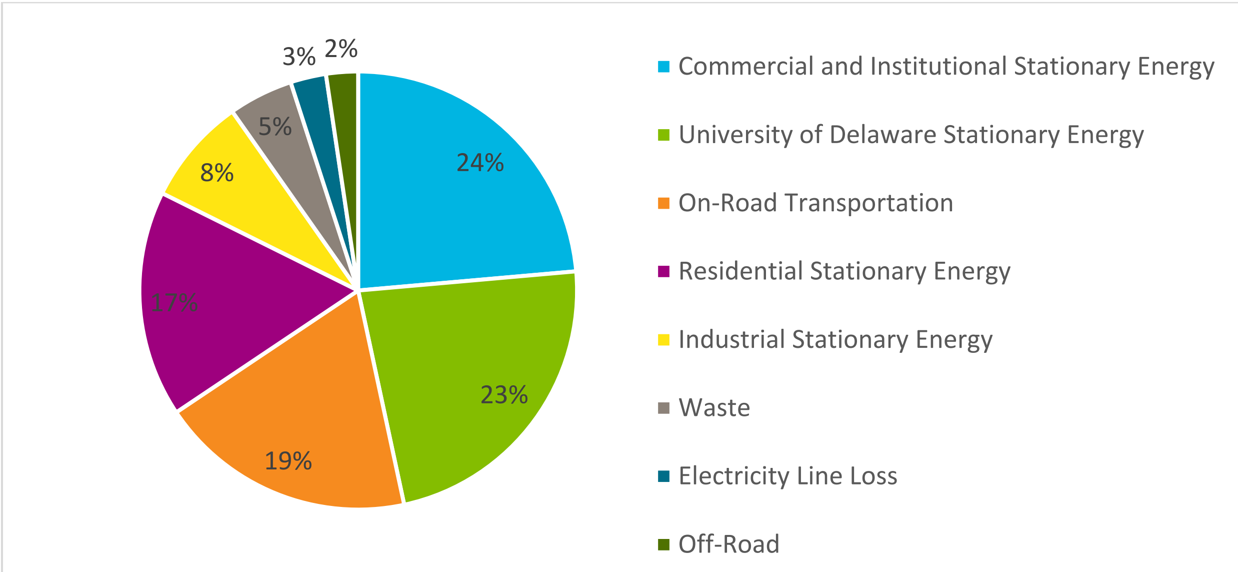

Figure 2. 2019 Community-wide GHG Emissions by Sector

Figure 3 provides additional detail on the inventory results and shows GHG emissions by sub-sector. When electricity and stationary fuel consumption emissions are separated into individual sectors, on-road transportation becomes the largest contributor to GHG emissions followed by University of Delaware electricity and then commercial and institutional electricity consumption.

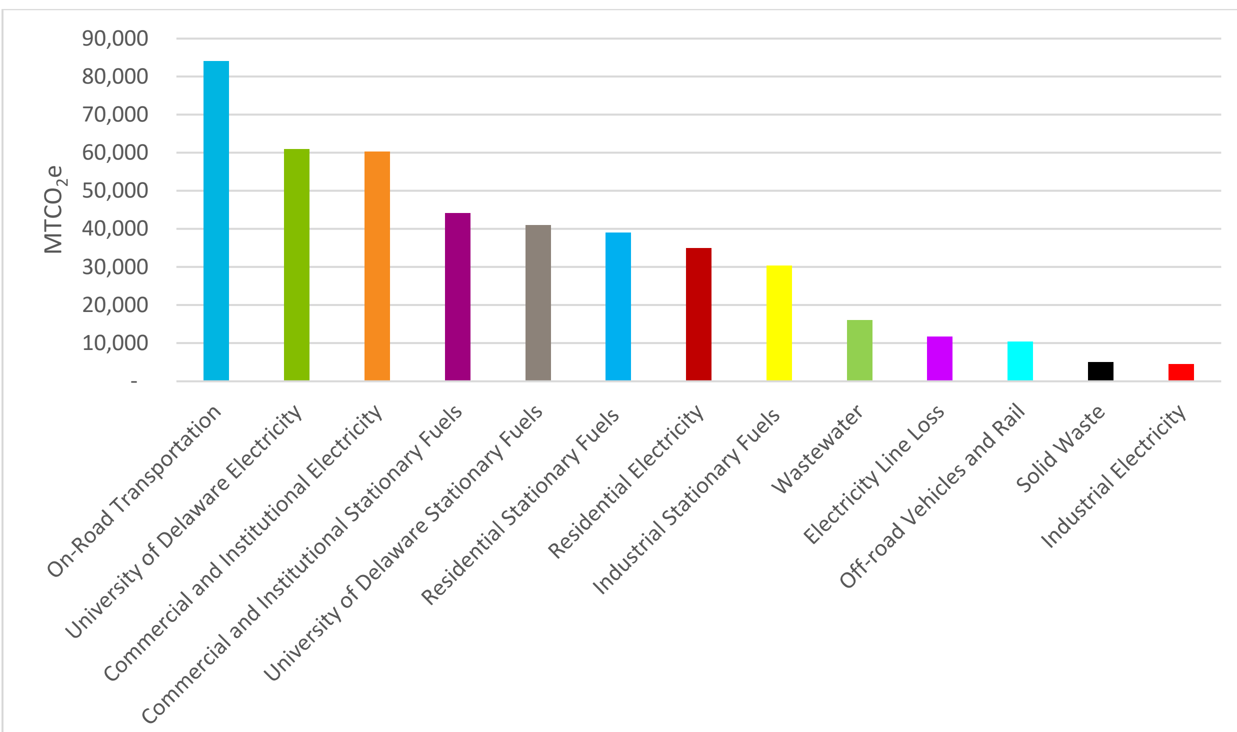

Figure 3. 2019 Community-wide GHG Emissions by Sub-Sector

2.3 Stationary Energy Sector Results

2.3.1 Electricity

Electricity consumption in the city generates 39% of total community emissions. The market-based method was used to calculate electricity emissions (see Methodology section *Market vs Location-based Methods* for further explanation). Figure 4 illustrates the distribution of electricity emissions by end user. The University of Delaware is the largest contributor of emissions (35%), followed by commercial (31%) and residential (20%) customers. Total electricity transmission and distribution line loss generates 7% of total emissions, while the remaining emissions are from industrial (3%), municipal (2%), schools (1%), and other institutional (1%) customers. The distribution of emissions by end users can be helpful in future climate planning stages when developing GHG reduction strategies.

The City's Electric Department purchases electrical power from the wholesale electric utility Delaware Municipal Electric Corporation (DEMEC) and distributes it through the local power grid. The default electricity provider in the region is Delmarva Power, and there are two Delmarva accounts within the city's boundaries (Folk Park Gate and Curtis Pump Station). All community-wide electricity activity data was obtained from actual utility meter readings except for municipal street and traffic lights which was estimated.

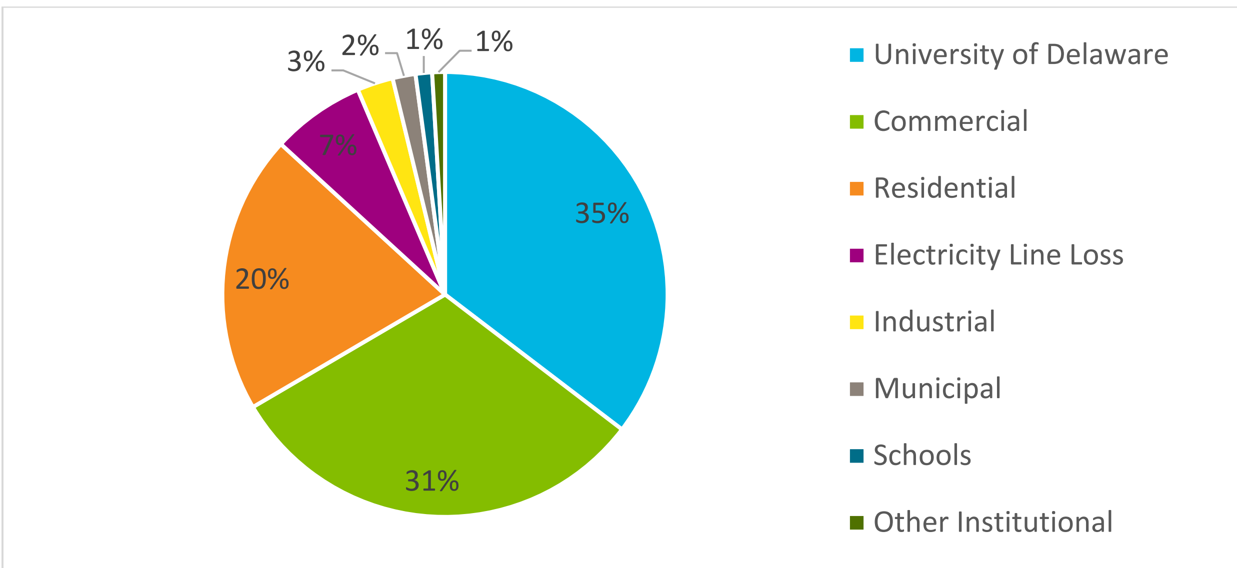

Figure 4. 2019 Community-wide Electricity Emissions

2.3.2 Stationary Fuels

Natural gas, fuel oil, and propane represent 35% of total community emissions. As shown in Figure 5, natural gas contributes 82% of total stationary fuel emissions, followed by fuel oil (15%), fugitive natural gas emissions (2%), and propane (1%).

