



NEW  
YORK  
STATE

Department of  
Environmental  
Conservation

# Energy

## 2022 NYS GREENHOUSE GAS EMISSIONS REPORT

### SECTORAL REPORT #1

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## Format of This Report

This sectoral report provides a detailed explanation of methods, data, and trends for the energy 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 2022a and 2022b). 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.

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## Energy

This sectoral report provides information on greenhouse gas (GHG) emissions associated with the energy system. Most emissions in the energy sector are from the combustion of fuels (Table 1). This report also describes emissions within New York State from other uses of fossil fuels (such as for asphalt), the leakage of emissions in the oil and gas system (or fugitive emissions), and the use of greenhouse gases in electricity transmission. The CLCPA also requires that this report include emissions that occur outside of the state that are associated with imported electricity and imported fossil fuels. These emissions are not typically included in governmental greenhouse gas emission reports or the IPCC approach. Finally, one additional source of emissions is provided as an informational item. Per IPCC approach, the portion of transportation fuels used for international transport, or bunker fuels, has been excluded from emission totals (“Excluded Transportation”, Table 1).

The energy system is the primary source of greenhouse gas emissions in New York (Table 1). In 2020, total energy emissions were 257.44mmt CO<sub>2</sub>e or 75% of statewide gross emissions and over 80% of net emissions, when measured using CLCPA accounting. This represents a 25% reduction in gross emissions compared to 1990 and an 11% reduction compared to 2019. The majority of Energy emissions in 2020 were from either fuel combustion (58% of energy and 44% of total emissions) or were associated with the importing of those fuels or electricity (36% of energy and 27% of total emissions).

The steep emissions reduction in 2020 matches the trend seen at the national level and represents the impact of the COVID19 global pandemic on economic activity (EPA 2022b). These impacts are most pronounced in the transportation sector, which saw a 20% drop in emissions (a 15.28mmt CO<sub>2</sub>e reduction), and the related decline in emissions associated with imported fuels (8.79mmt CO<sub>2</sub>e). Other emission categories with significant changes include electric power, and residential, commercial and industrial (RCI) fuel combustion. Emissions from fuel combustion for electricity generation in the state increased 2mmt CO<sub>2</sub>e in 2020 and is representative of increased fossil-fueled energy generation as compared to 2019 (4,606.2 GWh). Overall, annual in-state electricity generation declined 2.3% and total use declined 3.6% (NYISO 2021). RCI emission declines include 5.23mmt CO<sub>2</sub>e in residential, 2.65mmt CO<sub>2</sub>e in commercial, and 1mmt CO<sub>2</sub>e in industrial fuel combustion. Much of these declines can be attributed to fewer heating degree days (Figure 1) and is discussed in more detail in that section of the report.

The trend in Energy emissions over time, or from 1990-2019, is also the same as that seen nationally, with an initial increase in emission from 1990 through the mid-2000’s and then a decline thereafter (EPA 2022b). Importantly, 2020 emissions are not representative of current conditions and energy emissions are expected to increase in future reports for 2021 and 2022, reflecting economic recovery following the pandemic. Minor differences in the emission values included in this report as compared to the 2021 Statewide GHG Emissions report are the result of continual updates and improvements to the methodology and data used to calculate emissions.

Further information on the relative contribution of the different emission sources within the energy sector are described in the sections below. The accompanying *Summary Report* provides a breakdown of these sources by economic sector as was used for the New York State Climate Action Council Draft Scoping Plan.

