Appendix B: Energy Sector Data and Methods

This appendix includes the data and methods used to estimate statewide greenhouse gas (GHG) emissions reported in *Sectoral Report # 1: Energy* of the 2025 Statewide GHG Emissions Report. The methodology follows NYSERDA (2024a) unless specified otherwise.

Fuel Combustion Emissions Calculations

New York reported carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions from fuel combustion activities in the energy sector for 1990-2023. To calculate CO_2 emissions, the total quantity of fuel consumed in New York State for a given source category (the fuel activity) was multiplied by the carbon content of the fuel and the ratio of the molecular weight of CO_2 to the molecular weight of carbon (Eq. 1). Methane (Eq. 2) and nitrous oxide (Eq. 3) emissions were calculated by multiplying the fuel activity for a given source category by the corresponding CH_4 and N_2O emission factor, respectively. Conversion factors in Equations 2 and 3 converted energy units from Joules to British Thermal Units (Btu), and mass units from kilograms (kg) to metric tons (mt). The U.S. Environmental Protection Agency (EPA) *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2023* provided the fuel-specific carbon contents and emission factors used in Equations 1-3 (EPA 2025a). See NYSERDA (2024a) for more details.

Equation 1

$$\boldsymbol{CO_{2,Total,y} = \Sigma_f \left(Fuel_{f,y} \cdot CC_{f,y} \cdot \left[\frac{44}{12}\right]\right)}$$

$CO_{2,\ Total,\ y}$ = Total annual CO_2 emissions (mt CO_2) for all fuels for year *y*.

$Fuel_{f,\ y}$ = Quantity of fuel *f* combusted in a given source category for year *y* (billion Btu).

$CC_{f,\ y}$ = Carbon content of fuel *f* for year *y* (mt C / billion Btu).

44/12 = Ratio of the molecular weight of CO_2 to the molecular weight of C (mt CO_2 / mt C).

Equation 2

$$\boldsymbol{CH_{4,Total,y} = \Sigma_f \left(Fuel_{f,y} \cdot EF_{CH_4,f} \cdot 1055.06 \cdot \frac{1}{1000}\right)}$$

$CH_{4,\ Total,\ y}$ = Total annual CH_4 emissions (mt CH_4) for all fuels for year y.

$Fuel_{f,\ y}$ = Quantity of fuel *f* combusted in a given source category for year *y* (billion Btu)

$EF_{CH4,\ f}$ = CH_4 emission factor for fuel *f* (kg CH_4 / trillion Joules)

1055.06 = Conversion factor from Btu to Joules.

1/1000 = Conversion factor from kg to mt.

Equation 3

$$N_2O_{Total,y} = \Sigma_f \left(Fuel_{f,y} \cdot EF_{N_2O,f} \cdot 1055.06 \cdot \frac{1}{1000} \right)$$

$N_2O_{Total,\,y}$ = Total annual N_2O emissions (mt N_2O) for all fuels for year y.

$Fuel_{f,\,y}$ = Quantity of fuel *f* combusted in a given source category for year *y* (billion Btu)

$EF_{N2O,\,f}$ = N_2O emission factor for fuel *f* (kg N_2O / trillion Joules)

1055.06 = Conversion factor from Btu to Joules.

1/1000 = Conversion factor from kg to mt.

Fuel Combustion: Electricity Generation

The U.S. Energy Information Administration (EIA) *State Energy Data System* (SEDS) provided the state-level fuel activity data used to calculate in-state GHG emissions associated with fuel combustion for electricity generation (EIA 2025a). Table 1 lists the fuel types combusted for electricity generation in New York State and their corresponding SEDS mnemonic series names. Emissions of CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by multiplying the fuel activity for each source category by the corresponding fuel carbon content or emission factor.

Table 1: EIA SEDS Fuel Consumption Variables for Electricity Generation

Source Category	EIA Mnemonic Series Name	Unit
Coal consumed by the electric power sector	CLEIB	Billion Btu
Distillate fuel oil consumed by the electric power sector	DFEIB	Billion Btu
Natural gas consumed by the electric power sector (including supplemental gaseous fuels)	NGEIB	Billion Btu
Petroleum coke consumed by the electric power sector	PCEIB	Billion Btu
Residual fuel oil consumed by the electric power sector	RFEIB	Billion Btu
Wood consumed by the electric power sector	WDEIB	Billion Btu

Fuel Combustion: Residential

Fuel combustion emissions from the residential sector were based on state-level fuel activity data from the EIA SEDS dataset (EIA 2025a). The fuel types combusted in the residential sector in New York State and their corresponding SEDS mnemonic series names were included in Table 2 below. Emissions of CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by multiplying the fuel activity for each source category by the corresponding fuel carbon content or emission factor.

Table 2: EIA SEDS Fuel Consumption Variables for the Residential Sector

Source Category	EIA Mnemonic Series Name	Unit
Coal consumed by the residential sector	CLRCB	Billion Btu
Distillate fuel oil consumed by the residential sector	DFRCB	Billion Btu
Kerosene consumed by the residential sector	KSRCB	Billion Btu
Hydrocarbon gas liquids consumed by the residential sector	HLRCB	Billion Btu
Natural gas delivered to the residential sector, used as consumption (including supplemental gaseous fuels)	NGRCB	Billion Btu
Wood energy consumed by the residential sector	WDRCB	Billion Btu

Fuel Combustion: Commercial

Fuel combustion emissions from the commercial sector were based on state-level fuel activity data from the EIA SEDS dataset (EIA 2025a). Table 3 lists the fuel types combusted in the commercial sector in New York State and their corresponding SEDS mnemonic series names. Emissions of CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by multiplying the fuel activity for each source category by the corresponding fuel carbon content or emission factor.

