

Broome County GHG Analysis

Processes and Methodology

This analysis follows the protocols set forth in the document "New York Community and Regional GHG Inventory Guidance" (September 2015, Version 1.0) published by NYSERDA's Climate Smart Communities program. Greenhouse Gas (GHG) analyses were performed for Broome County from two perspectives: Municipal (consisting of county owned facilities) and Community (consisting of Broome County as a whole). Data gaps for facilities that are not county-owned were addressed in accordance with the "New York Community and Regional GHG Inventory Guidance" by scaling statewide data using designated scaling factors published in the guidance.

As a part of this analysis, historical utility data for properties was collected and analyzed to determine the greenhouse gas emissions associated with electric and fossil fuel consumption. The data in this analysis is inclusive of the most recent 12 consecutive months of utility data for all county-owned buildings.

A summary table showing the properties, annual electric and natural gas consumption, and associated emissions resulting from energy consumption is shown in Figure 1. This table shows the properties as ranked by total emissions in units of Metric Tons of Carbon Dioxide Equivalents (MTCDE) resulting from energy consumption. The top 5 contributing properties account for 65% of the County's energy consumption-based emissions (Figure 2), and the top 10 contribute to 85% of the County's Emissions. Figure 3 represents GHG emissions intensities by showing the ratio of MTCDE per 1,000 square feet of building space. (Note that this chart omits the properties categorized as Pump Stations, Parks, OES Towers, and Solar, as these properties are outdoor facilities and not traditional buildings).

Figure 4 shows a 3D bar graph of each of the 56 properties' emissions superimposed onto a map of Broome County, in order to show a visual representation of the geographical partitioning of GHG emissions for county-owned properties.



