NEW YORK STATE | Department of Environmental Conservation

Waste

2022 NYS GREENHOUSE GAS EMISSIONS REPORT

SECTORAL REPORT #4

Kathy Hochul, Governor | Basil Seggos, Commissioner

Table of Contents

Format of This Report

This sectoral report provides a detailed explanation of methods, data, and trends for the Waste sector. The accounting used in this sectoral report follows the requirements of the Climate Leadership and Community Protection Act (CLCPA) and is in alignment with the 6 NYCRR Part 496 regulation, “Statewide GHG Emission Limits.” This includes the use of a 20-Year Global Warming Potential metric provided in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (IPCC 2013). The organization of this report and specific methodologies are based on the IPCC Taskforce on National Greenhouse Gas Inventories approach (or “IPCC approach”) as applied in the U.S. national greenhouse gas emissions report (IPCC 2006 and 2019, EPA 2021a). The accompanying Summary Report provides a comparison with other accounting methods, including by economic sector or using conventional accounting formats. DEC also intends to provide emission values for all years via the Open Data NY platform.

Tables

Waste

This sectoral report provides information on greenhouse gas emissions associated with the management and treatment of waste materials, broken into solid waste management, biological treatment of solid wastes, waste combustion, and wastewater (Table 1). Most solid wastes are sent to solid waste management facilities (landfills) or combustion facilities. Organic wastes may also be treated through composting or anaerobic digestion, which the IPCC approach refers to as the “biological treatment of solid wastes”. Finally, wastewater is either treated on-site in septic systems or collected, treated, and discharged via a centralized wastewater system. Emissions associated with the production, transportation, use, or recycling of materials may be found in the other sectoral reports, such as *Sectoral Report #1: Energy* or *Sectoral Report #2: Industrial Processes and Product Use*.

The organization of information in this report deviates from the IPCC approach and U.S. national greenhouse gas inventory in three ways. First, the IPCC approach for national governments assign waste combustion emissions to the energy sector as “waste-to-energy”. Although waste combustion facilities produce energy, their primary role in New York is in waste management. Secondly, some of the solid wastes produced in New York are exported to facilities outside of the state for disposal. The IPCC approach only consider emissions that occur within the given jurisdiction. However, the exporting of waste represents a potentially large source of emission leakage[1] for New York State, so this report includes emissions from solid wastes sent to landfills and combustion facilities in other states in emission totals. Finally, under the IPCC approach for national net emission accounting, the carbon dioxide (CO_2) produced from waste is considered biogenic and reported separately from other anthropogenic emissions. The same practice is applied in this report in that biogenic CO_2 is also excluded from net emission totals. However, CO_2 emissions associated with the combustion of waste and landfill gas are included as part of gross emission totals (Table 1, Table 2), while emissions associated with natural decomposition are omitted entirely.

An important consideration for the waste sector is that landfills are the dominant source of emissions and these emissions are generated over multiple decades. This means that current emissions are the result of waste deposited in landfills in the past and that waste deposited today will continue to produce emissions through 2050 and beyond. The “methane commitment” of landfilled waste is not quantified in this report. Methane commitment accounting quantifies the total lifetime amount of methane (CH_4) that could be generated from waste deposited in a landfill each year. The methodology employed in this report uses an emission factor for “CH_4 generation potential” of 100 m^3 per ton municipal solid waste (MSW) (EPA 2022a). This is equivalent to 5.71 metric tons CO2e per ton MSW using a 20-year Global Warming Potential. CH_4 generation potential does not account for oxidation of CH_4 in the cover layer, or CH_4 destruction via capture systems.

[1] For example, emission leakage might occur when emissions within a jurisdiction appear to be reduced, but the emission source has just been relocated outside of that jurisdiction.