Table 3: EIA SEDS Fuel Consumption Variables for the Commercial Sector

Source Category	EIA Mnemonic Series Name	Unit
Coal consumed by the electric power sector	CLCCB	Billion Btu
Distillate fuel oil consumed by the commercial sector	DFCCB	Billion Btu
Kerosene consumed by the commercial sector	KSCCB	Billion Btu
Hydrocarbon gas liquids consumed by the commercial sector	HLCCB	Billion Btu
Natural gas delivered to the commercial sector, used as consumption (including supplemental gaseous fuels)	NGCCB	Billion Btu
Residual fuel oil consumed by the commercial sector	RFCCB	Billion Btu
Wood energy consumed by the commercial sector	WDCCB	Billion Btu

Fuel Combustion: Industrial

Fuel combustion emissions in the industrial sector were based on state-level fuel activity data from the EIA SEDS dataset (EIA 2025a). Table 4 includes the fuel types consumed in the industrial sector in New York State along with their corresponding SEDS mnemonic series names.

Table 4: EIA SEDS Fuel Consumption Variables for the Industrial Sector

Source Category	EIA Mnemonic Series Name	Unit
Asphalt and road oil consumed by the industrial sector	ARICB	Billion Btu
Coal consumed at coke plants (coking coal)	CLKCB	Billion Btu
Coal consumed by industrial users other than coke plants	CLOCB	Billion Btu
*Distillate fuel oil consumed by the industrial sector	DFICB	Billion Btu
Kerosene consumed by the industrial sector	KSICB	Billion Btu
Hydrocarbon gas liquids consumed by the industrial sector	HLICB	Billion Btu
Lubricants consumed by the industrial sector	LUICB	Billion Btu
Lubricants consumed by the transportation sector	LUACB	Billion Btu
Miscellaneous petroleum products consumed by the industrial sector	MSICB	Billion Btu
Natural gas consumed by the industrial sector (including supplemental gaseous fuels)	NGICB	Billion Btu
Petroleum coke consumed in the industrial sector	PCICB	Billion Btu
Residual fuel oil consumed by the industrial sector	RFICB	Billion Btu
Special naphthas consumed by the industrial sector	SNICB	Billion Btu
Waxes consumed by the industrial sector	WXICB	Billion Btu
Wood energy consumed by the industrial sector	WDICB	Billion Btu

*Industrial distillate use adjusted by subtracting out off-highway distillate fuel oil use (SEDS mnemonic DFOFP).

The industrial sector consumed fossil fuels for energy and non-energy purposes from 1990-2023. Non-energy uses of fossil fuels included asphalt production, and manufacture of materials such as lubricants and plastics. The EPA *State Inventory Tool* (SIT) (EPA 2025b) provided industrial non-energy fuel use fractions to separate the portion of industrial fuel combusted for energy purposes (Eq. 4) from the portion of fuel used for non-energy purposes (Eq. 5). Note that the storage factor term in Equation 5 removed the fraction of industrial non-energy fuel consumption that did not produce GHG emissions to the atmosphere. The SIT included the storage factors used to estimate industrial non-energy fuel consumption emissions (EPA 2025b). Emissions of CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by multiplying the quantity of fuel consumed for each source category by the corresponding fuel carbon content or emission factor.

Equation 4

$$\boldsymbol{Fuel_{f,y} = TotalFuel_{f,y} \cdot (1 - NE_f)}$$

$Fuel_{f,y}$ = Quantity of fuel *f* combusted by the industrial sector for year *y* for energy purposes (billion Btu).

$TotalFuel_{f,y}$ = Total quantity of fuel *f* combusted by the industrial sector for year *y* (billion Btu).

NE_f = Fraction of fuel *f* consumed for non-energy purposes.

Equation 5

$$NonEnergy_{f,y} = TotalFuel_{f,y} \cdot NE_f \cdot (1 - Storage_f)$$

$NonEnergy_{f,y}$ = Quantity of fuel *f* consumed by the industrial sector for non-energy purposes (billion Btu).

$TotalFuel_{f,y}$ = Total quantity of fuel *f* combusted by the industrial sector for year *y* (billion Btu).

NE_f = Fraction of fuel *f* consumed for non-energy purposes.

$Storage_f$ = Fraction of non-energy fuel use not emitted to the atmosphere for fuel *f*.

Fuel Combustion: Transportation – On-Road Motor Vehicles

Emissions from on-road motor vehicles relied on fuel activity provided by the EIA SEDS (EIA 2025a) and EIA *Natural Gas Consumption by End Use* (EIA 2025h) datasets. EIA SEDS reported the quantity of motor gasoline (SEDS mnemonic MGMFP) and distillate fuel (SEDS mnemonic DFONP) sold in New York State. Note that the quantity of highway "special fuels" (SEDS mnemonic MGSFP) was subtracted from the total highway motor gasoline consumption (SEDS mnemonic MGMFP). The EIA *Natural Gas Consumption by End Use* dataset provided activity data for natural gas consumed by vehicles (EIA 2025h).

Highway fuel sales data may inaccurately capture GHG emissions from on-road motor vehicles. First, motor vehicle fuels can be purchased out-of-state and combusted in New York. Second, emissions produced by motor vehicles depend on vehicle year, vehicle model, weather conditions, and other variables (EPA 2025c). To address the concerns above, the Department of Environmental Conservation (DEC) scaled EIA SEDS fuel activity data for on-road motor vehicles using the fifth version of the EPA *Motor Vehicle Emission Simulator* (MOVES) model (EPA 2025c). MOVES calculates CO_2, CH_4, and N_2O emissions based on vehicle year, vehicle class, fuel type combusted, vehicle miles traveled (VMT), vehicle speed, idle fractions, and driving cycles (EIA 2025c). See NYSERDA (2024a) for more details regarding on-road transportation emissions estimates.