Facility Description		Annual Electric Use			Annual Natural Gas Use	Measureable Emmissions		
Property Name	Portfolio Manager ID	kWh	Peak kW	Annual kW	Therms	MTCDE from Electricity	MTCDE from Natural Gas	Total MTCDE
Broome County Public Safety Facility	30690466	1,406,581	661	6,342	186,216	481.5	986.9	1,468.5
Court Complex	31555480	1,034,979	395	4,216	169,661	354.3	899.2	1,253.5
Willow Point Nursing Center	30369753	1,512,721	733	3,758	88,436	517.9	468.7	986.6
Greater Binghamton Airport	31550909	1,416,817	359	3,510	76,532	485.1	405.6	890.7
Veterans Memorial Arena	30218572	897,507	715	6,842	70,759	307.3	375.0	682.3
E. L. Crawford County Office Building	30255051	1,361,206	599	5,134	23,705	466.0	125.6	591.6
Department of Social Services	30255095	716,860	265	2,249	15,123	245.4	80.2	325.6
Public Transportation Facility - Bus Garage	30255556	299,500	68	725	26,736	102.5	141.7	244.2
Jeffery P. Kraham Public Library	30255114	282,750	288	1,643	26,452	96.8	140.2	237.0
Highway Dept. Garage & Public Works	30690307	170,822	45	470	28,087	58.5	148.9	207.3
Health Department	30690286	255,200	93	814	16,652	87.4	88.3	175.6
Forum	30215568	154,800	153	1,467	16,462	53.0	87.2	140.2
Pump Station - 316 Twining Road	30772420	270,850	10	47	191	92.7	1.0	93.7
SWM - Landfill	31928469	249,645	206	1,259	-	85.5	-	85.5
Enjoie Golf Club House	30218636	1,323	15	31	12,014	0.5	63.7	64.1
Animal Shelter	30218582	64,940	16	162	6,374	22.2	33.8	56.0
Aging - Western Broome Senior Center	30215293	62,526	32	331	5,075	21.4	26.9	48.3
OES Special Ops Training & Storage Facility	30690473	50,640	27	222	5,548	17.3	29.4	46.7
Park - Otsiningo	30667680	100,378	43	245	-	34.4	-	34.4
Aging - Northern Broome Senior Center	30215273	100,159	28	260	-	34.3	-	34.3
DMV	30689185	59,622	14	139	1,020	20.4	5.4	25.8
Park - Storage Facility	30509174	62,744	92	482	-	21.5	-	21.5
Park - Greenwood	30667701	50,012	54	294	-	17.1	-	17.1
Park - Cole	30667735	42,640	28	128	-	14.6	-	14.6
OES Tower - Ely Park	31641303	41,990	10	93	-	14.4	-	14.4
OES Tower - Deposit	31642603	35,605	24	81	-	12.2	-	12.2
Intermodal Transportation Center - Greyhound	30255257	19,854	7	53	1,017	6.8	5.4	12.2
OES Tower - Port Crane	32529896	34,473	10	25	-	11.8	-	11.8
Park - Dorchester	30667688	31,671	18	87	-	10.8	-	10.8
Soil & Water Conservation District	30787383	13,440	10	35	1,141	4.6	6.0	10.6
OES Tower - Ingraham	31642580	30,399	15	62	-	10.4	-	10.4
Pump Station - Flint Road	30772413	28,237	15	70	14	9.7	0.1	9.7
OES Tower - Union	31642600	26,079	13	36	-	8.9	-	8.9
OES Tower - Whitney Point	32536175	25,131	12	31	-	8.6	-	8.6
Aging - Eastern Broome Senior Center	30215265	24,482	17	165	-	8.4	-	8.4
OES Tower - Lisle	31642234	18,318	11	30	-	6.3	-	6.3
OES Tower - Maine	31617213	18,035	4	18	-	6.2	-	6.2
OES Tower - Sanford	31642612	16,878	6	20	-	5.8	-	5.8
OES Tower - Windsor	31642610	16,093	11	25	-	5.5	-	5.5
OES Tower - Nabinger	31642594	14,942	0	0	-	5.1	-	5.1
Pump Station - 1155 Dunham Hill Road	30772440	13,479	-	-	-	4.6	-	4.6
Park - Grippen	30667710	13,228	20	51	-	4.5	-	4.5
Pump Station - 65 Commercial Drive	30772418	8,123	4	38	136	2.8	0.7	3.5
Windsor Highway Salt Storage Facility	30690322	8,481	7	20	-	2.9	-	2.9
Pump Station - 199 Commercial Drive	30772432	4,045	1	11	84	1.4	0.4	1.8
Pump Station - 2139 Airport Road	30772434	4,863	3	10	-	1.7	-	1.7
Pump Station - 10 Knapp Road	30772416	0	0	0	295	0.0	1.6	1.6
Highway - Vestal	31497364	3,783	-	-	-	1.3	-	1.3
Sheriff Vehicle Storage Building	30690454	3,605	4	15	-	1.2	-	1.2
DPW - Colesville RD	31515076	2,514	-	-	-	0.9	-	0.9
DPW - Knapp RD	31515062	1,626	-	-	-	0.6	-	0.6
Park - Bagsai	30667665	1,181	3	11	-	0.4	-	0.4
Park - Roundtop	30667753	-	-	-	-	-	-	0.0
Solar - Corporate Park South	31519131	-112,890	0	0	-	-38.6	-	-38.6
Solar - Corporate Park N	31519128	-3,257,546	0	0	-	-1,115.2	-	-1,115.2
Solar - Airport RD	31528662	-4,418,445	116	943	-	-1,512.7	-	-1,512.7
Totals		3,296,896			777,730	1,129	4,122	5,251

Figure 1: Broome County Owned Buildings in decending order of MTCDE emmissions due to utility energy consumption

Top 5 County Owned Buildings by Emissions (MTCDE)