In 2020, total statewide emissions for the waste sector were 41.95mmt CO_2e GWP20 on a gross basis, which was 12% of all statewide gross emissions (Table 1). Waste sector emissions decreased 3 percent from 1990 to 2020. The largest source of emissions in all years was what the IPCC approach refer to as “solid waste management” (or landfills). As discussed below, non-CO_2 emissions from composting and solid waste anaerobic digesters (i.e., the biologic treatment of solid wastes) are not estimated in this report and are not expected to contribute emissions at this time. Biogenic CO_2 is omitted in net totals and this includes CO_2 from the combustion of waste and waste gas.

Importantly, total emissions include those associated with the exporting of waste, which has increased from 1.18mmt CO_2e in 1990 to 16.26mmt CO_2e in 2020 (“Exported Waste”, Table 1). DEC seeks comment on whether exported wastes should be excluded from emission totals in the future given limitations on the State’s ability to directly control such emissions leakage.

Table 1. Waste Emissions, 1990-2020 (mmt CO2e GWP20)

* Includes in-state and out-of-state emission sources

Emission Category	1990	2005	2016	2017	2018	2019	2020
Solid Waste Management*	34.03	37.97	35.23	35.82	35.18	35.42	35.64
Biological Treatment of Solid Waste	no	ne	ne	ne	ne	ne	ne
Waste Combustion*	4.00	3.46	2.87	3.22	3.20	3.20	3.20
Wastewater	2.78	2.95	3.03	3.02	3.02	3.00	3.11
Gross Total	**40.81**	**44.39**	**41.13**	**42.06**	**41.39**	**41.62**	**41.95**
% of statewide gross total	*10%*	*10%*	*11%*	*11%*	*11%*	*11%*	*12%*
Net Total	**39.16**	**42.78**	**39.66**	**40.49**	**39.79**	**40.02**	**40.38**
% of statewide net total	*11%*	*10%*	*11%*	*12%*	*12%*	*12%*	*13%*
Exported Waste	1.18	10.70	15.50	15.67	15.84	16.05	16.26

“no” not occurring

“ne” not estimated

The waste sector is responsible for emissions of CO_2, CH_4, and nitrous oxide (N_2O). CH_4 is the primary greenhouse gas and represented 90% of all waste emissions in 2020 (Table 2). The relative amount of each gas reflects the types of waste management used in New York. CH_4 is primarily associated with solid waste management in landfills, which is the primary method used to manage waste. This is further emphasized when applying a 20-year GWP because CH_4 is shorter lived in the atmosphere than CO_2 and N_2O.

Table 2. 2020 Waste Emissions by Gas (mmt CO2e GWP20)

Emission Category	CO_2	Biogenic CO_2	CH_4	N_2O
Solid Waste Management	na	0.52	35.12	na
Biological Treatment of Solid Waste	na	ne	ne	ne
Waste Combustion	2.02	1.05	0.09	0.04
Wastewater	na	na	2.59	0.52
Gross Total	**2.02**	**1.57**	**37.80**	**0.56**

"ne" not estimated

"na" not applicable

Solid Waste Management

This IPCC category represents emissions associated with the wastes deposited in landfills. Once deposited in a landfill, wastes are decomposed by aerobic and anaerobic microorganisms, the latter of which produce methane. There are three types of landfills included in this report, municipal solid waste (MSW) landfills in the state, MSW landfills outside of the state (or exported waste), and industrial landfills. The majority of waste in the United States is managed in MSW landfills. Waste management in the U.S. underwent significant changes in the period leading up to the 1990 baseline year.[2] One of the changes in New York was to replace hundreds of open, unlined waste "dumps" with managed MSW landfills that are subject to state and federal regulations to protect the environment and public health. Over time, landfills have also increasingly adopted technologies to collect and destroy methane such as through landfill-gas-to-energy (LFGTE) or flaring, which converts CH_4 to CO_2 through combustion.

MSW landfills produce significantly more greenhouse gas emissions than industrial landfills in part because industrial landfills contain less organic material. The organic carbon, or plant-based, component of waste is the primary source of emissions and the low-oxygen landfill environment promotes the generation of additional CH_4 as these wastes decay. Organic materials make up a large portion of waste collected from homes and businesses and deposited in MSW landfills.