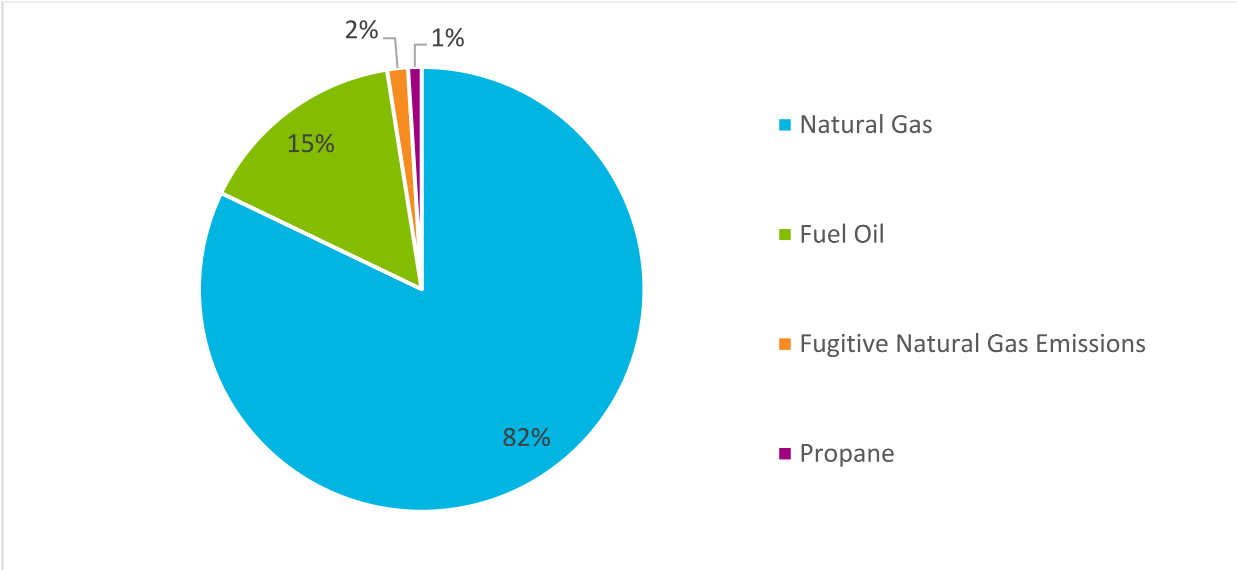

Figure 5. Stationary Fuel Emissions by Source ($MTCO_2e$)

Total stationary fuel emissions are almost evenly split between the University of Delaware, residential, commercial/institutional, and industrial customers (see Figure 6).

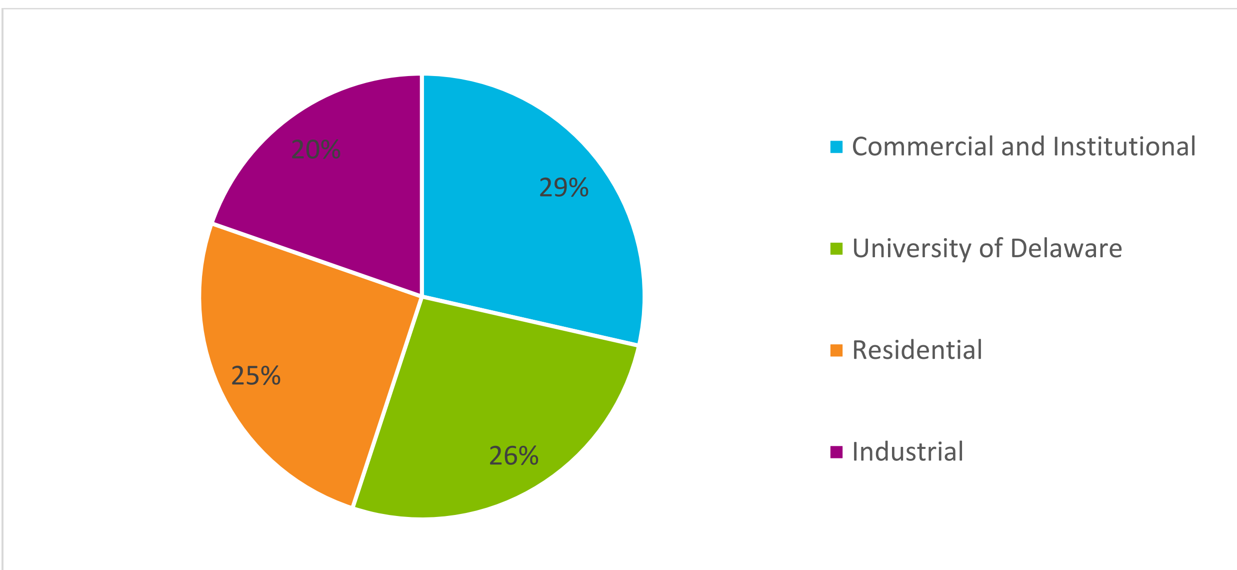

Figure 6. Stationary Fuel Emissions by Sector ($MTCO_2e$)

Actual stationary fuel consumption data was obtained for the University of Delaware and municipal buildings. As Delmarva Power was unable to provide metered data on natural gas consumption for community-wide customers, and private fuel oil and propane purchases cannot be measured directly, all other community stationary fuel consumption was estimated. Activity data and emissions were estimated using city building area, typical fuel sources, and energy intensity data for the region (e.g., cubic feet natural gas/square foot). Table 3 presents the stationary energy activity data and GHG emissions results.

Table 3. Stationary Fuel Activity Data and Emissions

Sector	Fuel Type	Activity Data	Emissions ($MTCO_2e$)	% of Stationary Energy Emissions
Commercial and Other Institutional	Natural Gas	598,138,560 CF	32,596	21%
	Fuel Oil	1,067,656 gal	10,933	7%
	Fugitive	NA	601	<1%
University of Delaware	Natural Gas	712,932,000 CF	38,852	25%
	Fuel Oil	138,483 gal	1,418	1%
	Propane	3,088 gal	18	<1%
	Fugitive	NA	716	<1%
Residential	Natural Gas	584,262,295 CF	32,181	21%
	Fuel Oil	472,790 gal	4,841	3%
	Propane	258,293 gal	1,500	1%
	Fugitive	NA	587	<1%
Industrial	Natural Gas	429,573,072 CF	23,410	15%
	Fuel Oil	645,313 gal	6,608	4%
	Fugitive	NA	432	<1%
Municipal	Natural Gas	866,800 CF	47	<1%
	Fugitive	NA	1	<1%

2.3.3 Fugitive Emissions

Fugitive emissions represent 1% of total community emissions. Fugitive emissions represent the intentional or unintentional release of emissions from the extraction, processing, storage, and transport of fuel to the point of final use. This inventory accounts for fugitive emissions that result from natural gas leakage in distribution pipelines. These emissions were estimated using the CIRIS Fugitive Emissions from Gas Distribution Calculator.

2.4 Transportation Sector Results

2.4.1 On-Road Transportation

On-road emissions, such as from passenger cars, trucks, and buses, represent 19% of total community emissions. Newark's on-road vehicle miles traveled (VMT) were modeled from a CUBE travel demand model using EPA MOVES3. This model includes all transportation within the city's geographic boundary, regardless of the trip's origin or destination.

2.4.2 Off-Road Emissions

Off-road emissions, such as from landscaping and construction equipment, represent 2% of total community emissions. Off-road emissions were estimated using the EPA

MOVES3: NONROAD model for New Castle County. The County-level off-road outputs from the model were scaled down using city-specific scaling factors.

2.4.3 Commuter Rail

Commuter rail emissions from Amtrak and SEPTA represent 0.01% of total community emissions. Both commuter rail lines are electric, and their consumption was estimating using the total rail distance in Newark and number of stops at the Newark station. The City of Newark does not supply electricity to the commuter rails, so their emissions are reported separately from the community electricity emissions.

2.5 Waste Sector Results

2.5.1 Solid Waste

City-collected waste and University of Delaware waste combined generate 1% of total community emissions. As shown in Figure 7, City-collected waste generates 72% of waste emissions while the University generates the remaining 28%. Data on waste collected by private haulers was not available.

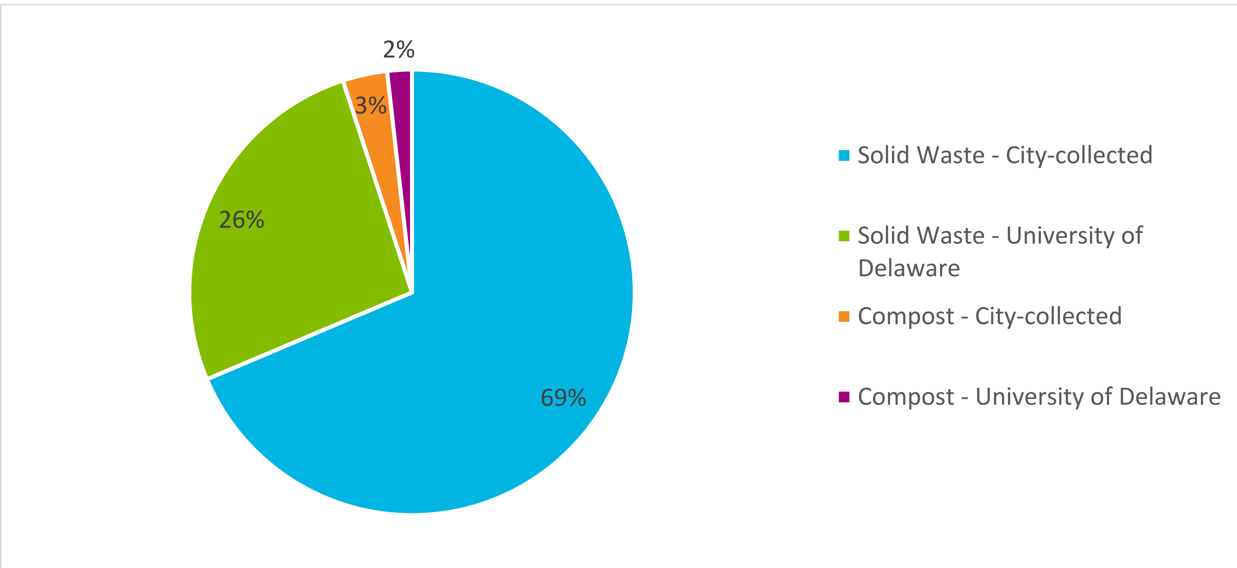

Figure 7. Solid Waste Emissions ($MTCO_2e$)

95% of waste emissions are from municipal solid waste sent to Cherry Island Landfill while 5% are from waste made into compost. Solid waste generates emissions through the anaerobic decomposition of organic matter. Composting drastically reduces these emissions, but still produces some emissions due to the small amount of anaerobic decomposition that may occur. The GPC does not direct cities to estimate waste recycling emissions separately; however, these emissions could be reflected in a city's inventory if a recycling facility is present within the city boundary, in which case the facility's energy emissions would be included in the stationary energy sector.