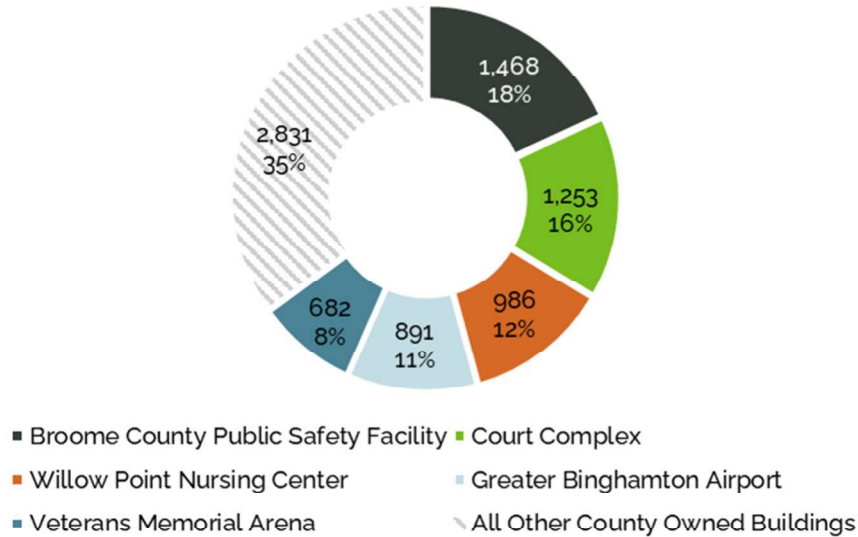


Figure 2: Top 5 Buildings by Utility Consumption Emissions

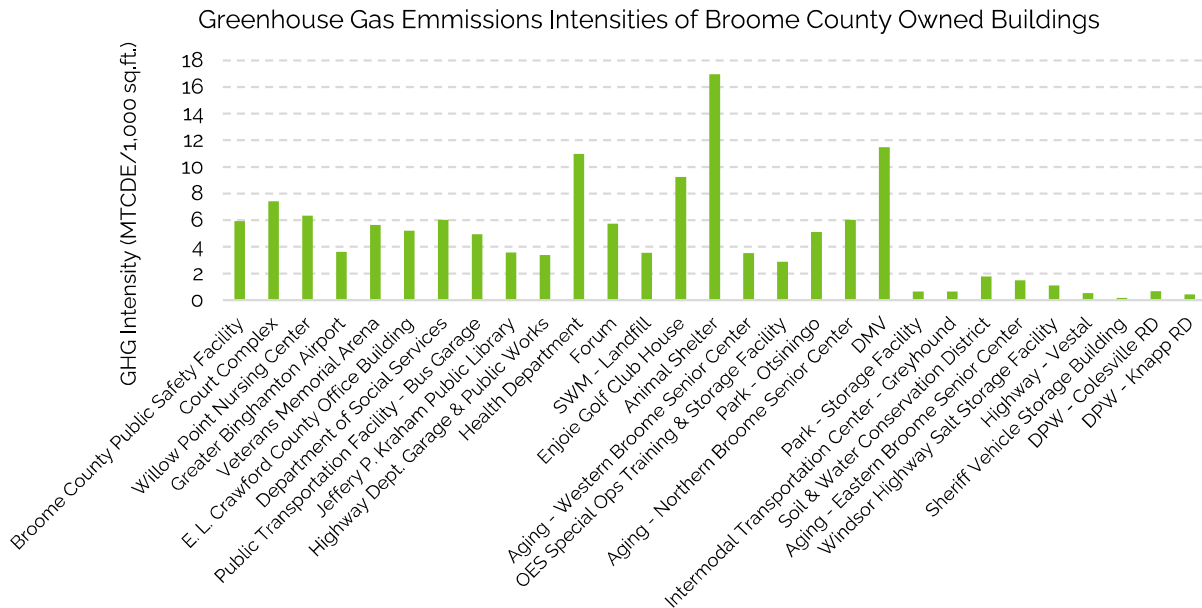


Figure 3: GHG Emissions Intensities

The information gathered and analyzed was used in order to fill out a Detailed GHG Inventory Report for the Municipality, Broome County -owned properties (Figure 5) and for the Community, Broome County as a whole (Figure 6) per guidance established in the New York



Community and Regional GHG Inventory Guidance. All greenhouse gasses are reported in units of MTDCE, which is an industry standard that weighs the global warming potential (GWP) of each greenhouse gas compared to a baseline of the GWP of Carbon Dioxide (CO₂). The GWP weighting utilized in this analysis is based on the fifth assessment report of the Intergovernmental Panel on Climate Change (IPPC) published in 2014. The three primary contributors to greenhouse gas emissions in building operations are: Carbon Dioxide with a GWP of 1, Methane (CH₄) with a GWP of 21, and Nitrous Oxide (N₂O) with a GWP of 310, per the IPCC's report.