The biogenic portion of diesel fuels (biodiesel) and motor gasoline (ethanol) were estimated for on-road motor vehicles. The ethanol fraction was estimated by dividing the EIA SEDS quantity of fuel ethanol consumed in New York State for transportation (SEDS mnemonic EMTCB) by the total quantity of motor gasoline used by vehicles. Likewise, the biodiesel fraction was calculated as the ratio of the EIA SEDS biodiesel consumption consumed in the transportation sector (SEDS mnemonic BDACB) to the total quantity of distillate fuel consumed by vehicles in New York State. The biogenic portion of diesel fuel and ethanol consumed in New York State by on-road motor vehicles was calculated by applying the biodiesel fraction and ethanol fraction to the total distillate fuel and motor gasoline consumption, respectively.

Fuel Combustion: Transportation – Aviation

This section discusses calculations of GHG emissions from domestic flights that depart from New York State. Greenhouse gas emissions estimates from international flights that depart from New York State are described under the **Fuel Combustion: Bunker Aircraft** section.

Aviation fuel combustion emissions used aviation gasoline and jet fuel activity data reported in EIA SEDS (EIA 2025a). Before 2019, SEDS aviation fuel use data relied on reporting by fuel suppliers for each state. For reporting year 2019 and after, the EIA adjusted SEDS data for years 2010-present using flight miles reported to the Bureau of Transportation Statistics (BTS) to better reflect the supply and consumption of aviation fuels across state borders. To maintain consistency across the timeseries, SEDS fuel consumption data for New York and New Jersey for 1990-2009 were summed together and multiplied by the fraction of New York total (i.e., international and domestic flights) passenger, freight, and mail flight miles relative to the combined New York and New Jersey total flight miles (Eq. 6). Aviation flight miles data were sourced from the BTS Table T-100 (BTS 2025).

Equation 6

$$AviationFuel_{f,y} = TotalFuel_{f,y} \cdot \frac{FlightMiles_{Total,NY}}{FlightMiles_{Total,NY} + FlightMiles_{Total,NJ}}$$

$AviationFuel_{f,y}$ = Adjusted quantity of fuel *f* combusted by the aviation sector for a given year *y* between 1990-2009.

$TotalFuel_{f,y}$ = Total quantity of fuel *f* combusted by the aviation sector for year *y* (billion Btu) as reported by EIA SEDS for 1990-2009.

$FlightMiles_{Total,NY}$ = Total passenger, freight, and mail miles for New York flights.

$FlightMiles_{Total,NJ}$ = Total passenger, freight, and mail miles for New Jersey flights.

EIA SEDS jet fuel activity data included the quantity of fuel consumed for international and domestic flights. To estimate jet fuel used for domestic flights from New York, the adjusted SEDS fuel activity data were multiplied by the fraction of New York domestic flight miles (passenger, freight, and mail miles) relative to the total New York flight miles across the entire timeseries (Eq. 7). The BTS Table T-100 supplied the domestic and total passenger, freight, and mail flight miles (BTS 2025). Note that aviation gasoline was combusted only for domestic flights and did not require adjustment using Equation 7.

Equation 7

$$JetFuel_{Domestic,y} = JetFuel_{Total,y} \cdot \frac{FlightMiles_{Domestic,NY}}{FlightMiles_{Total,NY}}$$

$JetFuel_{Domestic,y}$ = Estimated quantity of jet fuel consumed for New York domestic flights for year *y*.

$JetFuel_{Total,y}$ = Total quantity of jet fuel consumed for domestic and international flights for year *y* (billion Btu).

$FlightMiles_{Domestic,NY}$ = Total passenger, freight, and mail miles for New York domestic flights.

$FlightMiles_{Total,NY}$ = Total passenger, freight, and mail miles for New York domestic and international flights.

Emissions of CO_2, CH_4, and N_2O for New York domestic flights were calculated by multiplying the adjusted domestic aviation gasoline and jet fuel activity by the relevant fuel carbon content or emission factor provided by the EPA (EPA 2025a).

Fuel Combustion: Transportation – Railroad

Fuel combustion emissions from railroad activity relied on SEDS distillate fuel oil data (EIA 2025a) for 1990-2020. EIA SEDS discontinued reporting for railroad distillate fuel oil consumption after 2020. For the remaining timeseries, NYSERDA (2024a) extrapolated railroad distillate fuel oil emissions using the method described below.

First, total transportation distillate fuel oil use (DFTRP) was calculated by summing historical railroad, military, vessel bunkering, and on-road transportation fuel use for each year from 2016-2019. The summed total distillate fuel oil use (DFTRP) was divided by the total transportation sector distillate fuel consumption reported by EIA SEDS (DFACP) to create the ratio DFTRP / DFACP for each year from 2016-2019. The ratio DFTRP / DFACP was averaged over years 2016-2019 and multiplied by the SEDS total transportation sector distillate fuel oil use (DFCAP) for each individual year after 2020. The resulting product represented the extrapolated total transportation distillate fuel oil use (DFTRP) for each year from 2021-2023.

Next, the historical SEDS railroad distillate fuel oil consumption (DFRRP) for 2016-2019 was divided by the total transportation distillate fuel oil use (DFTRP) calculated above. The ratio DFRRP / DFTRP represented the railroad distillate fuel oil sector split for a given year. The railroad distillate fuel oil sector split was averaged over years 2016-2019 and multiplied by the total transportation distillate fuel oil use (DFTRP) calculated above for each year after 2020 to extrapolate the railroad distillate fuel oil consumption in New York.

Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying the corresponding fuel carbon contents or emission factors (EPA 2025a) to the total quantity of fuel consumed. Biogenic CO_2 emissions for railroad distillate fuel oil combustion were calculated by multiplying the total railroad distillate fuel use by the distillate fuel biogenic fraction. The biogenic fraction for distillate fuel was estimated as the ratio of the reported biodiesel consumption from the SEDS data (BDACB) relative to the total diesel used in transportation.

Fuel Combustion: Transportation – Military

The military sector combusted distillate fuel oil and residual fuel oil from 1990-2023. The SEDS dataset supplied military distillate (SEDS mnemonic DFMIP) and residual fuel oil (SEDS mnemonic RFMIP) activity in New York for 1990-2020 and discontinued these data for years after 2020. To extend the military fuel activity timeseries for 2021-2023, the same approach used to extrapolate railroad fuel use data was applied to the military fuel use data following NYSERDA (2024a).

Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying fuel-specific carbon contents or emission factors (EPA 2025a) to the total quantity of fuel consumed. Biogenic CO_2 emissions were estimated for distillate fuel following the method described in the **Fuel Combustion: Transportation – Railroad** section.

Fuel Combustion: Transportation – Bunker Vessel

The Transportation – Bunker Vessel sector combusted distillate and residual fuel oil from 1990-2023. The EIA SEDS dataset provided distillate fuel oil (SEDS mnemonic DFBKP) and residual fuel oil (SEDS mnemonic RFBKP) consumption for vessel bunkering for years 1990-2020 but discontinued these data after 2020. Bunker vessel distillate and residual fuel oil consumption for years after 2020 was extended following the method described in the **Fuel Combustion: Transportation – Railroad** section (NYSERDA 2024a).

Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying fuel-specific carbon contents or emission factors to the total quantity of fuel consumed. Biogenic CO_2 emissions were estimated for distillate fuel following the method described in the **Fuel Combustion: Transportation – Railroad** section.

Fuel Combustion: Transportation – Bunker Aircraft

Bunker aircraft fuels were combusted for international flights that departed from New York. New York bunker aircraft fuel activity was calculated by subtracting the quantity of jet fuel combusted for domestic flights from the total jet fuel use. Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying fuel-specific carbon contents or emission factors to the quantity of jet fuel consumed for international flights. Emissions from aviation gasoline did not apply to international flights for 1990-2023.

Fuel Combustion: Transportation – Other Nonroad (Diesel)

The SEDS dataset provided distillate fuel oil activity data for the other nonroad transportation sector (SEDS mnemonic DFOFP) for years 1990-2023. Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying fuel-specific carbon contents or emission factors to the total quantity of fuel consumed. Biogenic CO_2 emissions were estimated for distillate fuel following the method described in the **Fuel Combustion: Transportation – Railroad** section.

Fuel Combustion: Transportation – Other Nonroad (Gasoline)

The SEDS dataset provided fuel activity data for the other nonroad uses of motor gasoline for 1990-2020. Federal Highway Administration (FHWA) *Highway Statistics Series* data reported other nonroad motor gasoline consumption for years after 2020 (FHWA 2025). Table 5 shows the FHWA table used to retrieve other nonroad motor gasoline activity for years after 2020 along with the equivalent SEDS mnemonic series name.

Table 5: Federal Highway Administration Gasoline Combustion Activity Data

EIA SEDS Mnemonic Series Name (MSN) Equivalent	Data Category	FHWA Highway Statistics Series Table
MGIYP	Motor Gasoline – Industrial/Commercial	MF-24
MGCUP	Motor Gasoline – Construction	MF-24
MGAGP	Motor Gasoline – Agricultural	MF-24
MGPNP	Motor Gasoline – Public Nonhighway	MF-24
MGMSP	Motor Gasoline – Miscellaneous/Unclassified	MF-24
**MGLGP	Motor Gasoline – Lawn and Garden	MF-24
*MGMRP/MGBTP	Motor Gasoline – Marine/Boating	MF-24
**MGRVP	Motor Gasoline – Recreational Vehicle	MF-24

*SEDS used the mnemonic MGMRP for 1990-2014 and MGBTP for 2015-2023.

**Data for 1990-2014 backcasted using New York State population data.

Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying fuel-specific carbon contents or emission factors (EPA 2025a) to the total quantity of fuel consumed. Biogenic CO_2 emissions were estimated for motor gasoline by applying the ethanol fraction for each year in the timeseries to the fuel activity data. The ethanol fraction was estimated by computing the ratio of ethanol consumption in the SEDS dataset (SEDS mnemonic EMTCB) to the total motor gasoline used in the transportation sector.

Fuel Combustion: Transportation: Natural Gas Pipeline

The transportation sector included greenhouse gas emissions from natural gas transmission pipeline fuel for years 1990-2023. The EIA *Natural Gas Consumption by End Use* dataset reported the natural gas pipeline fuel transport under the series name NA1480_SNY_2 (EIA 2025h). Emissions for CO_2 (Eq. 1), CH_4 (Eq. 2), and N_2O (Eq. 3) were calculated by applying the relevant fuel carbon contents or emission factors (EPA 2025a) to the total quantity of fuel consumed.

Emissions from New York State Oil and Gas Systems

The *New York State Oil and Gas Sector Methane Emissions Inventory: 1990-2022* (NYSERDA 2024b) includes an estimate of CH_4 emissions from in-state oil and gas systems. Note that 2023 CH_4 emissions from in-state oil and gas systems were assumed to remain unchanged from 2022 CH_4 emissions. The in-state methane emissions inventory for oil and gas systems did not include emissions of CO_2 or N_2O. Following NYSERDA (2024a), DEC calculated pollutant ratios of CO_2/CH_4 and N_2O/CH_4 using data from EPA (2025a) and applied these pollutant ratios to in-state oil and gas CH_4 emissions to calculate CO_2 and N_2O emissions. For oil systems, pollutant ratios were estimated for the exploration, production, transportation, and abandoned oil wells segments. Natural gas system pollutant ratios covered the following seven segments: exploration, gathering and boosting, production, processing, transmission and storage, distribution, and abandoned gas wells.