2.5.2 Wastewater

Wastewater treatment and effluent generates 4% of total community-wide emissions. Community wastewater is sent to the Wilmington Regional Wastewater Treatment facility which is operated by the City of Wilmington. Wastewater is treated through an activated sludge and anaerobic digestion process which produces methane. A portion of the methane is recovered and used for fuel in on-site boilers while the rest is flared. The wastewater effluent produces nitrous oxide when it is discharged into the environment.

3.0 Municipal Operations GHGH Inventory Results

3.1 Protocol and Boundaries

The municipal GHG inventory follows the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (Corporate Standard). This standard was created by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) and applies to companies, government agencies, universities, and other organizations. This standard was selected as it is one of the most widely used GHG accounting standards and was created under the same GHG Protocol initiative as the GPC protocol, which was applied to Newark's community-wide GHG inventory. The GHG Emissions Calculation Tool is an Excel-based tool from GHG Protocol and WRI that helps entities estimate their GHG emissions based on the GHG Protocol. This tool is currently available as a beta version and was used to manage and report Newark's municipal GHG emissions.

The Corporate Standard covers the accounting and reporting of six GHGs covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), which are all reported as CO_2 equivalents (CO_2e); the seventh Kyoto Protocol gas, nitrogen trifluoride (NF_3), was added to the Kyoto Protocol after the creation of the Corporate Standard.

To accurately consolidate GHG emissions, an organizational boundary and operational boundary must be defined. AECOM selected the operational control approach to define the municipal organizational boundary. Under the operational control approach, an entity accounts for 100% of the GHG emissions from operations over which it has operational control. The operational boundary includes Scope 1 (e.g., stationary fuel combustion, transportation, fugitive emissions) and Scope 2 emissions (e.g., purchased electricity). Scope 3 emissions, such as solid waste disposal, wastewater treatment, and employee commuting/business travel are considered optional within the Corporate Standard and were not included in the municipal inventory.

The community-wide and municipal inventories largely overlap: all municipal emissions are included in the community-wide inventory except for generator fuel consumption, fugitive emissions from refrigerants, and electricity consumption from Delmarva Power accounts outside of the city's geographic boundary.

3.2 Municipal Operations Inventory Results Summary

In 2019, City of Newark municipal operations generated 4,422 $MTCO_2e$. Table 4 shows the emissions sources, activity data, total emissions, and if activity data was estimated or based on actual data (e.g., bills or metered data). It also identifies if the emissions are included in the community-wide inventory.

Table 4. 2019 Municipal Inventory Activity Data and Emissions

Emissions Source	2019 Activity Data	Emissions ($MTCO_2e$)	Activity Data Estimated or Actual?	Included in Community-wide Inventory?
Scope 1: STATIONARY				
Transportation - Gasoline	87,775 gal	774	Actual	Y*
Transportation - Diesel	67,023 gal	685	Actual	Y*
Natural Gas	8,668 CCF	48	Actual	Y
Generator Fuel - Diesel	1,100 gal	11	Actual	N
Fugitive Emissions from Refrigerants**	0 lbs	0	Actual	N
Scope 2: PURCHASED ELECTRICITY				
Electricity – Metered Consumption	5,697,489 kWh	2,171	Actual	Y***
Electricity – Street and Traffic Lights (estimated)	1,910,963 kWh	734	Actual	Y
TOTAL (Incomplete)		4,422		

*It is assumed that the MOVES model reflects municipal fleet VMT.
**There are no fugitive emissions from refrigerants reported for the 2019 inventory because systems were recharged in 2019.
***Only electricity consumption within city geographic boundaries is included in community inventory.

Figure 8 shows total municipal emissions by sector. Electricity consumption generates most municipal emissions (66%), with fleet fuel consumption following (33%). Natural gas contributes 1% of total emissions while generator fuel contributes the remainder. Compared to the community inventory, municipal operations generate approximately 1% of community-wide emissions.

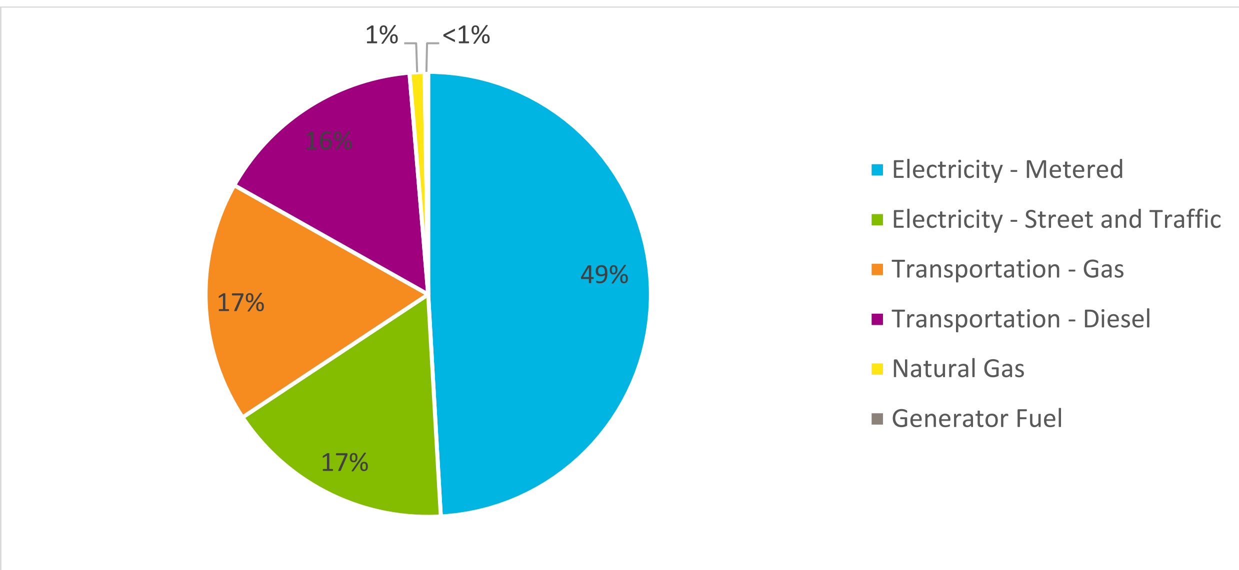

Figure 8. 2019 Municipal Operations GHG Inventory

3.2.1 Electricity

Electricity consumption contributes 66% of total municipal emissions. The market-based method was used to calculate electricity emissions (see Methodology section *Market vs Location-based Methods* for further explanation). Municipal electricity activity data was obtained from actual utility meter readings except for municipal street and traffic lights which was estimated by City staff. Figure 9 shows that 72% of total electricity consumption is from DEMEC accounts, 3% is from Delmarva, and 25% is from street and traffic light estimated consumption. DEMEC accounts serve buildings, public spaces, water treatment processes, parking lots, and other facilities while Delmarva accounts primarily serve gates, wells, and pump stations.

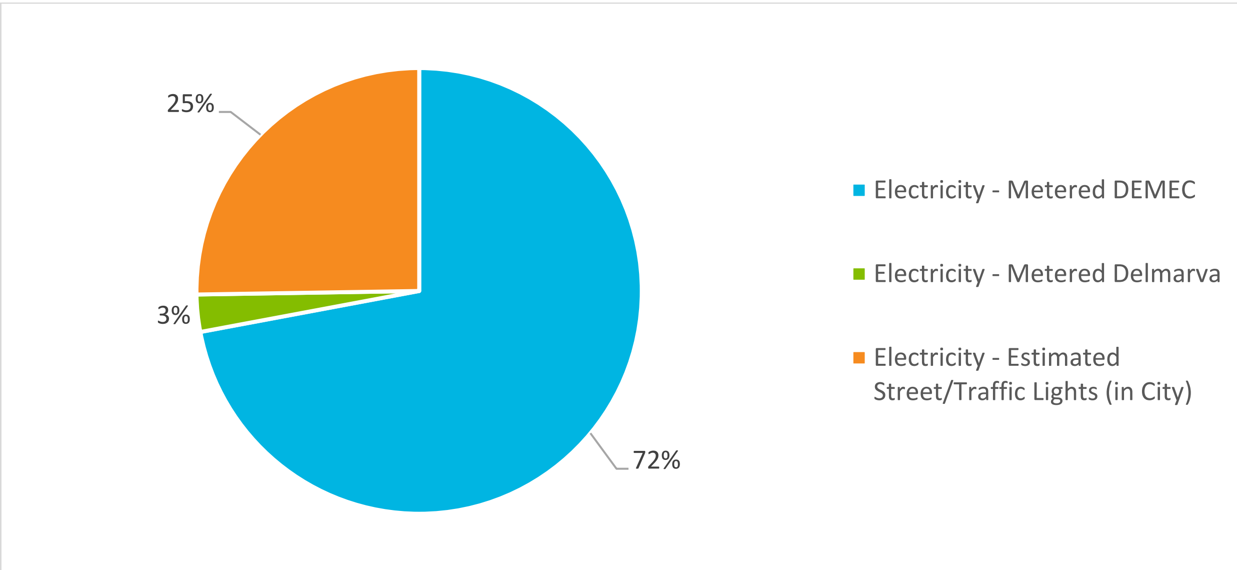

Figure 9. Municipal Electricity Emissions ($MTCO_2e$)

3.2.2 Transportation

Transportation generates 33% of total municipal operations emissions. This sector includes emissions from municipal fleet vehicles, like passenger cars and trucks, as well as off-road vehicles, such as lawn mowers. As shown in Figure 10, the majority of transportation fuel consumption is from the Police department (32%) and Refuse (22%).