Methodology

The EPA State Inventory Tool (or SIT, EPA 2022a) was used to estimate emissions from waste placed in landfills either in New York or exported to landfills in other states. In keeping with IPCC approach, the SIT applies a First Order Decay (FOD) model to estimate emissions generated by a specified volume of waste in a landfill environment. The amount of CH_4 that was oxidized or destroyed was subtracted from the emission estimate. Currently, the SIT uses a FOD model and assumptions based on the EPA LandGEM model. DEC is currently evaluating alternative methods as well as ways to incorporate additional sampling (see Planned

[2] As described in the New York State Solid Waste Management Plan

Improvements). Some portion of waste deposited in industrial landfills may be organic, but this would be a smaller overall percentage of waste compared to MSW landfills. The EPA SIT estimates the annual emissions of industrial landfill waste as 7% of annual MSW landfill emissions. The industrial landfill emissions were added to MSW landfill emissions to generate total solid waste landfill emissions.

For in-state solid waste management multiple data sources were compiled to generate a full time series. The SIT FOD model assumes that emissions are generated continuously for decades after waste was deposited in a landfill. Hence, annual waste data are needed as far back as 1960 to estimate emissions in 1990. Due to lack of state data, SIT default landfill disposal tonnage values were used for 1960-1985 that are derived from national per capita waste generation rates. Facility-reported tonnage values were used for the period 1986-2018, using interpolation to provide values for any years without data. Historical information was gathered from annual reports of the NY State Assembly (NYS Assembly 2002). SIT default LFGTE and flaring values were used for 1990-2008, and data reported to DEC were used for 2009-2018. A combustion efficiency percentage and CO_2 emission factor were applied to the CH_4 capture data and these emissions are included in the New York landfills totals. Data covering the 2019 and 2020 period are currently under review. For the purposes of this report, 2018 data were used to fill in for 2019 and 2020. These values will be updated when data are available.

For this report, additional information was used to estimate emissions from wastes exported out of the state to either landfills or combustion facilities. For example, historical NY State Assembly reports suggest that very little waste was exported prior to the widespread closure of local dumps around 1990 to meet federal standards. However, an increasing volume was exported after 1990. For 1986-2001, waste tonnages were used as reported by the NYS Assembly (NYS Assembly 2002). A combination of data sources was used to estimate the total amount of exported waste after this period, including information collected by DEC from waste transfer facilities, municipal offices, and as shared by other states. DEC has collated data for 2008-2018 and interpolation was used to provide values for 2002-2007. An unknown quantity of waste is exported without passing through a waste transfer facility, i.e., direct-hauled, and likely results in an underestimation of total exported waste tonnage. DEC will continue to seek new information sources to further refine this estimate.

Results

The estimated total emissions produced by landfills remained relatively stable between 1990 and 2018, when exported waste is included (Table 3). However, if exported wastes are excluded, there would be an appearance of a reduction in total emissions of 60% (from 33.25 to 19.97mmt CO_2e). This reflects both the diversion of MSW to out of state landfills, and the enhanced adoption of CH_4 capture and destruction systems. Since the SIT method for estimating industrial waste is based on a ratio of MSW landfill emissions, they reflect the same trends as MSW landfills in this analysis.

CO_2 emissions from out-of-state landfills is not included in this report and listed as "na" in the table below. This is due to a lack of data on the CH_4 capture and destruction systems employed at out of state facilities.