GHG Emissions Scope

When municipalities aim to make plans to reduce their greenhouse gas emissions through policy changes and operational improvements, it is important to understand the sources of greenhouse gas emissions. GHG emissions are divided into four "Scopes." Scope 1 includes direct emissions that occur physically within the boundary of the county, for example emissions from fossil fuels burned within facilities and facility owned equipment. Scope 2 includes indirect emissions, such as those produced by power plants due to the electricity from the grid that is used within the county, regardless of where the power plants themselves are located. Scope 3 includes indirect, upstream, or lifecycle emissions that are attributed to county affiliated activities, regardless of where they occur. The last scope is "Biogenic" which are CO₂ emissions that are considered to be "carbon neutral" as the carbon produced through burning biomass materials is considered to have been withdrawn from the atmosphere during growth of the biomass substance(s).

Municipal GHG Inventory

The Municipal GHG Inventory presented in Figure 5, is a representation of the emissions and energy of the buildings and properties owned and operated by Broome County. Utility data was provided by Broome County for each of the 56 properties. This data was compiled and analyzed to develop an annual baseline of utility energy consumption, and the affiliated emissions resulting from the electrical and natural gas utility consumption. From the provided data, a baseline of annual utility consumption was created. The emissions due to electrical energy consumption were determined by utilizing NYSERDA's published data for "Annual Average of Short-run Marginal Emission Factors, Full Fuel Cycle" specifically for Upstate NY for the year 2023, which provides the average CO₂, CH₄, and N₂O emitted per MWh of electricity generated. This was then converted to MTDCE by using the conversion factors published by IPCC as mentioned above. For Natural gas emissions, a value of MTDCE per therm was utilized as published by the United States Environmental Protection Agency (EPA), which sites that their conversion factor is based upon the average heat content of natural gas in the year 2020.

This analysis assumes that municipal buildings do not consume any propane, fuel oil, coal, or wood, as Broome County did not provide any data for delivered fuels other than electricity or natural gas. All 56 properties were assumed to be categorized as Commercial. For Energy Generation and Supply, research of Broome County yielded that the county does not currently have any active power plants, and their sole source of energy generation comes from the



Broome County Landfill. Data from New York States Department of Environmental Conservation's (DEC) 2020 Annual Report was used to determine 2020 Waste Quantity (tons) and the cubic feet of landfill gas recovered for energy through the landfill's gas reclamation processes. (Landfill data was cross-referenced with data published on Broome County's website for accuracy verification).

Conversion factors and ratios published in the GHG Inventory Guidance document were utilized to determine Scope 1 and Biogenic MTCDE for the landfill. Emissions from Transmission and Distribution Losses were estimated based upon the GHG Inventory Guidance's published lost and unaccounted for (LAUF) gas rate. Emissions of Sulfur Hexafluoride (SF6) are reported on a national level in the GHG Inventory Guidance as a ratio of MTCDE/MMBTU of electricity consumed annually, which was scaled to Broome County per their annual MMBTU of electricity found during the utility data analyses. Ozone depleting substitutes from sources such as refrigerant leaks and fire retardants are reported in the GHG Inventory Guidance on a national level as a ratio per capita and was scaled to Broome County based upon the approximate number of civil service employees published by the Broome County Department of Personnel on the county's website (gobroomecounty.com).

For On-Road transportation emissions, the first task was to determine total Vehicle Miles Traveled (VMT) of county owned vehicles on an annual basis, which was derived from vehicle fleet data provided by the county. These VMT were then attributed to vehicle classes as defined by the GHG Inventory Guidance Table 17: "Default Vehicle Mix by Economic Development Region" per the Southern Tier region, which encompasses Broome County. Affiliated Emissions factors were taken from Table 15: "U.S. DOT 2010 fleet average fuel economies, and related GHG emission factors" to determine the CO₂, CH₄, and N₂O emissions estimates for the Broome County owned vehicles. (Note that since most gasoline has 10% ethanol, 10% of the Gasoline emissions were partitioned as Biogenic).