**Table 1. Energy Emissions, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Fuel Combustion	220.90	232.53	173.50	166.44	175.91	172.60	150.46
Other Fossil Fuel Use	1.44	2.21	1.23	1.23	1.17	0.90	0.83
Fugitive Emissions	17.49	20.88	15.33	14.85	14.36	14.57	14.25
Electricity Transmission	4.02	1.61	0.15	0.14	0.13	0.13	0.11
Out of State Energy Emissions*	101.61	133.97	114.35	103.31	107.93	101.90	91.79
<b>Gross Total</b>	<b>345.45</b>	<b>391.20</b>	<b>304.57</b>	<b>285.96</b>	<b>299.50</b>	<b>290.10</b>	<b>257.44</b>
<i>% of Statewide Gross Total</i>	<i>85%</i>	<i>85%</i>	<i>79%</i>	<i>77%</i>	<i>78%</i>	<i>77%</i>	<i>75%</i>
<b>Net Total</b>	<b>338.62</b>	<b>382.42</b>	<b>294.22</b>	<b>275.75</b>	<b>288.72</b>	<b>279.18</b>	<b>248.19</b>
<i>% of Statewide Net Total</i>	<i>93%</i>	<i>91%</i>	<i>85%</i>	<i>84%</i>	<i>84%</i>	<i>83%</i>	<i>81%</i>
Excluded Transportation Emissions	15.35	13.87	19.73	19.67	18.93	17.99	8.68

\*Not an IPCC Category

The primary greenhouse gas emitted by the energy sector is carbon dioxide (CO<sub>2</sub>) for 73% of energy emissions (Table 2). Under the IPCC approach for national governments, the CO<sub>2</sub> produced by burning biogenic or plant-based fuels is reported but treated separately from other anthropogenic emissions. The same practice is applied in this report.<sup>1</sup> In this report, biogenic sources of CO<sub>2</sub> are included in gross emission totals but omitted in net totals. A small fraction of the fuels used in New York are currently biogenic, so biogenic fuel emissions are much lower than fossil fuel emissions.

The second most common greenhouse gas is methane (CH<sub>4</sub>; 26% of energy emissions), primarily from leakage or intentional venting in the oil and gas system in New York and through the fuel system. Notably, 76% of energy sector methane is associated with out-of-state sources. Nitrous oxide (N<sub>2</sub>O) is also a byproduct of fuel combustion, but at a lower emission rate than the gases above. Finally, the major source of sulfur hexafluoride (SF<sub>6</sub>) globally is as an insulating gas in electricity transmission and distribution equipment, but its leakage rate in New York declined significantly since the 1990s.

<sup>1</sup> Per 6 NYCRR Part 496

**Table 2. 2020 Energy Emissions by Gas (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>CO<sub>2</sub></b>	<b>Biogenic CO<sub>2</sub></b>	<b>CH<sub>4</sub></b>	<b>N<sub>2</sub>O</b>	<b>SF<sub>6</sub></b>
Fuel Combustion	138.81	9.25	1.84	.56	na
Other Fossil Fuel Use	0.83	na	na	na	na
Fugitive Emissions	0.15	na	14.10	+	na
Electricity Transmission	Na	na	na	na	0.11
Out of State Energy Emissions*	40.10	+	51.55	0.14	na
<b>Gross Total</b>	<b>179.89</b>	<b>9.25</b>	<b>67.49</b>	<b>0.70</b>	<b>0.11</b>

\* Not an IPCC Category

“+” less than 0.01mmt

“na” not applicable

### Fuel Combustion

This IPCC category represents emissions associated with the burning of fossil and biogenic fuels. Fuel combustion is the largest source of greenhouse gas emissions in the state. This includes fuels combusted for electricity, transportation, and heating in residential, commercial, and industrial buildings in New York (Table 3). Petroleum refining, which existed in the state until 1991, represented a source of fuel combustion emissions in the 1990 baseline year, but it is not an emission source currently.

NYSERDA (2022a) is a technical supplement that is cited throughout this report and provides additional information on data and methods used in this section. Unless otherwise noted, the Energy Information Administration State Energy Data System (EIA SEDS) was used as the primary data source for the fuel combustion analysis and this section of the report is organized to align with that dataset. The EIA SEDS is the authoritative source of information on the nationwide transmission of fuels, and it aligns with the EPA’s national greenhouse gas emissions report (EPA 2022b). However, there are minor differences in how emission sources are organized in the IPCC approach. For example, industrial fuel combustion includes emission sources from industries that the IPCC approach split across multiple subcategories.