Table 3. Solid Waste Management Emissions by Gas, 1990-2020 (mmt CO2e GWP20)

Gas/Location	**1990**	**2005**	**2016**	**2017**	**2018**	**2019**	**2020**
Biogenic CO_2	**0.05**	**0.33**	**0.51**	**0.49**	**0.52**	**0.52**	**0.52**
New York landfills	0.05	0.33	0.51	0.49	0.52	0.52	0.52
Out of State landfills	na	na	na	na	na	na	na
CH_4	**33.98**	**37.64**	**34.72**	**35.32**	**34.65**	**34.89**	**35.12**
New York landfills	33.20	27.55	19.82	20.26	19.41	19.44	19.46
Out of State landfills	0.78	10.10	14.90	15.07	15.24	15.45	15.66
Gross Total	**34.03**	**37.97**	**35.23**	**35.82**	**35.18**	**35.42**	**35.64**
Exported Waste	0.78	10.10	14.90	15.07	15.24	15.45	15.66

"na" not applicable

Biological Treatment of Solid Waste

In addition to landfilling, organic solid waste can be treated through composting or anaerobic digestion.[3] The types of solid waste management described in this IPCC category are not considered to be a large source of emissions in New York because they have not been widely adopted to date. However, if new State and federal policies promote adoption of these practices as alternatives to landfilling, their relative contribution to waste sector emissions are expected to increase. Hence, this sector will continue to be monitored (see Planned Improvements).

Like decomposition that naturally occurs in soils, the CO_2 generated from composting organic waste would not be included in greenhouse gas accounting. The emissions of CH_4 and N_2O are minimal and will depend on the management of the compost. Current State regulations require large compositing facilities to manage organic waste in a way that minimizes these emissions.[4]

Anaerobic digestion is used to accelerate the decomposition of organic waste without oxygen (i.e., in an anaerobic environment), which promotes CH_4 production. The CH_4 may be captured and used for energy production but there is the potential for CH_4 leaks from piping and other sources. There are very few on-site, solid waste anaerobic digestors currently operating in New York. As the number of facilities increases and data become available, the CH_4 emissions from these digesters will be included in the Waste sector. The use of anaerobic digestion at wastewater facilities or farms would be reported elsewhere (i.e., as wastewater or agricultural emission sources). Any emissions resulting from the use of digester gas as an energy fuel, including leakage or "fugitive emissions", will be reported in the Energy sector.

[3] The IPCC approach also includes mechanical-biological treatment, but this is not used in New York.
[4] 6 NYCRR Part 361

Waste Combustion

This category of emissions includes the CO_2, CH_4, and N_2O associated with the combustion of municipal wastes sent to regulated combustion facilities in the state or exported to such facilities outside of the state (Table 4). Wastes combusted in other contexts were not included. As in the case of fuel combustion for energy, the primary greenhouse gas from the combustion of waste is CO_2. Due to the mixed compositional nature of MSW, the waste contains both organic and fossil-derived carbon (e.g., such as plastics). Emissions therefore include fossil CO_2 and biogenic-CO_2, the latter of which is deducted when calculating net emission totals. Unlike landfilling, municipal waste combustion was not associated with a large volume of CH_4 because there is no anaerobic decomposition.

Methodology

Emissions for this category were estimated by applying EPA MSW emission factors to the amount of waste combusted, both by in-state and out-of-state facilities (EPA 2022c). The SIT was not used because it does not estimate biogenic CO_2, or emissions from the combustion of organic material. The remaining CO_2 comes from fossil-derived materials, such as plastics, rubbers, and synthetic fibers. For in-state combustion, state data were used for the period 1990-2018, using interpolation to provide values for any years without data. 2018 values were used for 2019 and 2020 and will be updated when data become available. For out-of-state combustion, facility destination information is only available beginning in 2016. However, as waste disposal contracts with combustors are generally long-term and constant, recent waste tonnage information was used to estimate emissions going back to the year that a facility began operating.

The EPA emission factor for CO_2 includes fossil and biogenic CO_2, which are both anthropogenic. However, biogenic CO_2 is conventionally excluded. As a planned improvement, DEC is evaluating methods for apportioning CO_2 emissions as biogenic or fossil, particularly for historic time periods in which there may not be a record of waste composition. For this report, the biogenic portion of annual total CO_2 was estimated for the period 2010-2020 by applying the percent of total CO_2 emitted from in-state waste combustion facilities reporting to the U.S. EPA Greenhouse Gas Reporting Program (GHGRP) to be biogenic (EPA 2022d). For the period 1990-2009 the average percent biogenic CO_2 of the 2010-2020 period was applied. The annual ratio of in-state biogenic to non-biogenic CO_2 emissions was applied to out-of-state waste combustion CO_2 emissions. In 2018, in-state waste combustion resulted in 1.5mmt of fossil CO_2, which was 60% of total in-state waste combustion CO_2. The remaining 0.99mmt CO_2 were of biogenic origin.