Petroleum refining activities ceased in New York in 1991. To estimate statewide petroleum refinery emissions in 1990 and 1991, NYSERDA (2024a) applied the ratio of state-to-national crude oil distillation capacity based on Form *EIA-820* (EIA 2023) to the national refinery emissions totals for 1990 and 1991.

Overview of the Upstream Fuel Lifecycle Analysis

The Climate Leadership and Community Protection Act (CLCPA) requires the statewide GHG emissions total to include “upstream”, out of state emissions associated with the generation of imported electricity and the extraction, processing, and transmission of fossil fuels to the New York border (ECL § 75-0105). As such this analysis included upstream emissions associated with New York electricity imports from PJM, ISO-NE, Ontario, and Quebec. Upstream, out of state emissions were calculated by multiplying the fuel activity for a given source category by an upstream fuel cycle emission factor. The upstream fuel cycle analysis included emissions from petroleum products, natural gas, and coal; biofuels were excluded.

DEC generated upstream emission factors using fuel lifecycle analysis (LCA) models that estimated the GHG emissions over the supply chain of a fuel. The Argonne National Laboratory Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model (ANL 2025), National Energy Technology Laboratory (NETL) Natural Gas LCA Model (NETL 2019; NETL 2025), and NETL Coal LCA Model (NETL 2020) were used to produce upstream emission factors for petroleum products, natural gas, and coal, respectively. The sections below include more details about the fuel cycle analyses and use of the LCA models.

Upstream Fuel Lifecycle Emission Factors for Petroleum Fuels

Emission factors for the upstream fuel cycle of New York imported petroleum fuels were sourced from the Argonne National Laboratory GREET model (ANL 2025). Following NYSERDA (2024a), DEC modified transportation and distribution parameters in GREET to reflect the transmission distances by mode of transport of imported petroleum fuels to the New York State border, ISO-NE, PJM, Quebec, and Ontario. The other inputs in GREET, such as the share of conventional oil in the United States, were set to their default values.

Petroleum products arrived in New York, ISO-NE, PJM, Quebec, and Ontario via pipeline, tanker, and barge from the origin locations listed in Table 6. The Petroleum Administration for Defense Districts (PADD) refer to specific regions of the United States used to track the domestic movements and supply of petroleum products (EIA 2012). New York is located within PADD 1B (Central Atlantic) that is a subdivision of PADD 1 (East Coast). The distances between the petroleum product origin point and destination are included in Table 6 (NYSERDA 2024a).

Table 6: Transmission Distances for Petroleum Products by Mode of Transportation (miles)

Origin (Mode) → Destination ↓	PADD 3 (Pipeline)	PADD 1 (Pipeline)	Canada (Pipeline)	Africa, Middle East, Europe, Asia, Oceania (Tanker)	Caribbean, South America, Mexico (Tanker)	PADD 3 (Barge)	Canada (Barge)	PADD 1B (Barge)
NY	1410	40	2000	4920	2125	2200	-	-
ISO-NE	1600	-	-	4735	2250	2460	350	600
PJM	1250	40	1725	5090	2100	2160	-	-
Quebec	-	-	150	-	-	-	-	-
Ontario	-	-	400	-	-	-	-	-

The EIA and Rosenberg and Janney (2006) provided data to estimate the quantity of petroleum products shipped via a specific mode of transportation. The EIA *Company-Level Imports* dataset (EIA 2025b) supplied data on annual petroleum imports via international tanker and Canadian pipeline. Data on the domestic shipments of petroleum products between each PADD and the production of petroleum within a PADD were taken from the EIA *Movement by Pipeline between PAD Districts* (EIA 2025c) and the EIA *Refinery and Blender Net Production* (EIA 2025d) datasets, respectively. The share of New York receipts by pipeline from PADD 1 were estimated as the quantity of petroleum produced in PADD 1 relative to the sum of the PADD 1 production and net receipts of petroleum from PADD 3 by PADD 1 (Eq. 8a). New York receipts by pipeline from PADD 3 were calculated as the net quantity of petroleum received from PADD 3 by PADD 1 relative to the sum of the PADD 1 production and net receipts of petroleum from PADD 3 by PADD 1 (Eq. 8b). The calculated shares were multiplied by the New York State pipeline capacity (481,800 Mbbl/yr) to estimate the quantity of petroleum product shipped to New York from a given PADD via pipeline. Note that the pipeline capacity of 481,800 Mbbl reflects the capacity of the Colonial, Sun, and Buckeye pipelines reported in Rosenberg and Janney (2006).

Equation 8a

$$\boldsymbol{NYReceipt_{PADD1,Pipeline,y} = \frac{Production_{PADD1,y}}{Production_{PADD1,y} + NetReceipt_{PADD3\rightarrow PADD1,y}} \cdot 481,800\ Mbbl}$$

Equation 8b

$$\boldsymbol{NYReceipt_{PADD3,Pipeline,y} = \frac{NetReceipt_{PADD3\rightarrow PADD1,y}}{Production_{PADD1,y} + NetReceipt_{PADD3\rightarrow PADD1,y}} \cdot 481,800\ Mbbl}$$

$\mathbf{NYReceipt_{PADD1,Pipeline,y}}$ = Estimated quantity of fuel received in New York from PADD 1 via pipeline for year *y* (Mbbl).

$\mathbf{NYReceipt_{PADD3,Pipeline,y}}$ = Estimated quantity of fuel received in New York from PADD 3 via pipeline for year *y* (Mbbl).