The most significant trend in fuel combustion emissions since 1990 was a 62% reduction from the electricity sector (Table 3). However, another major source of emissions is the transportation sector, in which emissions grew 11% from 1990 to 2019 and represented 45% of fuel combustion emissions in 2019. In 2020, transportation emissions declined 10% as compared to 1990, but are unrepresentative of current trends due to the impacts of the COVID19 global pandemic. Emissions are expected to return to previous patterns in future years. The second largest source of emissions is the use of fuels in residential buildings, such as for heating and cooking, followed by electricity generation and commercial fuel use.

**Table 3. Fuel Combustion Emissions, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Electric Power	63.63	56.22	28.58	22.94	25.17	22.12	24.13
Residential	39.18	46.44	34.90	35.42	41.31	40.73	35.50
Commercial	27.24	29.93	21.53	21.86	23.01	22.70	20.05
Industrial	20.74	13.71	9.18	8.77	8.98	9.01	8.01
Transportation	70.09	86.24	79.31	77.44	77.43	78.04	62.76
Petroleum Refining	0.01	no	no	no	no	no	no
<b>Gross Total</b>	<b>220.90</b>	<b>232.53</b>	<b>173.50</b>	<b>166.44</b>	<b>175.91</b>	<b>172.60</b>	<b>150.46</b>

“no” not occurring

The majority of fuel combustion emissions in 2020 were from the burning of petroleum fuels, which is unsurprising as these are the main fuels used in transportation (Table 4). However, emissions from the combustion of petroleum fuels had declined 44% since 1990, while emissions from natural gas increased nearly 46%. Emissions from the combustion of coal declined 98%.

**Table 4. Fuel Combustion Emissions by Fuel Category, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

<b>Fuel Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Petroleum Fuels	131.61	139.82	92.73	89.97	92.82	92.44	73.85
Natural Gas	47.59	59.02	71.04	67.84	74.02	71.11	69.35
Coal	33.61	23.95	2.54	1.57	1.37	1.31	0.54
Wood	8.09	9.75	7.19	7.06	7.70	7.74	6.71
<b>Gross Total</b>	<b>220.89</b>	<b>232.53</b>	<b>173.50</b>	<b>166.44</b>	<b>175.91</b>	<b>172.60</b>	<b>150.46</b>

## Electricity Generation

This category addresses emissions from facilities whose primary activity is to generate electricity that will be transmitted via the electricity grid. Per IPCC approach, this category does not include electricity generated for local use, or distributed sources of generation such as industrial facilities or combined heat and power (CHP) facilities (a form of industrial fuel combustion). Although some excess portion of electricity may be shared with the electricity grid, that is not the main function of these emission sources. Instead, all emissions associated with on-site combustion of fuels is covered in the Residential, Commercial, and Industrial Fuel Combustion section below. Additionally, this section focuses on emission sources located within New York. Emissions resulting from Imported Electricity are described in a separate section below.

The mix of fuels used to generate electricity in New York has changed over time. For the 1990-2020 timeseries, these fuels included coal, distillate fuel oil, natural gas, petroleum coke, residual fuel oil, and wood. Additional information on the sources of fuels used in New York can

be found in the annual NYSERDA “Patterns and Trends” report and NYISO “Gold Book” and “Power Grid” reports (e.g., NYSERDA 2021, NYISO 2021a and b).

### Methodology

Emissions from fuel combustion are generally estimated by applying standard emission factors to the volume or energy content (BTUs) of fuels used in each sector. An alternative approach would be to summarize data that may be reported by facilities as part of state or federal air pollution regulations, however these data sources do not cover all sources or gases for the full 1990-2020 timeseries. For this report, annual BTUs of fuel consumed were taken from the EIA SEDs dataset and emission factors for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O were from the EPA (NYSERDA 2022a, EPA 2022b Table A-32).

### Results

The most significant emission reduction in this report was the decrease in fuel combustion emissions in the electricity sector from 1990 to current by over 60% (Table 3). This is related to the transition away from fuels with higher combustion emissions to those with lower combustion emissions; as natural gas usage has increased, the use of coal and petroleum fuels such as residual fuel oil has declined (Table 5). As described in NYSERDA (2022a), the emissions from the extraction, processing, transmission, and distribution of these fuels have not followed the same pattern. Note, according to the SEDS dataset, petroleum coke was not a source of fuel prior to 1996 or after 2011.