Results

Waste combustion emissions in 2018, and reported here for 2019 and 2020 until data becomes available, were 3.2mmt, a reduction of 20% since 1990 (Table 4). The majority of emissions are CO_2 (96%), with some CH_4 and N_2O from incomplete combustion. Exported wastes are a small portion of total waste combustion emissions and this has not changed appreciably over the timeseries.

Table 4. Waste Combustion Emissions by Gas, 1990-2020 (mmt CO2e GWP20)

Gas/Location	1990	2005	2016	2017	2018	2019	2020
CO_2	**2.24**	**2.05**	**1.79**	**2.01**	**1.99**	**1.99**	**2.02**
New York facilities	2.08	1.65	1.30	1.52	1.50	1.50	1.53
Out of State facilities	0.16	0.40	0.49	0.49	0.49	0.49	0.49
Biogenic CO_2	**1.60**	**1.27**	**0.97**	**1.08**	**1.08**	**1.07**	**1.05**
New York facilities	1.38	1.09	0.88	1.00	0.99	0.99	0.96
Out of State facilities	0.22	0.18	0.09	0.09	0.09	0.09	0.09
CH_4	**0.11**	**0.10**	**0.08**	**0.09**	**0.09**	**0.09**	**0.09**
New York facilities	0.10	0.08	0.06	0.07	0.07	0.07	0.07
Out of State facilities	0.01	0.02	0.02	0.02	0.02	0.02	0.02
N_2O	**0.05**	**0.04**	**0.03**	**0.04**	**0.04**	**0.04**	**0.04**
New York facilities	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Out of State facilities	+	+	+	+	+	+	+
Gross Total	**4.00**	**3.46**	**2.87**	**3.22**	**3.20**	**3.20**	**3.20**
Exported Waste	0.40	0.60	0.60	0.60	0.60	0.60	0.60

"+" less than 0.01mmt

Wastewater

Wastewater can contain liquid organic matter along with suspended solids that can produce greenhouse gases. There are two primary mechanisms for treating wastewater, in on-site septic systems or in a centralized system which accepts domestic and industrial wastewater through sewers, treats it, and then discharges it into aquatic systems. As with solid waste management, the anthropogenic component of wastewater emissions can be mitigated through management. The biogenic CO_2 associated with natural decomposition is not estimated here.

Wastewater treatment practices involve both aerobic and anaerobic decomposition. CH_4 is generated by microorganisms when the organic carbon in wastewater is allowed to decompose under anaerobic conditions. Septic systems treat the solid component of the wastewater anaerobically, producing additional CH_4. This is less common in centralized systems as the majority of wastewater treatment facilities in New York use aerobic treatment methods, and the remainder using anaerobic methods utilize methane capture to mitigate emissions. However, anaerobic pockets can develop in facilities utilizing aerobic treatment methods, depending on operational factors. On a per capita basis, centralized systems (108.9 kg CO_2e per year) are much less emissive than septic systems (353.3 kg CO_2e per year). N_2O production is stimulated by the action of microorganisms on nitrogen compounds that enter wastewater in human waste, kitchen waste, industrial wastewater, and other sources.

Methodology

The SIT method was used with revised emission factors to estimate CH_4 and N_2O production from wastewater (EPA 2022a). Inputs used for both gases included the state population (U.S. Census Bureau 2020) and the fraction of the population with septic wastewater treatment

(0.186) based on a national average from the American Housing Survey (U.S. Census Bureau 2017). Septic system CH_4 emissions were calculated by applying a default emission factor of 10.7 g CH_4 per person per day (Leverenz et al. 2010) to the fraction of the state population using septic system wastewater treatment.