Community GHG Inventory

The Community GHG Inventory presented in Figure 6, is a representation of the emissions and energy for the entirety of Broome County. Since data is not readily available for every property throughout the entire county, methodologies for scaling data that is available are used where possible. For residential, commercial, and industrial energy consumption, the starting point was gathering available utility statistics for New York State. The US Energy Information Administration (EIA) databases were researched in order to find the New York State Energy total consumption data for published fuel types. The EIA additionally has published information partitioning the total energy per each sector: Residential, Commercial, Industrial, and transportation. From these data sets, New York State energy consumption data was scaled down to Broome County based on dividing the State energy consumption by the state population and multiplying by the population of Broome County. This raw data was then trued up by analyzing Heating Degree Days (HDD) and Effective Housing Units (EHU) of Broome County compared to New York State as a whole, to create a correction factor for the energy consumption by fuel type for each sector. 30-year average HDD data from the National Weather Service was used for New York State as a whole and the Southern Tier which includes Broome County. EHU was determined for both New York State and Broome County using data



researched from the United States Census Bureau detailing quantities of single unit detached, single unit attached, and multi-family housing units, and applying the formulas set forth in the GHG Inventory Guidance.

For determining MTCDE for propane, fuel oil, and wood; CO₂ equivalent emissions per MMBTU as published by the EPA were utilized. Research found that the Broome County Landfill is the only active electrical generation facility in the county, so MSW and Landfill gas emissions for the community are the same as for the municipality. Note that data was not readily available for Industrial processes within Broome County. Emissions of Sulfur Hexafluoride (SF₆) are reported on a national level in the GHG Inventory Guidance as a ratio of MTCDE/MMBTU of electricity consumed annually, which was scaled to Broome County per their annual MMBTU of electricity established earlier. Ozone depleting substitutes from sources such as refrigerant leaks and fire retardants are reported in the GHG Inventory Guidance on a national level as a ratio per capita and was scaled to Broome County based upon the population of Broome County as of July 1, 2022, per the United States Census Bureau.

For on-road transportation emissions, total VMT for Broome County was taken from 2010 NYSDOT Reported Vehicle Miles Traveled, per the GHG Inventory Guidance. Then the same methodology utilized in the Municipal Inventory Report was used for the Community Inventory Report. Transport data for Rail, Marine, and Off-Road were taken from the GHG Inventory's Tables A-3: "2002 Diesel Consumption (Gallons) by Rail Mode by County" and Table A-4: "2010 GHG Emissions by Off-road Vehicles and Pleasure Craft." The data for Gallons of diesel used by rail were converted to MMBTU per conversion rate published by the United States Department of Transportation: Bureau of Transportation Statistics, and to MTCDE per EPA reported GHG emissions Factors.

In order to determine the sewage treatment MTCDE, the first step was to find the emissions for New York State through utilizing the EPA's State Inventory and Projection Tool: "Wastewater Module." This tool provided the output emissions for New York state as a whole, which was then scaled to Broome County based on population ratios. For Agriculture emissions, the same methodology was used as for Wastewater, however the EPA's "Ag Module" of the State Inventory and Projection Tool was used. Most of the data utilized in the Community GHG Inventory was based on scaled data reported at the state or national level, as county specific data was not readily available. Accuracy of this report could be improved in the future if the county establishes community protocols to record and analyze relevant data that the GHG Inventory utilizes.