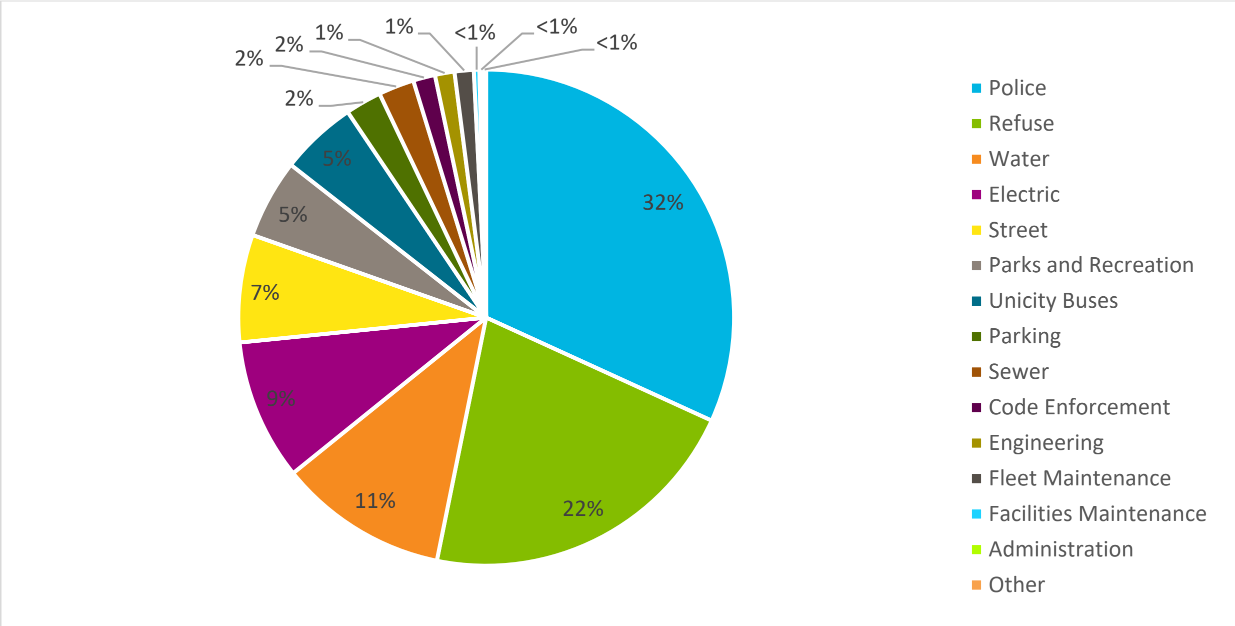

Figure 10. Fleet Emissions ($MTCO_2e$)

3.2.3 Natural Gas

Natural gas consumption generates 1% of total municipal emissions. Natural gas is used for heating and generators.

3.2.4 Generator Fuel

Generator diesel fuel consumption generates 0.3% of total municipal emissions. 1,100 gallons of diesel fuel were consumed for the backup generators. These generators serve the Water department, Fleet Maintenance Yard, City Hall, and Police Station.

3.2.5 Refrigerants

Refrigerant leakage from systems like air conditioners or freezers can produce GHG emissions. The only municipal buildings with system-wide air conditioning are the City Hall and Police Department, and these units were not recharged with refrigerant in 2019.

4.0 GHG Inventory Next Steps

4.1 Communicating Results

Reporting emissions as metric tonnes of carbon dioxide ($MTCO_2e$) equivalent is required by most reporting standards. However, this metric is often not accessible to the general public. To better communicate results, the City can select noteworthy activity data to share on a regular basis. The activity data could be expressed as a "per capita" value to allow high-level progress tracking, especially in years where a full inventory is not reported. Examples of 2019 per capita activity data include the following:

- 4,697 vehicle miles driven per resident
- 12,387 kWh consumed per resident
- 0.3 tons of waste generated per resident

Direct comparisons of total community-wide GHG inventories can be misleading as these comparisons do not consider the size or population of the communities, emissions activities present in the community, the inventory protocol followed, data availability and accuracy, etc. Per capita emissions tend to be a more useful comparison metric as it reflects the size of the community (though does not normalize for the other comparative challenges previously listed). When considering total reported community emissions, Newark generated 13.1 $MTCO_2e$/person in 2019. However, when only considering emissions sources required by the GPC for BASIC reporting, Newark generated 12.8 $MTCO_2e$/capita. The table below lists the per capita emissions of cities of a similar population size (<50,000) and climate region as Newark that are part of the Global Covenant of Mayors.[3] These cities follow an emissions reporting framework that is based on the GPC, though reporting years may vary. Again, it is important to note that these cities' reported emission sources might not perfectly align with Newark's. Additionally, these cities represent those that are already committed to/working toward climate action and may therefore represent the lower end of the emissions per capita spectrum.

City	Newark, DE	Lexington, MA	Charlottesville, VA	Blacksburg, VA	Burlington, VT
Emissions per capita ($MTCO_2e$/person)	12.8	13.3	6.5	8.7	8.4

Another option for communicating GHG inventory results is using the EPA GHG Equivalencies Calculator[4] to translate activity data or GHG emissions into concrete terms, such as the following example:

- 2019 community-wide GHG emissions in Newark are equivalent to the following:
  - Driving 1 billion miles in an average gas car (or driving to the moon and back 2,300 times), OR driving 32,000 miles per Newark resident
  - Powering nearly 56,000 homes for a year – 4 times the number of homes in Newark, OR powering 1.7 homes per Newark resident

[3] https://www.globalcovenantofmayors.org/our-cities/
[4] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

- The amount of carbon sequestered annually by a forest covering 1/3rd of Delaware, OR 15 acres of forest per Newark resident

These kinds of illustrative comparisons can help residents to think about their own contributions to global climate change.

Additionally, the City could provide links to various online carbon impact calculators where residents can calculate their personal GHG emissions, such as the CoolClimate Network Carbon Footprint Calculator[5]. These communications be made available through the City website in a dashboard format as was also recommended in *Sustainable Newark*.

4.2 Emissions Reporting Schedule

Regularly evaluating community-wide and municipal operations GHG emissions through future inventories will provide information on the City's overall emissions trends and help track progress toward GHG targets. Future inventories can also help the City understand which specific emission sectors and activities are demonstrating GHG reduction progress or are facing challenges. However, frequent full reporting of GHG inventories can be resource intensive (e.g., staff time, funding). Limited resources may be better spent implementing and tracking GHG reduction actions from the City's future Climate Action Plan (CAP).

For consistency, the City should aim to align its GHG reporting periods with *Sustainable Newark* ─ the City's sustainability plan. *Sustainable Newark* is to be updated every 5 years and recommends that the City initially establish a GHG inventory reporting schedule of every 2 or 3 years and eventually transition to annual reports.[6] AECOM recommends developing complete community-wide and municipal operations GHG inventories at least every 5 years to coincide with *Sustainable Newark* updates. In intermediary years, primary emissions activity data, such as electricity consumption, municipal fleet fuel consumption, and waste collected, should be collected annually to better monitor emissions trends in-lieu of full inventory development. Should community-wide natural gas consumption data become available in the future, it should also be collected annually.

4.3 GHG Inventory Improvement Opportunities

AECOM recommends the following to improve future GHG inventories:

- Continue the dialogue with Delmarva Power and develop a process by which natural gas data for Newark customers can be provided. Delmarva's legal group would need to authorize a data exchange, but it is unknown what actions may be needed to obtain permissions. The City should write an official letter to Delmarva asking to release the data. The letter should highlight the benefits of releasing the data including the following:
    - A streamlined data delivery process will help Delmarva respond more easily as other jurisdictions begin to request similar data as energy and climate planning evolves.
    - Other utilities currently offer this data on a regular basis.

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[5] https://coolclimate.berkeley.edu/calculator
[6] https://newarkde.gov/DocumentCenter/View/12803/SustainableNewark_FINAL_30OCT19?bidId=

  - Releasing the data increases transparency and demonstrates Delmarva's willingness to work with its customers on their climate planning goals.