For centralized wastewater systems, CH_4 and N_2O emissions were calculated using the methodology and emission factors from the IPCC approach (IPCC 2019, Volume 5, chapters 2 and 6). CH_4 was estimated based on the maximum amount of CH_4 that can be produced from a given quantity of organic matter in wastewater (0.6 kg CH_4 per kg BOD), where biochemical oxygen demand (BOD) was used as a proxy for the amount of organic matter in wastewater. The average amount of organic matter generated per person in the U.S. was assumed to be 0.09 kg BOD per day. A correction factor of 0.05 was applied to estimate the fraction of wastewater organic matter that was converted anaerobically (Scheehle and Doorn 2003). Direct N_2O emissions from wastewater treatment facilities were estimated assuming production of 4 g N_2O per person per year. Another emission factor of 0.005 g N_2O-N generated per g wastewater nitrogen (N) was applied to an estimate of the total N present in both septic and non-septic wastewater. The emission factor was selected under the default assumption that effluent was discharged to an aerobic environment that was not nutrient-impacted or oxygen-impaired. The total N in wastewater was calculated based on the average U.S. protein consumption, the average N content of protein, and a scaling factor (1.75) to account for the presence of N derived from sources other than human waste in wastewater. The most recent national GHG inventory includes improved methods for assessing emissions from wastewater discharge (EPA 2022b). These have not yet been incorporated into the SIT but may be considered in future updates of this report (Planned Improvements).

Results

Based on this analysis, emissions from wastewater treatment have increased 12% since 1990 in New York State (Table 5). Of note is that while only an estimated 18.6% of New York's State population utilizes septic systems, they account for 43% of total wastewater emissions. As this SIT-based analysis is fundamentally linked to census population data, this trend reflects demographic trends. These estimates will likely be refined in future years to reflect additional emission measurements (Planned Improvements).

Table 5. Wastewater Emissions, 1990-2020 (mmt CO2e GWP20)

Gas/Treatment	1990	2005	2016	2017	2018	2019	2020
CH_4	**2.32**	**2.46**	**2.52**	**2.52**	**2.51**	**2.50**	**2.59**
Centralized Wastewater	1.22	1.29	1.32	1.32	1.32	1.31	1.36
Septic Systems	1.10	1.17	1.20	1.20	1.19	1.19	1.23
N_2O	**0.47**	**0.50**	**0.51**	**0.51**	**0.51**	**0.50**	**0.52**
Centralized Wastewater	0.38	0.41	0.42	0.42	0.41	0.41	0.43
Septic Systems	0.08	0.09	0.09	0.09	0.09	0.09	0.09
Gross Total	**2.78**	**2.95**	**3.03**	**3.02**	**3.02**	**3.00**	**3.11**

Planned Improvements

Improvements to the waste sector inventory are ongoing. Like the "key categories" prioritized by the IPCC, certain areas of improvement, such as solid waste management, will be prioritized in the near-term because they are expected to have a significant influence on the emission totals and State policy.

Solid Waste Management

This report uses the same methodologies used by the U.S. EPA and other governments as recommended by the IPCC approach. Future analyses will seek to refine the EPA SIT model and incorporate more information on local climatic conditions, such as precipitation and temperature, as well as sampling data from active landfills. Additionally, data on historic and current waste composition is needed. Refining the model to incorporate this information will refine estimates and be responsive to potential declines in organic matter content in MSW. Over time, DEC would seek to develop a methodology that accurately portrays statewide emissions and that is consistent with facility-level measurements and top-down data, where available (see *Summary Report*). At this time, facility data are typically focused on gas collection systems and do not include measurements from the entire landfill.

Other areas of future improvements will include further refinements to the estimate of exported waste emissions, industrial landfill emissions, as well as information on the "methane commitment" of landfills.