**Table 5. Electricity Emissions by Fuel Type, 1990-2029 (mmt CO<sub>2</sub>e GWP20)**

Emission Category	1990	2005	2016	2017	2018	2019	2020
Coal	25.04	20.60	1.51	0.61	0.68	0.46	0.16
Distillate Fuel	0.47	0.69	0.15	0.11	0.34	0.16	0.08
Natural Gas	12.59	16.52	25.82	21.09	22.72	20.73	23.19
Petroleum Coke	no	1.33	no	no	no	no	No
Residual Fuel	25.45	16.59	0.30	0.30	0.76	0.17	0.10
Wood	0.07	0.49	0.80	0.83	0.67	0.60	0.61
<b>Gross Total</b>	<b>63.63</b>	<b>56.22</b>	<b>28.58</b>	<b>22.94</b>	<b>25.17</b>	<b>22.12</b>	<b>24.13</b>

“+” less than 0.01mmt

“no” not applicable

### Residential, Commercial, and Industrial Fuel Combustion

This sectoral category includes emissions from the combustion of fuels in residential, commercial, and industrial buildings such as for space heating, cooking, and industrial processes. Based on the EIA SEDS data, the types of fuels used from 1990 to 2020 in residential and commercial buildings in New York included coal, distillate fuel oil, kerosene, liquefied petroleum gas (LPG), natural gas, residual fuel oil, and wood. Industrial fuels included coal, distillate fuel oil, kerosene, LPG, natural gas, petroleum coke, residual fuel oil, special

naphthas, and wood. Additional information on the sources of fuels used in New York can be found in the annual NYSERDA “Patterns and Trends” report (e.g., NYSERDA 2021).

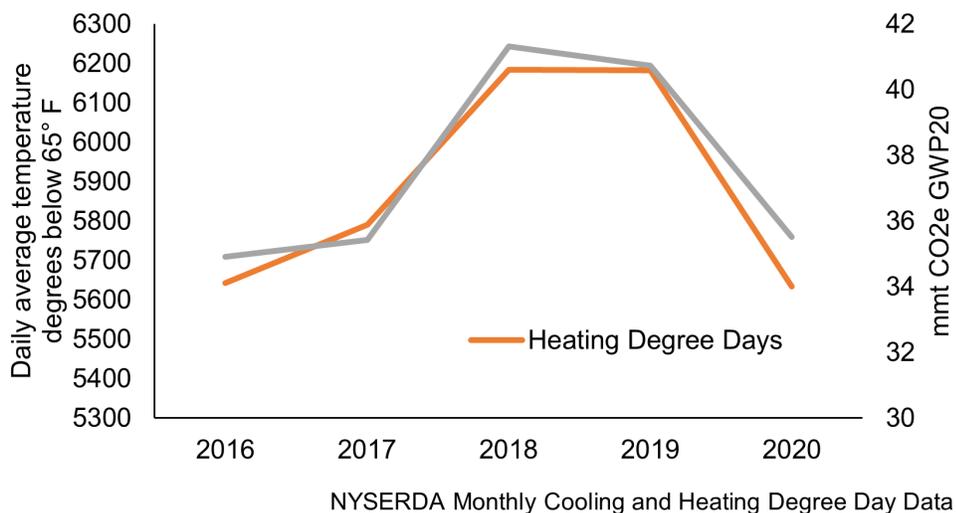
### Methodology

The method used to estimate emissions from fuel combustion in buildings is the same as that used for electricity generation. Annual BTUs of fuel consumed were gathered from the EIA SEDs dataset and emission factors for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O were from the EPA (NYSERDA 2022a). Distillate fuel oil emission factors were applied to kerosene and natural gas emission factors were applied to LPG. One notable aspect of this analysis is that when using the EIA SEDS dataset, states must also consider the volume of fuels that were not combusted but used for other purposes, as described in the Other Uses of Fossil Fuels section below.