$Production_{PADD1,y}$ = Production of petroleum in PADD 1 as taken from the EIA *Refinery & Blender Net Production* dataset (EIA 2025d) for year *y* (Mbbl).

$NetReceipt_{PADD3 \rightarrow PADD1,Pipeline,y}$ = Net receipts of petroleum products in PADD 1 from PADD 3 via pipeline as taken from the EIA *Movements by Pipeline between PAD Districts* dataset (EIA 2025c) for year *y* (Mbbl).

481800 Mbbl = The reported pipeline capacity of the Colonial, Sun, and Buckeye pipelines (Mbbl) reported in Rosenberg and Janney (2006).

EIA *Movements by Tanker and Barge* data provided information on the transport of petroleum products via tanker and barge from PADD 3 to PADD 1B (EIA 2025e). Rosenberg and Janney (2006) reported the total quantity of petroleum products received in New York from PADD 3 via tanker and barge in 1995 as 3,988 Mbbls. To estimate the quantity of PADD 1B petroleum receipts allocated to New York, the PADD 1B petroleum receipts reported by the EIA for a given year were multiplied by the ratio of the 1995 New York petroleum receipts to the total 1995 PADD 1B receipts (Eq. 9).

Equation 9

$$NYFuelReceipts_{PADD3 \rightarrow PADD1B,TB,y} = \frac{3,988\ Mbbl}{NetReceipt_{PADD3 \rightarrow PADD1B,TB,1995}} \cdot NetReceipt_{PADD3 \rightarrow PADD1B,TB,y}$$

$NYFuelReceipts_{PADD3 \rightarrow PADD1B,TB,y}$ = Quantity of fuel received by PADD 1B from PADD 3 via tanker and barge allocated to New York for year *y* (Mbbl).

3988 Mbbl = Quantity of petroleum fuel received by New York in 1995 via tanker and barge as reported by Rosenberg and Janney (2006).

$NetReceipt_{PADD3 \rightarrow PADD1B,TB,y}$ = Quantity of fuel received by PADD 1B from PADD 3 via tanker and barge for year *y* as reported by the EIA *Movements by Tanker and Barge* (EIA 2025e) dataset.

$NetReceipt_{PADD3 \rightarrow PADD1B,TB,1995}$ = Quantity of fuel received by PADD 1B from PADD 3 via tanker and barge for 1995 as reported by the EIA *Movements by Tanker and Barge* (EIA 2025e) dataset.

Additional data and assumptions were made to estimate upstream petroleum emissions for New York electricity imports. PJM barge receipts from PADD 3 covered the portion of PADD 1B petroleum fuel receipts not allocated to New York. The remaining consumption for PJM that was not supplied by international imports or PADD 3 barge receipts was estimated to come from PADD 1 or PADD 3 pipelines. Next, ISO-NE receipts by barge from PADD 3 came from PADD

1A receipts by barge reported in the *EIA Movements by Tanker and Barge between PAD Districts* dataset (EIA 2025e). The remaining apparent consumption for ISO-NE that was not supplied by international imports or PADD 3 barge receipts was assumed to come by barge from PADD 1B. Table 7 summarizes the datasets used to estimate the quantity of petroleum products shipped to NY, ISO-NE, PJM, Quebec, and Ontario, and the mode of transportation used to move the fuels.

Table 7: Datasets used to Estimate Transportation and Distribution of Petroleum Products

Destination → Origin (Mode) ↓	NY	ISO-NE	PJM	Ontario	Quebec
PADD 3 (Pipeline)	1. EIA *Refinery and Blender Net Production* 2. EIA *Movement by Pipeline between PAD Districts*	-	Remaining apparent consumption for PJM, not supplied by international imports or PADD 3 barge receipts.	-	-
PADD 1 (Pipeline)	1. EIA *Refinery and Blender Net Production* 2. EIA *Movement by Pipeline between PAD Districts*	-	Remaining apparent consumption for PJM, not supplied by international imports or PADD 3 barge receipts.	-	-
Canada (Pipeline)	EIA *Company Level Imports*	EIA *Company Level Imports*	EIA *Company Level Imports*	Assume 100% via pipeline	Assume 100% via pipeline
Africa, Middle East, Europe, Asia, Oceania (Tanker)	EIA *Company Level Imports*	EIA *Company Level Imports*	EIA *Company Level Imports*	-	-
Caribbean, South America, Mexico (Tanker)	EIA *Company Level Imports*	EIA *Company Level Imports*	EIA *Company Level Imports*	-	-
PADD 3 (Barge)	EIA *Movements by Tanker and Barge*: PADD 1B receipts from PADD 3 allocated to NY from reported 1995 NY receipts from PADD 3	EIA *Movements by Tanker and Barge*: PADD 1A receipts from PADD 3	EIA *Movements by Tanker and Barge*: Portion of PADD 1B receipts from PADD 3 not allocated to NY	-	-
PADD 1B (Barge)	Remaining apparent consumption not supplied by international imports or PADD 3 barge receipts.	Remaining consumption not supplied by international imports or PADD 3 barge receipts.	-	-	-
Canada (Barge)	-	EIA *Company Level Imports*	-	-	-

Upstream emissions for motor gasoline were based on GREET gasoline blendstock emission factors. Emission factors for waxes and lubricants reflected GREET residual fuel oil emissions, that were scaled using emissions data for waxes and lubricants from Sun et al. (2019). NYSERDA (2024a) provides additional information on the estimation of upstream fuel cycle emission factors for petroleum products.