Biological Treatment of Solid Waste

As discussed above, this report does not include emissions from this category because there were not sufficient data, the number of emission sources is small, and current regulations require these sources to be operated in a manner that would limit emissions. However, these emissions will be analyzed in future reports, particularly as more organic waste is diverted from landfills.

Waste Combustion

Of primary interest in this category is the composition of waste from organic/biogenic sources versus fossil sources such as plastics. However, this distinction would not affect the estimation of gross emissions. Additionally, the DEC will seek to improve estimates of the share of exported waste sent to out-of-state combustors.

Wastewater

Future inventories will incorporate state-specific data to determine the fraction of New Yorkers using septic versus non-septic wastewater management. The current methodology assumes aerobic treatment at centralized wastewater treatment facilities. Methods for separating and accounting aerobic versus anaerobic centralized wastewater treatment will be reviewed. The impact of the water quality (nutrient and eutrophic status) of water bodies that receive wastewater will be incorporated into N_2O emissions estimates. Finally, the contribution of industrial and commercial wastewater to CH_4 and N_2O emissions will also be included explicitly when such data are available.

Abbreviations

AR6	IPCC Sixth Assessment Report
BOD	Biological oxygen demand
CH_4	Methane
CLCPA	NYS Climate Leadership and Community Protection Act
CO_2	Carbon dioxide
CO2e	Carbon dioxide equivalent
DEC	NYS Department of Environmental Conservation
EPA	U.S. Environmental Protection Agency
FOD	First order decay
GHG	Greenhouse gas
GWP	Global Warming Potential
GWP100	100-Year Global Warming Potential
GWP20	20-Year Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram
LFGTE	Landfill gas-to-energy
mt	metric tons
mmt	million metric tons
MSW	Municipal solid waste
N	Nitrogen
N_2O	Nitrous oxide
NA	Not applicable
NE	Not estimated
NO	Not occurring
NYCRR	New York Codes, Rules and Regulations
NYS	New York State
SIT	EPA State Inventory Tool

References

Scheehle, E.A. and Doorn, M. 2003. “Improvements to the U.S. Wastewater Methane and Nitrous Oxide Emissions Estimates.” Paper presented at the 12th International Emission Inventory Conference, San Diego, CA, April 2003. https://www3.epa.gov/ttnchie1/conference/ei12/green/scheehle.pdf

EPA. 2022a. State Greenhouse Gas Inventory and Projection Tool. March 2020. Washington, D.C.: U.S. Environmental Protection Agency. https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool

EPA. 2022b. *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2020.* EPA 430-R-22-003. Washington, D.C.: U.S. Environmental Protection Agency. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2020

EPA. 2022c. "Table 1. Stationary Combustion. Municipal Solid Waste." *GHG Emission Factors Hub*. April 2022 Update. Washington, D.C.: U.S. Environmental Protection Agency.

EPA. 2022d. Greenhouse Gas Reporting Program (GHGRP). https://www.epa.gov/enviro/greenhouse-gas-customized-search

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. [H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe (eds.)] Hayma, Japan: The National Greenhouse Gas Inventories Programme, The Intergovernmental Panel on Climate Change.

IPCC. 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. [Stocker, T.F., D. Qin, G.-K., Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

IPPC. 2019. 2019 *Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.* [Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds.)]. Hayama, Kanagawa, Japan: The National Greenhouse Gas Inventories Programme, The Intergovernmental Panel on Climate Change.

Leverenz, H.L., Tchobanoglous, G., and Darby, J.L. 2010. "Evaluation of greenhouse gas emissions from septic systems." *Final Report*. Alexandria, VA, USA, and London, United Kingdom: Water Environment Research Foundation and IWA Publishing.

NYS Assembly. 2002. "Where will the garbage go?" Albany, NY, USA: Legislative Commission on Solid Waste Management. https://nyassembly.gov/comm/SolidWaste/20031114/

U.S. Census Bureau. 2017. American Housing Survey.

U.S. Census Bureau. 2020. U.S. Census Bureau International Database.