- If natural gas utility data cannot be obtained, the City could improve its stationary estimates by refining the property database used for stormwater utility billing. The database could better describe the actual building uses and define building areas that account for multiple floors and mixed uses.
- Continue to track enrollment in the 100% renewable electricity program and determine the total community-wide electricity consumption under the program. Continue to use the market-based electricity emissions calculation method to reflect the impact of enrollment (the emissions factor for those enrolled should be zero).
- Evaluate other sources for vehicle travel data. Google Environmental Insight Explorer provides annual data on community VMT, among other information. The VMT data reflects actual trips from geospatial data based on continuous observation and better represents changes in travel due to COVID-19. Both C40 Cities and ICLEI recommend using Google EIE to obtain on-road transport VMT. The City should contact the Google Environmental Insight Explorer team to request data access for the City of Newark, particularly the model's community VMT data. This data can either be used to replace information from the WILMAPCO regional travel demand model (which is updated every 2-3 years) or can be collected annually and used to describe directional changes in the community's vehicle travel volume (i.e., VMT) and mode (e.g., transit, driving, biking).
- Work with private waste contractors to better understand the quantity of private waste collected in the city.
- Develop a streamlined method for tracking City-owned behind-the-meter solar electricity generation and report total kWh and avoided emissions in future inventories. Though reduced electricity consumption will already be reflected in community electricity data, tracking the total renewable energy production and avoided GHG emissions will help to illustrate the benefits of the program.

5.0 Future CAP Development Process

5.1 Climate Action Plan Development Steps

Most CAPs follow a similar development approach, which can include various iterations of the following steps:

1. **Develop a GHG Inventory**: Complete a base year GHG inventory (Newark completed this step with its 2019 GHG inventories).
2. **Forecast Emissions**: Develop emissions forecasts using growth indicators and evaluating potential plans and policies that would impact future emissions, such as utility or state-wide renewable-energy procurement plans/goals or ZEV adoption forecasts.
3. **Establish GHG Reduction Targets**: Establish near- and long-term GHG targets upon which to frame CAP development, such as a net zero target year and interim target, if desired.
4. **Evaluate Target Achievement Scenarios**: Develop a target achievement scenario through evaluation of multiple high-level technologic changes that can achieve the local reduction targets.
5. **Develop Initial Actions**: Develop CAP actions that contribute to GHG reduction strategy and scenario achievement.
6. **Select and Prioritize Actions**: Develop an action selection and prioritization process to evaluate the pros and cons of each action and determine which actions will be included in the CAP and/or prioritized for immediate implementation.
7. **Establish an Implementation and Monitoring Approach**: Establish an approach for implementing actions and monitoring CAP and target achievement progress
8. **Develop a Climate Action Plan**: Develop a CAP document to be shared publicly and updated on a recurring schedule as new information is available.
9. **Ongoing Community/Stakeholder Engagement**: Engage the community and stakeholders throughout the CAP development and implementation process with an emphasis on highlighting the voices of underserved/marginalized residents.
10. **Consider Climate Vulnerability and Resilience/Adaptation Opportunities**: Consider including a climate resilience and adaptation analysis as part of the CAP to understand potential local climate hazards and adaptation strategies.

As the City looks to move beyond *Step 1: Develop a GHG Inventory*, the process outlined above can provide further guidance on future CAP development.

5.2 Preliminary GHG Reduction Strategies

Based on the results of the emissions inventories, the following preliminary climate strategies can help reduce emissions from major sources in Newark and could be used as the starting point for GHG reduction analysis as part of climate action plan development. This is not an exhaustive list and reflects common strategies within the primary emissions sectors that might be included in a CAP:

1. Electricity (39% of total emissions)
    a. Transition from fossil-fuel electricity sources (such as natural gas) to carbon-free electricity sources (such as solar and wind).
2. Building Stationary Fuel (26% of total emissions)
    a. Increase energy efficiency of existing buildings through efficient equipment and enhanced envelope performance.
    b. Retrofit existing fossil fuel equipment with electric or zero-carbon options.
    c. Require new construction to be all-electric.
3. Transportation (19% of total emissions)
    a. Shift private vehicle trips to alternate modes of transport, such as active modes (e.g., walking, biking, rolling) and public transit (e.g., buses and trains).
    b. Increase the use of zero-emissions vehicles for private and public transit.
    c. Increase use of zero-emissions off-road vehicles and equipment, like lawn mowers and construction equipment.
4. Solid Waste (1% of total emissions)
    a. Increase composting and recycling.
    b. Decrease waste generation.

An emissions planning scenario includes multiple strategies that will help the City meet its emission reduction targets. Once the City has selected a scenario, it will need to develop actions to achieve GHG reduction strategies like the examples provided above. For example, to decarbonize existing residential buildings, the City could consider the following actions:

- Incentivize electrification of fossil fuel systems (e.g., natural gas hot water heaters, HVAC equipment, stoves/cooktops).
- Develop mandates for fossil fuel equipment replacement at time of sale, end of useful life, etc.

To decarbonize the municipal vehicle fleet and off-road equipment, the City could consider the following actions:

- Develop a Zero Emission Vehicles (ZEV) fleet procurement policy.
- Require all off-road equipment under City contract (e.g., lawnmowers, leaf blowers, construction equipment, etc.) to be zero- or low-emissions.

6.0 GHG Inventory Methodologies and Data Collection

6.1 Community GHG Inventory Methodology

6.1.1 Electricity

Electricity consumption was obtained from City-provided electricity consumption data. The data covered all DEMEC electricity consumption in the city and was organized by specific location categories. Each category was assigned an inventory sector (see table below). Municipal electricity data was provided separately in municipal utility bills. Municipal streetlight and traffic light data was estimated using the bulb wattage and assumed hours per year.

GHG Inventory Sectors	Location Categories from Electricity Data
Residential	RENTAL_E, RENTAL_HEAT_E, RESIDENTIAL_E, RESI_HEAT_E
Commercial	CHURCHS_E, COMMERCIAL_E, HOSPITALS_E
Industrial	INDUSTRIAL_E
Municipal	From separate municipal utility data provided by City
Municipal - Street and traffic lights	From separate electricity consumption estimations provided by City
Other Institutional	GOVERNMENT_E, STATE_E (Note: This electricity consumption was derived by subtracting the total municipal in-boundary electricity consumption from these two categories)
Schools	OTHER SCHOOLS_E
University	UD_NON_ESA_METERS, UD_ESA_METERS

There are two municipal electric accounts under Delmarva Power that are within the city's boundaries (Folk Park Gate and Curtis Pump Station). This electricity consumption was obtained from Delmarva bills and added to the total DEMEC electricity consumption. Municipal electricity consumption for facilities outside of the city's geographic boundaries was not included here but is included under the municipal inventory.

Electricity transmission and distribution line losses are not required to be reported under the GPC BASIC approach. However, the City of Newark has decided to disclose these emissions to better understand the impact of line loss. These transmission and distribution losses were calculated by subtracting the "behind the meter" electricity consumption data from the "front of meter" system load electricity data provided by the City. The difference is the total electricity line loss, which is approximately 7%.

The DEMEC electricity emissions factor was generated using its 2019 energy fuel source mix and the World Bank's Climate Action for Urban Sustainability (CURB) tool. AECOM created a user-friendly Excel tool that reproduces CURB's methodology for calculating an emissions factor from fuel mixes. If the DEMEC fuel mix changes in the future, this Excel tool can be updated with the new fuel mix to calculate the new emissions factor. The EPA 2019 eGRID emissions factors for the RFC East region were used to calculate the electricity emissions from Delmarva accounts and location-based emissions.

Market vs. Location-based Methods

Electricity emissions are generated from powerplants outside the city that produce electricity using a mix of fuel types (e.g., coal, natural gas, solar). Cities can assess emissions from electricity consumption using two methods: a location-based method or a market-based method. A location-based method is based on an average emission factor for the electrical grid that represents the energy produced in a region. The market-based method is based on allocating emissions from energy generators to consumers based on "contractual instruments" such as utility-specific emission factors, energy attribute certificates, or other contracts. The GPC requires electricity emissions to be reported using the location-based method, which in this case entails using the EPA eGRID emissions factors for the RFC East region. However, to better reflect the impact of Newark's Renewable Energy Program, the market-based method is used in the community-wide 2019 GHG inventory and is recommended for future GHG inventories. The market-based method considers the specific electricity fuel mix of DEMEC-procured energy and renewable energy consumption due to enrollment in the Renewable Energy Program. Because the Renewable Energy Program was not available until after May 2021, only the DEMEC fuel mix had an emissions impact on the 2019 inventory. Location-based and market-based emissions are included for comparative purposes below.

The 2019 market-based emissions are 21% higher than the location-based emissions. This is because DEMEC's electricity emission factor (0.3844 $MTCO_2e$/MWh) is higher than the eGRID region's factor (0.3168 $MTCO_2e$/MWh). Even though DEMEC uses more renewable energy than the eGRID region (29% renewables for DEMEC vs 5% renewables for eGRID RFC East), the eGRID region uses much more carbon-free energy due to its large nuclear load (29% carbon-free for DEMEC vs 42% carbon-free for eGRID RFC East). Therefore, the eGRID region's electricity emissions factor is lower than DEMEC's.

	Electricity Emissions ($MTCO_2e$)	
Sector	**Market-Based**	**Location-Based**
Residential	34,923	28,815
Commercial	53,729	44,332
Industrial	4,505	3,717
Municipal	2,874	2,379
Other Institutional	1,583	1,306
Schools	2,063	1,702
University of Delaware	60,957	50,295
Line Loss	11,694	9,648
TOTAL	**172,328**	**142,194**

As of May 2021, the City offers an option of enrolling in a 100% renewable option for all electric accounts. The new rate will automatically apply to all new electric accounts created after May 26, 2021. As of December 31st, 2021, approximately 20% of city-wide electric accounts are in the 100% renewable program. Participation in this program will be reflected in the 2021 inventory and future inventories when following the market-based calculation method.