Upstream Fuel Lifecycle Emission Factors for Natural Gas

The 2025 Statewide GHG Emissions Report included an estimate of upstream natural gas emissions, or the emissions associated with the production, processing, and transmission of natural gas to the New York border. Upstream natural gas emission factors for CH_4, CO_2, and N_2O were based on the NETL Natural Gas LCA Model that estimated greenhouse gas emissions for each stage of the natural gas supply chain (Table 8). To generate upstream natural gas emission factors for 1990-2016, DEC used the NETL Natural Gas LCA Model based on 2016 natural gas system operating conditions (NETL 2019). For years 2020-2023, DEC ran the most recent version of the NETL Natural Gas LCA Model based on year 2020 natural gas system emissions (NETL 2025). Emission factors for years 2017-2019 were estimated by interpolating between the emission factors for years 2016 and 2020. NETL (2025) provides additional information on the changes made between the 2016 and 2020 version of the natural gas LCA model.

Table 8: Stages of the Natural Gas Fuel Lifecycle included in the NETL Natural Gas LCA Model

Stage	Stage Name
1	Production
2	Gathering and Boosting
3	Processing
4	Transmission Station
5	Storage
6	Transmission Pipeline
7	Distribution

Following NYSERDA (2024a), the U.S. natural gas basins assumed to supply gas to New York State included Gulf Coast, East Texas, Anadarko, Arkoma, and Appalachia. NETL (2025) estimated emissions for conventional, shale, and/or tight gas production within each basin (Table 9). Parameters in the NETL Natural Gas LCA Model were adjusted to better represent the GHG emission intensity for each year of the timeseries using stage-level scaling factors. To calculate the stage-level scaling factors, the ratio of the national GHG emissions from each stage of the natural gas supply chain (EPA 2025a) relative to the total U.S. natural gas production (EIA 2025f) was computed for each year. Next, the natural gas emissions to production ratio for each year was divided by the year 2016 (using the 2016 NETL Natural Gas LCA Model) or year 2020 (using the 2020 NETL Natural Gas LCA Model) emissions to production ratio. The quotient represented the scaling factor for a given year and natural gas supply chain stage (Eq. 10). See NYSERDA (2024a) for more details on the calculation of the stage-level scaling factors.

Table 9: Scenarios Modeled for New York State Upstream Natural Gas Emissions

NETL Scenario Number	Scenario Name
1	Appalachian – Shale
2	Gulf Coast – Conventional
3	Gulf Coast – Shale
4	Gulf Coast – Tight
8	East Texas – Conventional
9	East Texas – Shale
10	East Texas – Tight
11	Arkoma – Conventional
12	Arkoma – Shale
14	Anadarko – Conventional
15	Anadarko – Shale
16	Anadarko – Tight

Equation 10

$$\textit{Scaling Factors}_{Stage,y} = \frac{\textit{GHG Emissions}_{Stage,y}}{\textit{US NG Production}_{y}} \div \frac{\textit{GHG Emissions}_{Stage,2016/2020}}{\textit{US NG Production}_{2016/2020}}$$

Scaling Factors$_{\text{Stage, y}}$ = Scaling factors for a given stage of the natural gas supply chain and given year *y*.

GHG Emissions$_{\text{Stage, y}}$ = GHG emissions for a given stage and year *y*.

US NG Production$_{\text{y}}$ = Total U.S. natural gas production for a given year *y*.

GHG Emissions$_{\text{Stage, 2016/2020}}$ = GHG emission in the year 2016 or 2020 for a given stage of the natural gas supply chain.

US NG Production$_{\text{2016/2020}}$ = Total U.S. natural gas production for the year 2016 or 2020.

The calculated scaling factors for CH_4, CO_2, and N_2O were applied to the default parameters in the NETL Natural Gas LCA Model for each relevant stage of the natural gas fuel cycle listed in Table 10. Following NYSERDA (2024a), scaling factors for CH_4 emissions were applied to venting processes without flaring. For N_2O emissions, the scaling factors were applied to flaring processes. Carbon dioxide emissions from flaring processes were scaled using the same factors as N_2O. Lastly, scaling factors were applied to CO_2 emissions from acid gas removal in the processing stage.

Table 10: Scaling Factors Applied to the NETL Model for each Stage and Process

Greenhouse Gas	Natural Gas Fuel Lifecycle Stage	Process
CH_4	Production	Venting
CH_4	Gathering and Boosting	Venting
CH_4	Processing	Venting
CH_4	Transmission and Storage	Venting
CH_4	Distribution	Venting
CO_2	Processing	Acid gas removal
CO_2, N_2O	Production	Flaring
CO_2, N_2O	Gathering and Boosting	Flaring
CO_2, N_2O	Processing	Flaring
CO_2, N_2O	Transmission and Storage	Flaring
CO_2, N_2O	Distribution	Flaring

The pipeline transmission distance in the NETL Natural Gas LCA Model was modified to better represent the transmission distance of natural gas to the New York border. New York City was chosen as the natural gas delivery point to avoid double counting emissions associated with in-state distribution of natural gas. Table 11 shows the natural gas transmission distances from the extraction point to New York City. NYSERDA (2024a) provides additional details for the calculation of upstream natural gas emission factors.

Table 11: Natural Gas Transmission Distances from Source Basin to New York City (taken from NYSERDA 2024)

Basin	Origin City	Destination City	Distance (miles)
Gulf Coast	Houston, TX	New York, NY	1,420
East Texas	Houston, TX	New York, NY	1,420
Anadarko	Oklahoma City, OK	New York, NY	1,320
Arkoma	Fort Smith, AR	New York, NY	1,170
Appalachia	Pittsburgh, PA	New York, NY	315

Upstream Fuel Lifecycle Emission Factors for Coal

The methodology used to estimate upstream coal emission factors follows NYSERDA (2024a). A brief description of the methods underlying upstream fuel cycle emission factors for coal is included below.