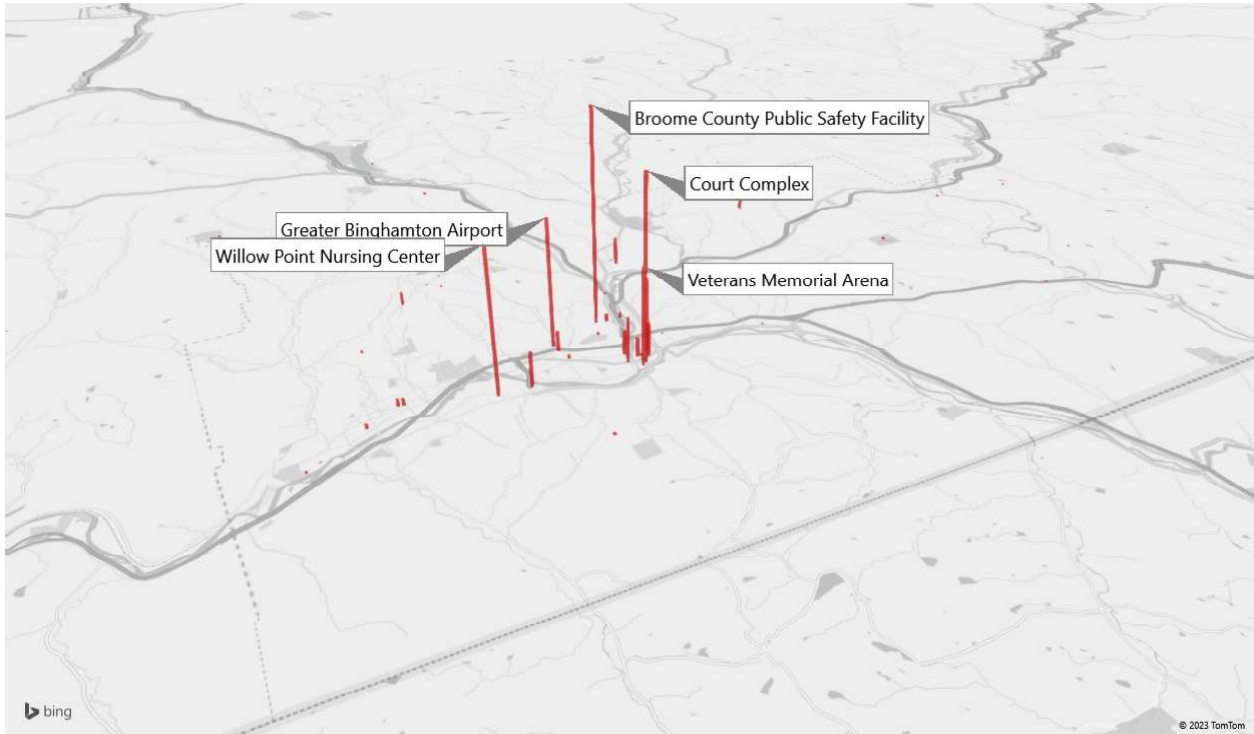


Figure 4: 3-D map of Broome County Buildings' Emissions from utility energy consumption



Detailed GHG Inventory Report - Broome County Owned Buildings					
Broome County GHG Emissions (2023)					
Sector/Source	GHG Emissions (MTCDE)				Energy Use (MMBTU)
	Scope 1	Scope 2	Scope 3	Biogenic	
Residential Energy Consumption					
Electricity / Steam	-	0	-	-	0
Natural Gas	0	-	-	-	0
Propane / LPG	0	-	-	-	0
Distillate Fuel Oil (#1, #2, #4, Kerosene)	0	-	-	-	0
Coal	0	-	-	-	0
Wood	0	-	-	-	0
Commercial Energy Consumption					
Electricity / Steam	-	1,129	-	-	11,249
Natural Gas	4,122	-	-	-	77,773
Propane / LPG	0	-	-	-	0
Distillate Fuel Oil (#1, #2, #4, Kerosene)	0	-	-	-	0
Coal	0	-	-	-	0
Wood	0	-	-	-	0
Industrial Energy Consumption					
Electricity / Steam	-	0	-	-	0
Natural Gas	0	-	-	-	0
Propane / LPG	0	-	-	-	0
Distillate Fuel Oil (#1, #2, #4, Kerosene)	0	-	-	-	0
Residual Fuel Oil (#5 & #6)	0	-	-	-	0
Coal	0	-	-	-	0
Petroleum Coke	0	-	-	-	0
Motor Gasoline (E-10)	0	-	-	-	0
Other Oils	0	-	-	-	0
Wood	0	-	-	-	0
Energy Generation and Supply					
Natural Gas	0	-	-	-	0
Distillate Fuel Oil (#1, #2, #4, Kerosene)	0	-	-	-	0
MSW	71,888	-	-	91,493	1,802,263
Landfill Gas	94	-	-	18,647	357,467
Electricity T&D Losses	0	-	-	-	-
Natural Gas T&D Losses	74	-	-	-	-
Industrial Processes					
Cement Production	0	-	-	-	-
Pulp and Paper Manufacturing	0	-	-	-	-
Product Use (HFC, ODS)					
Use of SF6 in the Utility Industry	10	0	0	0	-
All Refrigerantes except SF6	2,598	0	0	0	-
Transport: On-Road					
Motor Gasoline (E-10)	442	-	-	49	6,974
Diesel	84	-	-	-	1,143
Ethanol (E-85)	*	-	-	-	-
Biodiesel	*	-	-	-	-
Transport: Rail, Marine, Off-Road, Air					
Motor Gasoline (E-10)	*	-	-	*	*
Diesel	*	-	-	-	*
Residual Fuel Oil (#5 & #6)	*	-	-	-	*
Natural Gas	*	-	-	-	*
Propane / LPG	*	-	-	-	*
Jet Kerosene (Air)	*	-	-	-	*
Waste Management					
Landfill Methane	71,888	-	-	91,493	-
MSW Incineration	94	-	-	18,647	-
Sewage Treatment	-	-	-	-	-
Agriculture					
Enteric Fermentation / Manure	0	-	-	-	-
Soils / Fertilizer	0	-	-	-	-
Totals by Scope	79,313	1,129	0	110,190	2,256,869