6.1.2 Stationary Fuels

The City requested natural gas use data from Delmarva Power but was informed that this information is privileged and could not be released unless Delmarva's legal group granted permission. The City was able to provide actual municipal operations stationary fuel consumption data, and University of Delaware fuel consumption was collected from the University 2018-2019 Academic Year GHG inventory. All other community stationary energy fuel consumption was estimated using building-specific energy intensities, household quantities, and building area. Emission factors were obtained from the 2020 EPA Emission Factors for Greenhouse Gas Inventories[7] (there was no Emissions Factor document produced in 2019).

While the stationary fuel emissions were largely based on estimated activity information, the emissions results do not appear to be unusual as stationary fuels are typically a large emissions source for communities in colder or even moderate climates. Additionally, the proportion of Newark's stationary fuel emissions to total community emissions (35%) is in alignment with the University of Delaware's proportion of stationary fuel emissions in its GHG inventory (32%). However, the lack of high-quality natural gas data will limit Newark's ability to track emissions reduction progress and accurately compare emissions across sectors. It is recommended that the City continue to work with Delmarva Power to enable data reporting on community-wide natural gas consumption to support future GHG inventories (see *Climate Planning Recommendations* section).

Residential Stationary Energy

Heating fuel types for all residential housing was estimating using the 2019 5-year American Community Survey estimates for Newark, table S2504.

Heating Source	Heating source by Occupied Housing Unit (%)	Heating source by Occupied Housing Unit (Quantity)
Natural Gas	59.9%	7,133
Electricity	29.9%	3,561
Fuel Oil	6.9%	822
Propane	2.0%	238
Other	0.7%	83
No Fuel	0.6%	71

Average household energy consumption per main heating fuel for the Northeast Region was obtained from the 2015 Residential Energy Consumption Survey table CE2.2. This data considers that households will use multiple different fuel types depending on their primary heating fuel.

[7] https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf

Table CE2.2	Average Site Energy Consumption (MMBTU/household)			
Main Heating Fuel	**Natural Gas**	**Electricity**	**Fuel Oil/Kerosene**	**Propane**
Natural Gas	78.0	24.5	0	0
Electricity	10.2	37.6	0	0
Fuel Oil	16.0	28.2	10.6	79.4
Propane	0	31.6	63.2	0

Applying the average site energy consumption data to the housing units per primary heating source data generates total energy consumption for all households (note that electricity consumption data generated here was excluded from the inventory as it is already accounted for under the electricity sector from an empirical data source).

	Total Energy Consumption per Fuel Source for All Occupied Housing Units (MMBTU)		
Heating Source	**Natural Gas**	**Fuel Oil**	**Propane**
Natural Gas	556,412	0	0
Electricity	36,320	0	0
Fuel Oil	13,148	65,245	8,710
Propane	0	0	15,053
Total	**605,880**	**62,245**	**23,763**

In the electricity data provided by the City, electricity consumption data for residential and rental properties that use electric heat was included as a separate line item but was not integrated into the inventory.

Commercial, Institutional and Industrial Stationary Energy

Actual natural gas utility data was provided for municipal operations. University of Delaware natural gas, fuel oil, and propane consumption data was obtained from the 2018-2019 Academic Year GHG Inventory (this year was used as a proxy for inventory year 2019).[8] The University of Delaware used a different emission factor source (EPA Mandatory Reporting Rule for Greenhouse Gases) and GWP source (IPCC AR4) than what was used in the Newark CIRIS analysis, so the University's reported emissions are slightly different than what is reported in Newark's inventory.

Other commercial, institutional, and industrial stationary energy consumption was estimated using tax parcel building area and energy intensities from the EIA 2012 Commercial Building Energy Consumption Survey (CBECS) Table C27 and C35.[9] The EIA tables provided natural gas and fuel oil energy intensities per principal building activity in specific regions. Propane energy intensity information was not provided, and propane was not identified as a main commercial space energy source for the Mid-Atlantic region. Additionally, fuel oil energy intensity was not available for the Mid-Atlantic region, therefore the Northeast region was selected as a proxy.

[8] https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf
[9] https://www.eia.gov/consumption/commercial/data/2012/

Principal Building Activity	Natural Gas Energy Intensity for the Middle Atlantic (cubic feet/square foot)	Fuel Oil Energy Intensity for the Northeast (gallons/square foot)
Service	76.8	0.11
Office	35.4	0.06
Religious Worship	26.3	0.11
Mercantile- Retail	25.2	0.11
Lodging	41	0.11
Health Care	66.8	0.15
Food Service	169.4	0.11
Education	48.5	0.15
Public Assembly	42.2	0.11
Warehouse and Storage	17.9	0.11

Building area in the city was obtained from New Castle County tax parcel data. Each building was assigned a building type. These building types and their associated areas were mapped to each CBECS principal building activity. University of Delaware campus and municipal building area were identified by parcel ID number and excluded from total areas as their natural gas and oil consumption were provided separately. Both the “Exempt Residential” and “Residential” building types included mixed-uses, so the entirety of their building area was included in the commercial analysis. Additionally, some parcels and associated building area were duplicated in the parcel data. Therefore, the total building area included in the commercial, institutional, and industrial stationary energy estimations are most likely higher than reality. In lieu of actual empirical activity data, this is an acceptable approach to estimate fuel use and is conservative in its results such that the stationary energy emissions are likely over-estimated instead of under-estimated.

CBECS Principal Building Activity	Survey Building Types Included	Total Building Area (square feet)
COMMERCIAL		
Service	AUTOMTV-CNTR, AUTO-SHWROOM, BARBER-SHOP	380,486
Office	BANK, CLUB-HOUSE, GOVRNMT-BLDG, OFFICE, COMMERCIAL, EXEMPT COMMERCIAL, #N/A, EXEMPT RESIDENTIAL, RESIDENTIAL	14,131,071
Religious Worship	CHURCH	12,193
Mercantile- Retail	CONVENC-STOR, RETAIL-STORE	484,443
Lodging	HOTEL, MULT-RESDNCE	157,110
Health Care	MEDICAL-OFC, VETER-MEDICL	13,821
Food Service	RESTAURANT	171,425
Education	SCHOOL	240,146
Public Assembly	SKATING-RINK, THEATER	4,600
Warehouse and Storage	STORAGE-WHSE	441,527

INDUSTRIAL		
Service	INDUST-MFCTR, INDUSTRIAL	5,510,407
Warehouse and Storage	DISTRIB-WHSE	356,079
	TOTAL	21,903,308

The CBECS energy intensities were applied to the parcel square footage information to generate total natural gas and fuel oil consumption estimates.

CBECS Principal Building Activity	Total Natural Gas Consumption (cubic feet)	Total Fuel Oil Consumption (gallons)
COMMERCIAL		
Service	29,221,325	41,853
Office	500,239,913	847,864
Religious Worship	320,676	1,341
Mercantile- Retail	12,207,964	53,289
Lodging	6,441,510	17,282
Health Care	923,243	2,073
Food Service	29,039,395	18,857
Education	11,647,081	36,022
Public Assembly	194,120	506
Warehouse and Storage	7,903,333	48,568
INDUSTRIAL		
Service	423,199,258	606,145
Warehouse and Storage	6,373,814	39,169
TOTAL	**1,027,711,632**	**1,712,969**

6.1.3 Fugitive Emissions

This inventory accounts for fugitive emissions stemming from natural gas leakage in distribution pipelines. Natural gas fugitive emissions were calculated by using the CIRIS Fugitive Emissions from Gas Distribution Calculator. CIRIS applies a default natural gas leakage rate to the total natural gas consumed in Newark to calculate emissions.

6.1.4 On-Road

Newark on-road vehicle miles traveled (VMT) by road type were generated by WILMAPCO using the EPA MOVES3 model. WILMAPCO used a CUBE travel demand model which uses the geographic method to include all VMT within the city's geographic boundaries.

The Delaware Department of Natural Resources and Environmental Control updates certain portions of the MOVES input files annually, such as vehicle registration/fleet distribution, at the start of the new model year. Other portions are updated every two or three years, depending on what the "triggering" event for the update is/are. See the *Climate Planning Recommendations* section for more information on the city's options to use annual Google EIE VMT data as an alternative data source.

Emissions factors by road type and vehicle type were generated by AECOM staff using the EPA MOVES3 model for New Castle County in 2019. AECOM provided a VMT by vehicle mix breakdown for the County that was applied to Newark VMT to further refine emissions estimates.

6.1.5 Off-Road

Off-road emissions were estimated using the EPA MOVES3 Nonroad model. The Nonroad model generates county-level GHG emissions. New Castle County emissions were scaled down to the city-level using city-specific scaling factors such as population from the Delaware Population Consortium and employment and housing units from the 2019 American Community Survey (ACS).

Nonroad Sector	Scaling Factor	Source
Recreational	Population	Delaware Population Consortium
Construction	Service Population	Delaware Population Consortium + ACS
Industrial	Service Population	Delaware Population Consortium + ACS
Lawn and Garden	Housing units	ACS
Commercial	Service population	Delaware Population Consortium + ACS
Railroad Equipment	Service Population	Delaware Population Consortium + ACS

Note: Service population = population + employment

Per GPC guidance, certain off-road sources are reported under the Stationary Energy sector, such as off-road commercial equipment, lawn and garden equipment, and construction and industrial equipment. Off-road emissions from recreational and railroad equipment are reported under the Transportation sector. Emissions are reported as such in the CIRIS tool should the city choose to share its emissions file for voluntary reporting purposes. However, in Table 1 of this report, all off-road emissions are shown within the Transportation sector for the sake of clarity.

6.1.6 Commuter Rail

Amtrak and SEPTA commuter rail electricity consumption was estimated using the 2019 National Transit Database electricity consumption per mile for SEPTA commuter rail, total annual one-way trips that stop in Newark from rail schedules, and total length of rail in Newark calculated using GIS. The City of Newark does not supply electricity to the commuter rails. Therefore, the eGRID emissions factor was used.