NYSERDA (2024a) derived emission factors for coal extraction and processing from the NETL Coal LCA Model (NETL 2020). To account for changes in coal mine methane over the 1990-2023 timeseries, basin-specific scaling factors were applied to the year 2016 upstream coal emission factors derived from the NETL Coal LCA Model. To calculate the scaling factors, the basin-specific underground coal mine methane emissions taken from the EPA *U.S. GHG Inventory* (EPA 2025a) were divided by the quantity of underground coal extracted from a basin for a given year. Form *EIA-923* reported the amount of underground coal extracted from a specific basin (EIA 2025g). The underground coal mine methane emissions to underground coal production ratio for a given year was divided by the year 2016 underground coal mine methane emissions to coal production ratio to produce the scaling factors (Eq. 11). These scaling factors were applied to the extraction and processing stage of the coal lifecycle.

Equation 11

$$Scaling\ Factor_{Basin,y} = \frac{CH_4\ Emissions_{Basin,y}}{Coal\ Production_{Basin,y}} \div \frac{CH_4\ Emissions_{Basin,2016}}{Coal\ Production_{Basin,2016}}$$

Scaling Factor$_{Basin,\ y}$ = Scaling factor for a specific coal basin for year *y*.

CH_4 Emissions$_{Basin,\ y}$ = Underground coal mine methane emissions from a specified basin for year *y*.

Coal Production$_{Basin,\ y}$ = Quantity of underground coal extracted within a specified basin for year *y*.

CH_4 Emissions$_{Basin,\ 2016}$ = Underground coal mine methane emissions from a specified basin for year 2016.

Coal Production$_{Basin,\ 2016}$ = Quantity of underground coal extracted within a specified basin for year 2016.

The transmission distance and mode of transportation were modified in the NETL Coal LCA Model to estimate emissions associated with coal transmission. NYSERDA (2024a) used data from the EIA *Annual Coal Distribution Report* (EIA 2024a) that specified the quantity of coal transported from a specific state and the mode of transportation used. The percentage of coal received by New York, ISO-NE, PJM, Quebec, and Ontario via a specific mode of transportation was applied to utility data from Form *EIA-923* (EIA 2025g). Transportation distances to New York and the neighboring electricity import regions were modified in the NETL Coal LCA Model using the coal transportation distances reported in NYSERDA (2024a).

Imported Electricity Emissions

New York imported electricity from ISO-NE, PJM, Quebec, and Ontario for years 1990-2023. ISO-NE encompasses Connecticut, Maine, Massachusetts, Rhode Island, New Hampshire, and Vermont. The PJM territory covers Delaware, Maryland, New Jersey, Pennsylvania, and Washington, D.C. A brief description of the method underlying imported electricity emissions for 1990-2023 is included below and in NYSERDA (2024a).

NYSERDA (2024a) split the imported electricity emissions timeseries into two periods based on data availability. For 1990-2004, net electricity imports were calculated as the difference between the in-state electricity generation and total system demand as reported in the New York Independent System Operator (NYISO) *Gold Book* (NYISO 2024). Electricity imports for years 2005-present relied on hourly interchange data between NYISO, and PJM, ISO-NE, Quebec, and Ontario (NYISO 2025). Note that when NYISO was a net exporter of electricity to a neighboring power control region, the emission factor was assumed to be zero metric tons per megawatt-hour (NYSERDA 2024a).

Electricity generation and GHG emissions from ISO-NE were based on the EIA *Net Generation by State by Type of Producer by Energy Source* dataset (EIA 2024b) for 1990-1999 and the ISO-NE *Net Energy and Peak Load by Source* report (ISO-NE 2024) for years 2000-present. PJM electricity generation and emissions relied on the EIA *Net Generation by State by Type of Producer by Energy Source* dataset (EIA 2024b) for 1990-2003 and the PJM *Generation Attribute Tracking System* (PJM 2024) for 2004-present. Emission factors were calculated by dividing the GHG emissions from ISO-NE and PJM by the total quantity of electricity generated in ISO-NE and PJM, respectively.

Emission factors for electricity imports from Ontario and Quebec were sourced from Canada's *National Inventory Report 1990-2023* (Environment and Climate Change Canada 2025). Emission factors for 1990, 2000, 2005, and 2012-present were included in the Canada's GHG inventory with the other years in the timeseries estimated using interpolation (NYSERDA 2024a).

The imported electricity emissions analysis includes emissions from the Linden Cogeneration Plant and Bayonne Energy Center in New Jersey. These power plants are directly connected to the NYISO and supply electricity to New York. The EPA *Air Markets Program* (AMP) provided direct carbon dioxide emissions from the Linden Cogeneration Plant and Bayonne Energy Center for years 2009-present (EPA 2025d). To develop emission factors for the Linden Cogeneration and Bayonne Energy Center facilities, the CO_2 emissions supplied from the AMP data were divided by the electricity generated at each plant using Form EIA-923 data (EIA 2025g).

Abbreviations

BTS	Bureau of Transportation Statistics, U.S. Department of Transportation
Btu	British thermal unit
CH_4	Methane
CLCPA	NYS Climate Leadership and Community Protection Act
CO_2	Carbon dioxide
DEC	NYS Department of Environmental Conservation
ECL	Environmental Conservation Law
EIA	Energy Information Administration, U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration, U.S. Department of Transportation
GHG	Greenhouse gas
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies
kg	Kilogram
LCA	Lifecycle Analysis
MOVES	Motor Vehicle Emission Simulator model
mt	Metric Ton
N_2O	Nitrous oxide
NETL	National Energy Technology Laboratory
NYISO	New York Independent System Operator
NYSERDA	NYS Energy Research and Development Authority
PADD	Petroleum Administration for Defense District
SEDS	EIA State Energy Data System
SIT	EPA State Inventory Tool
VMT	Vehicle Miles Traveled

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