* Information was not available for these items

Figure 5: Municipal GHG Inventory Report

Detailed GHG Inventory Report - Broome County					
Broome County GHG Emissions (2023)					
Sector/Source	GHG Emissions (MTCDE)				Energy Use (MMBTU)
	Scope 1	Scope 2	Scope 3	Biogenic	
Residential Energy Consumption					
Electricity / Steam	-	205,939	-	-	2,052,459
Natural Gas	415,214	-	-	-	7,834,221
Propane / LPG	42,679	-	-	-	697,568
Distillate Fuel Oil (#1, #2, #4, Kerosene)	163,457	-	-	-	2,213,436
Coal	0	-	-	-	0
Wood	58,664	-	-	-	617,079
Commercial Energy Consumption					
Electricity / Steam	-	194,229	-	-	1,935,757
Natural Gas	391,605	-	-	-	7,388,774
Propane / LPG	40,252	-	-	-	657,905
Distillate Fuel Oil (#1, #2, #4, Kerosene)	154,163	-	-	-	2,087,582
Coal	0	-	-	-	0
Wood	55,328	-	-	-	581,992
Industrial Energy Consumption					
Electricity / Steam	-	68,213	-	-	679,831
Natural Gas	137,530	-	-	-	2,594,909
Propane / LPG	14,136	-	-	-	231,054
Distillate Fuel Oil (#1, #2, #4, Kerosene)	54,141	-	-	-	733,151
Residual Fuel Oil (#5 & #6)	-	-	-	-	-
Coal	-	-	-	-	-
Petroleum Coke	-	-	-	-	-
Motor Gasoline (E-10)	-	-	-	-	-
Other Oils	-	-	-	-	-
Wood	19,431	-	-	-	204,394
Energy Generation and Supply					
Natural Gas	0	-	-	-	0
Distillate Fuel Oil (#1, #2, #4, Kerosene)	0	-	-	-	0
MSW	71,888	-	-	91,493	1,802,263
Landfill Gas	94	-	-	18,647	357,467
Electricity T&D Losses	0	-	-	-	-
Natural Gas T&D Losses	16,998	-	-	-	-
Industrial Processes					
Cement Production	*	-	-	-	-
Pulp and Paper Manufacturing	*	-	-	-	-
Product Use (HFC, ODS)					
Use of SF6 in the Utility Industry	4,300	-	-	-	-
All Refrigerantes except SF6	73,166	-	-	-	-
Transport: On-Road					
Motor Gasoline (E-10)	777,554	-	-	86,286	12,258,278
Diesel	148,522	-	-	-	2,009,773
Ethanol (E-85)	-	-	-	-	-
Biodiesel	-	-	-	-	-
Transport: Rail, Marine, Off-Road, Air					
Motor Gasoline (E-10)	20,113	-	-	-	285,412
Diesel	49,691	-	-	-	672,409
Residual Fuel Oil (#5 & #6)	-	-	-	-	-
Natural Gas	1,108	-	-	-	20,862
Propane / LPG	17,177	-	-	-	272,132
Jet Kerosene (Air)	-	-	-	-	-
Waste Management					
Landfill Methane	71,888	-	-	91,493	-
MSW Incineration	94	-	-	18,647	-
Sewage Treatment	23,952	-	-	-	-
Agriculture					
Enteric Fermentation / Manure	70,487	-	-	-	-
Soils / Fertilizer	24,425	-	-	-	-
Totals by Scope	2,846,075	468,381	0	196,427	48,188,708

* Information was not available for these items

Figure 6: Community GHG Inventory Report