Freight rail activity emissions were not included because activity data could not be obtained, and emissions are expected to be de minimis.

6.1.7 Solid Waste

The CIRIS Solid Waste calculator and Biological Treatment calculator were used to calculate municipal solid waste (MSW) emissions and composted waste emissions, respectively. Inputs for the Solid Waste Calculator include total waste in metric tonnes, landfill gas collection efficiency, proportion of landfill gas collected used as energy source, and municipal solid waste characterization. Inputs for the Biological Treatment calculator include metric tonnes of waste, type of waste (wet or dry), and treatment type (composting or anaerobic digestion).

Solid waste amounts and destinations were obtained from City-reported data and from the University of Delaware (UD) 2018-2019 Academic Year GHG Inventory.[10] It should

[10] https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf

be noted that 2018-2019 academic year waste data was used a proxy for UD 2019 waste data. University waste destinations were assumed to be the same as the City-collected waste destinations. The University used the EPA WARM model to calculate solid waste emissions, which uses a different calculation methodology than CIRIS, so the University-reported waste emissions are different from those estimated for the City of Newark GHG inventory. Collection efficiency and methane generation was obtained from the EPA flight database for Cherry Island Landfill. The City reported that a portion of C&D waste was landfilled. This waste was also assumed to be sent to Cherry Island Landfill. The MSW waste characterization was based on the 2016 Delaware Waste Characterization Study. All composted waste was assumed to be wet waste.

All solid waste emissions were reported under the Waste sector. The CIRIS calculator recommends reporting emissions from the combustion of landfill gas with energy recovery under the Stationary Energy sector. However, as landfill gas combustion is outside of the city's boundaries, it is therefore a Scope 3 emissions source and the Stationary Energy sector within the CIRIS tool does not have an appropriate scope 3 sub-sector in which to report these emissions. Therefore, these emissions have been included under Waste Scope 3 emissions and aggregated with emissions from the direct release of landfill gas and combustion of landfill gas without energy recovery.

6.1.8 Wastewater

Wastewater emissions were calculated using the CIRIS Wastewater Calculator. Inputs include population and amount of methane recovered. Population was obtained from the Annual Projections from the Delaware Population Consortium - Population Projections Places (all municipalities) for 2019. The amount of methane recovered was calculated by calculating the total amount of methane produced in CIRIS and applying the percent of methane recovered from information provided by the City of Wilmington.

Industrial wastewater is also generated in Newark. The CIRIS default wastewater equation includes a correction factor to estimate industrial discharge.

6.2 Community GHG Inventory Data Collection

Table 55 shows the sources of all activity and emissions factor data and includes notes on emissions calculation methodologies.

Table 5. 2019 Community-wide GHG Inventory Data Tracking

Emissions Source	Data Type	Data Source	Notes
Electricity	Activity Data	Provided by the City of Newark Electric Department	The City purchases electricity from DEMEC for all addresses within city limits and provided city-wide electricity consumption data. There are two Delmarva electricity accounts within city limits paid for by the City of Newark. The City provided Delmarva consumption.
	Emissions Factor	Provided by DEMEC	AECOM derived DEMEC's electricity emissions factor using DEMEC's given fuel mix and the Climate Action for Urban Sustainability (CURB) tool.[11] 29% of DEMEC's resource mix is from solar while 71% is from fossil fuels.
Residential natural gas, propane, and fuel oil	Activity Data	AECOM derived from 2019 5-year American Community Survey Estimates and 2015 Residential Energy Consumption Survey	Delmarva Power cannot provide natural gas data for customers within Newark City limits due to legal reasons. AECOM estimated residential natural gas, propane, and fuel oil consumption using 2019 Newark Census data on heating source by occupied housing unit and 2015 Residential Energy Consumption Survey (RECS) data on average energy consumption per heating fuel per household for the Northeast Region.
	Emissions Factor	Collected from 2020 EPA GHG Emission Factors Hub	2020 EPA emissions factors for natural gas, propane, and distillate fuel oil No.2 were used to calculate emissions.
University of Delaware natural gas, propane, and fuel oil	Activity Data	Obtained from University of Delaware 2018-2019 Academic Year GHG Inventory	The University's 2018-2019 Academic Year inventory was used as a proxy for consumption data for the 2019 inventory year.
	Emissions Factor	Collected from 2020 EPA GHG Emission Factors Hub	The University Inventory used the EPA Mandatory Reporting Rule for Greenhouse Gases emissions factors and IPCC AR4 GWPs. The Newark Inventory uses emissions factors from the EPA Emissions Factor Hub and the IPCC AR5 GWPs. Therefore, the reported University emissions are slightly different than the Newark inventory emissions.

[11] CURB Tool: https://www.worldbank.org/en/topic/urbandevelopment/brief/the-curb-tool-climate-action-for-urban-sustainability

Emissions Source	Data Type	Data Source	Notes
Municipal natural gas	Activity Data	Provided by City of Newark	City provided natural gas consumption data from utility bills.
	Emissions Factor	Collected from 2020 EPA GHG Emission Factors Hub	2020 EPA emissions factors for natural gas were used to calculate emissions.
Non-residential natural gas and fuel oil	Activity Data	Building area provided in County Assessor parcel data Building energy intensities derived from 2012 Commercial Building Energy Consumption Survey	Natural gas activity data was not available from Delmarva Power. AECOM estimated non-residential building natural gas and fuel oil consumption using non-residential building floor area information from County Assessor parcel data and the natural gas and fuel oil energy intensities from the 2012 Commercial Building Energy Consumption Survey (CBECS). Commercial building propane consumption/intensity information is not available in CBECS.
	Emissions Factor	Collected from 2020 EPA GHG Emission Factors Hub	2020 EPA emissions factors for natural gas and distillate fuel oil No.2 were used to calculate emissions.
Fugitive emissions from natural gas systems	NA	NA	AECOM calculated fugitive natural gas emissions using the estimated natural gas consumption data and the Fugitive Emissions from Gas Distribution Calculator in the CIRIS tool.
On-Road Transportation	Activity Data	Provided by WILMAPCO/DelDOT using EPA MOVES3	Mike DuRoss manages the MOVES travel demand model for WILMAPCO and completed the VMT analysis for New Castle County. Mike provided Newark daily VMT by road type data for 2015, 2025, 2035 and 2045 calendar years. AECOM interpolated 2019 VMT values.
	Emissions Factor	Developed by AECOM using EPA MOVES3	AECOM staff provided New Castle County emissions rates by road type and vehicle type. AECOM provided VMT by vehicle mix breakdown for the County that was applied to Newark VMT to further refine emissions estimates.
Railways	Activity Data	AECOM derived from National Transit Database 2019, SEPTA 2019 Wilmington/Newark Line Rail Schedule, Amtrak 2019 Northeast Corridor Schedule, and GIS measurements	AECOM estimated Amtrak and SEPTA commuter rail electricity consumption using the 2019 National Transit Database electricity consumption per mile for SEPTA commuter rail, total annual one-way trips that stop in Newark from rail schedules, and total length of rail in Newark from GIS.

Emissions Source	Data Type	Data Source	Notes
	Emissions Factor	Collected from EPA eGRID 2019 *NOTE: Bhadresh Patel from Newark Electric Department confirmed that Newark does not supply electricity to the commuter rail trains.*	The City of Newark does not supply electricity to the commuter rails. Therefore, the eGRID emissions factor was used.
Off-Road	Emissions Factor	AECOM derived from EPA MOVES3, 2019 5-year American Community Survey Estimates, Delaware Population Consortium	AECOM used the EPA MOVES3: Nonroad model to estimate off-road emissions from New Castle County in 2019. Relevant sector-specific emissions were scaled down from the New Castle County total emissions estimates to the city level using scaling factors such as population from the Delaware Population Consortium and employment and housing units from the 2019 Census.
Landfilled waste	Activity Data	City-collected waste provided by City of Newark University of Delaware waste from 2018-2019 Academic Year GHG Inventory	The City provided waste tonnage data for single family residential and multifamily buildings up to four units as well as some condominiums and apartments. Landfilled waste is sent to Cherry Island Landfill which both flares and collects landfill gas to be used as an energy source. AECOM assumed that roughly 21% of City-reported C&D waste is also sent to Cherry Island Landfill. University of Delaware waste tonnage is from the 2018-2019 Academic Year Inventory and used as a proxy for calendar year 2019. Waste destinations were assumed to be the same as the City-collected waste.
	Emissions Factor	AECOM derived from Delaware Statewide Waste Characterization Study 2016 and EPA Flight Database	AECOM used the CIRIS Solid Waste Disposal Emissions Calculator to calculate solid waste emissions from landfills, which applies the methane commitment methodology for solid waste emission calculations. AECOM used the Delaware Statewide Waste Characterization Study 2016 to approximate waste types. AECOM used the EPA Flight Database to identify the Cherry Island Landfill gas collection efficiency and gas collected/used as an energy source.

Emissions Source	Data Type	Data Source	Notes
Composted Waste	Activity Data	Provided by City of Newark University of Delaware waste from 2018-2019 Academic Year GHG Inventory	The City provided the quantity of green waste collected and composted. University of Delaware waste tonnage is from the 2018-2019 Academic Year Inventory and used as a proxy for calendar year 2019. Waste destinations were assumed to be the same as the City-collected waste.
	Emissions Factor	NA	AECOM used the CIRIS Biological Treatment of Solid Waste Emissions Calculator to calculate emissions from composting.
Wastewater Treatment	Emissions	Wastewater treatment information provided by City of Wilmington Public Works Population from Delaware Population Consortium	AECOM used the CIRIS Wastewater Emissions Calculator to calculate wastewater treatment emissions. City population was obtained from the Delaware Population Consortium - Population Projections Places (all municipalities) for 2019.

6.3 Municipal Operations GHG Inventory Methodology

6.3.1 Electricity

Electricity data was provided by the City through a spreadsheet of DEMEC account electricity consumption and Delmarva bills. Municipal street and traffic lights electricity consumption is not metered and was estimated using the bulb wattage and approximate hours per year. There are two City-owned Delmarva electric accounts located within the city's geographic boundaries and five City-owned Delmarva accounts located outside the city's boundary. The electricity consumption from Delmarva accounts outside the city boundary has been included in the municipal operations inventory but not in the community-wide inventory.

Delmarva Account Locations	
Inside City Boundary	**Outside City Boundary**
Welsh Tract Road (Folk Park Gate) 500 Paper Mill Road (Curtis Pump Station)	1979 Old Cooches Bridge Road (Well #17) 700 Creek Road (Well #23-Backup Well) 42 Brookhill Dr. (Well #16) 400 Thompson Station (Louviers Water Tank) 211 Red Mil Road (Water Pit-Ruthby Interconnection)

Electricity Consumption Locations		
Provider	**Inside City (kWh)**	**Outside City* (kWh)**
DEMEC – Metered Accounts	5,450,872	0
DEMEC – Street and Traffic Lights (estimated)	1,910,963	0
Delmarva	148,745	97,872
TOTAL	**7,510,580**	**97,872**

*Not included in community-wide inventory

Market vs. Location-Based Methods

The GHG Protocol Corporate Standard – GHG Protocol Scope 2 Guidance recommends that entities with any operations in markets providing product or supplier-specific data in the form of contractual instruments shall report scope 2 emissions according to a location-based method and a market-based method. Entities shall choose which method's results to use for goal setting and other benchmarks. This is also termed "dual reporting." In order to better reflect the impact of Newark's Renewable Energy Program, the market-based method was used in both the municipal operations 2019 GHG inventory and the community-wide inventory and is recommended for future GHG inventories. The market-based method considers the specific electricity fuel mix of DEMEC-procured energy and percent renewable energy consumption due to enrollment in the Renewable Energy Program. Because the Renewable Energy Program was not available until after May 2021, only the DEMEC fuel mix had an emissions impact on the 2019 inventory. Location-based and market-based emissions are included for comparative purposes below.

Accounts	Activity Data (kWh)	Market-Based Emissions ($MTCO_2e$)	Location-Based Emissions ($MTCO_2e$)
DEMEC – Metered Accounts	5,450,872	2,093	1,727
Delmarva	246,617	78	78
DEMEC – Street and Traffic Lights (estimated)	1,910,963	734	605
TOTAL	**7,608,452**	**2,905**	**2,411**

It should be noted that DEMEC's electricity emission factor is higher than Delmarva's, meaning that for every kWh consumed under DEMEC, more GHG emissions are produced than under Delmarva. DEMEC's emissions factor was calculated using its given 2019 fuel mix and the World Bank's Climate Action for Urban Sustainability (CURB) tool. Delmarva Power does not calculate its own emissions factor and recommended using the eGRID regional emissions factor. Even though DEMEC uses more renewable energy than the eGRID region (29% renewables for DEMEC vs 5% renewables for eGRID RFC East), the eGRID region uses much more carbon-free energy due to its large nuclear load (29% carbon-free for DEMEC vs 42% carbon-free for eGRID RFC East). Therefore, the eGRID region's electricity emissions factor (and Delmarva's by proxy) is lower than DEMEC's.

AECOM created a user-friendly Excel calculator that reproduces CURB's methodology for calculating an emissions factor from fuel mixes. If the DEMEC fuel mix changes in the future, this calculator can be updated with the new fuel mix to calculate the new emissions factor.

6.3.2 Natural Gas

Natural gas data was provided by the City from Delmarva utility data.

6.3.3 Fugitive Emissions

Refrigerants

The only municipal buildings with system-wide air conditioning (AC) are the City Hall and Police Department. Most other buildings have wall units, for which the City does not have refrigerant data. The City Hall and Police Department AC units were not recharged with refrigerant in 2019. The GHG Emissions Calculation Tool only estimates refrigerant leakage emissions if there is data on the amount of new refrigerant added. Therefore, no fugitive refrigerant emissions were reported for 2019. Future inventories will account for refrigerant leakage spanning across multiple years once the refrigerant is recharged.

Natural Gas

Fugitive natural gas emissions are 1 $MTCO_2e$ or 0.02% of municipal emissions and are therefore negligible. The GHG Emissions Calculation tool does not currently support reporting for natural gas fugitive emissions, therefore these emissions were not included in the municipal inventory at this time. However, future revisions to the tool may provide this additionally functionality at which point the City could include this emissions source in future inventories.

6.3.4 Transportation

Gasoline and diesel fuel consumption data was provided by the City. In the GHG Emissions Calculation Tool, it was assumed that all gasoline vehicles were passenger vehicles, and all diesel vehicles were medium-duty trucks (these vehicle classifications impact the CH_4 and N_2O emissions, which are typically <1% of total transport emissions). Large lawnmowers and other off-road fuel uses are included under this sector as they could not be disaggregated.

1,100 gallons of generator fuel consumption was initially included in the fleet fuel data sent by the City. The City estimated the split of generator diesel fuel consumption between the divisions with generators (Water Facilities, Fleet Maintenance Yard, and City Hall and Police Station). These amounts were then subtracted from the Water Department and Fleet Maintenance diesel fuel amounts to disaggregate fleet fuel consumption from generator fuel consumption.

Generator Diesel Gallon Consumption	Fleet Fuel Data Edits
Water Facilities – 700 gallons	Subtracted from Water Facility diesel consumption data
Fleet Maintenance Yard – 200 gallons	Subtracted from Fleet Maintenance Yard diesel consumption data
City Hall and Police Station – 200 gallons	Subtracted from Fleet Maintenance Yard diesel consumption data

6.3.5 Generator Fuel

1,100 gallons of diesel fuel were consumed in backup generators. The City estimated that 700 gallons were for Water Facilities, 200 gallons were for Fleet Maintenance Yard, and 200 gallons were for City Hall and the Police Station. In the GHG Emissions Calculation Tool, this fuel was assumed to be distillate fuel oil No. 2. This generator fuel consumption was included in the departmental fleet fuel consumption, so the gallons were removed from their respective departments' consumption to disaggregate generator fuel data from fleet data (see Transportation section above for fuel consumption break-down).

6.4 Municipal Operations GHG Inventory Data Collection

Table 66 shows the sources of all activity and emissions factor data and includes notes on emissions calculation methodologies.

Table 6. 2019 Municipal Operations GHG Inventory Data Tracking

Emissions Source	Data Type	Data Source	Notes
Transportation	Activity Data	Provided by City of Newark Department of Finance	The City sent total fuel consumption by type and department. In the GHG Emissions Calculation Tool, it was assumed that all gasoline consumption was from passenger cars and all diesel consumption was from medium- and heavy-duty trucks. NOTE: The Water Department's generator diesel oil consumption was originally included under fleet diesel fuel reported and was disaggregated.
	Emissions Factor	Provided in the GHG Emissions Calculation Tool/EPA 2018	The default gasoline and diesel emissions factors in the GHG Emissions Calculation Tool were used. These emission factors are from the EPA's 2018 Emissions Factors Hub document (note: these factors also match the EPA 2020 Emissions Factor Hub document).
Natural Gas	Activity Data	Provided by City of Newark	City provided natural gas consumption data from Delmarva utility bills.
	Emissions Factor	Collected from 2020 EPA GHG Emission Factors Hub	2020 EPA emissions factors for natural gas were used to calculate emissions.
Fugitive emissions from refrigerants	Activity Data	Provided by City of Newark	The only buildings with central air conditioning are City Hall and the Police Department. No refrigerant was added to these systems in 2019. Most other buildings have wall units. The City has no available refrigerant data on these units, and they are most likely not recharged. The GHG Emissions Calculation Tool only accounts for refrigerant leakage when there is record of refrigerant being purchased, sold, or disposed. Any fugitive emissions from refrigerants will be aggregated and accounted for in the year when it is recharged. Therefore, no 2019 emissions from refrigerants are estimated in this inventory.

Emissions Source	Data Type	Data Source	Notes
Generator Fuel	Activity Data	Provided by City of Newark	The City provided total diesel fuel consumption for backup generators and estimated the quantity of fuel split between the Water Facilities, Fleet Maintenance Yard, City Hall and the Police Station generators. Generator fuel consumption was originally included in the departmental fleet fuel consumption. The estimated gallons were removed from their respective departments to disaggregate generator fuel data from fleet data.
	Emissions Factor	Provided in the GHG Emissions Calculation Tool/EPA 2018	The default diesel emissions factor in the GHG Emissions Calculation Tool will be used. This factor is from the EPA's 2018 Emissions Factors Hub document (this factor matches the EPA 2020 Emissions Factor Hub document).
Electricity	Activity Data	Provided by City of Newark Electric Department	The City purchases electricity from DEMEC and provided municipal electricity consumption data. The City also owns and operates facilities both in and outside of city boundaries that are served by Delmarva Power.
	Emissions Factor	AECOM derived DEMEC emissions factor Delmarva confirmed that EPA eGRID emissions factor should be used	AECOM derived DEMEC's electricity emissions factor using DEMEC's given fuel mix and the Climate Action for Urban Sustainability (CURB) tool. DEMEC's emissions factor is higher than Delmarva's as it uses less carbon-free energy sources, such as nuclear. Delmarva Power confirmed that the eGRID emissions factor for the RFC East region should be used.