### Results

It is important to review long term trends when considering changes in fuel combustion emissions associated with space heating because interannual changes are heavily influenced by seasonal weather patterns in addition to economic trends and technological change. In particular, residential fuel combustion in a given year is affected by the severity of weather in the cold seasons. Figure 1 compares residential fuel combustion emissions to the number of heating degree days in New York State, or the total number of degrees that the daily average temperature fell below 65° F in that year.<sup>2</sup>

**Figure 1. Heating Degree Days and Fuel Combustion**



When comparing 1990 emission levels to emissions in recent years (or 2016-2020), fuel combustion emissions in the Residential Commercial and Industrial (RCI) sources were 17-27% lower overall (Table 6). However, the largest portion of emissions is from residential fuel combustion, which was up to 5% higher in recent years compared to 1990. Commercial fuel

<sup>2</sup> Available at <https://www.nyserdera.ny.gov/about/publications/ea-reports-and-studies/weather-data/monthly-cooling-and-heating-degree-day-data>

combustion levels were 26% below 1990 and industrial fuel combustion levels were 61% below 1990 levels, likely in part to the decline in manufacturing over this time period.

**Table 6. RCI Fuel Combustion Emissions, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Residential	39.18	46.44	34.90	35.42	41.31	40.73	35.50
Commercial	27.24	29.93	21.53	21.86	23.01	22.70	20.05
Industrial	20.74	13.71	9.18	8.77	8.98	9.01	8.01
<b>Gross Total</b>	<b>87.17</b>	<b>90.08</b>	<b>65.61</b>	<b>66.05</b>	<b>73.30</b>	<b>72.44</b>	<b>63.57</b>

As in the case of the electricity sector, there has been a transition in the RCI energy sectors away from fuels with higher combustion emissions (Table 7). While combustion emissions from natural gas increased 28%, emissions of all other fuels decreased 64%.

**Table 7. RCI Fuel Combustion Emissions by Fuel Type, 1990-2019 (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Coal	8.56	3.35	1.03	0.96	0.70	0.85	0.38
Distillate	21.79	24.52	10.78	10.28	12.19	12.20	9.28
Natural Gas	34.73	41.73	43.58	45.21	49.66	48.52	44.50
Wood	8.02	9.25	6.39	6.24	7.03	7.14	6.10
Other	14.07	11.23	3.84	3.37	3.73	3.73	3.30
<b>Gross Total</b>	<b>87.18</b>	<b>90.08</b>	<b>65.61</b>	<b>66.05</b>	<b>73.30</b>	<b>72.44</b>	<b>63.57</b>

## Transportation

Emissions from the transportation sector are distinguished from other sources of fuel combustion emissions in that they are predominantly emitted by mobile sources (sources that can be moved). Road transportation comprises the largest subcategory of emissions and includes passenger cars and trucks, commercial light-duty trucks, motorcycles, buses, and heavy-duty trucks. Non-road transportation sources include aviation, marine, and rail as well as equipment used in agriculture, construction, landscaping, or recreation. The IPCC approach also include emissions associated with the operation of oil and natural gas pipelines and distribution. In this report, the leakage of emissions in this infrastructure is described below in the Fugitive Emissions section.

Transportation fuels used in New York for 1990-2020 included motor gasoline, diesel, compressed natural gas (CNG), and blended biofuels (ethanol and biodiesel). Emissions of gasoline and diesel blended with biofuels are reported together with the fossil fuel, and the biogenic CO<sub>2</sub> accounted for separately. One key aspect of transportation emissions accounting relates to the treatment of fuels used for international transport, or bunker fuels (Table 10). The current report follows the IPCC guidance and focuses on fuels used for domestic transportation and so only considers fuels used for trips that start in New York and whose destination is within the United States.

## *Methodology*

Non-Road Transportation: Non-road emission sources were estimated using fuel volume data from EIA SEDS and emission factors from the EPA, with minor adjustments as described in NYSERDA (2022a). A key exception is the analysis of aviation emissions which is based on a combination of SEDS fuel volumes and information from the Bureau of Transportation Statistics. This approach enables New York to include fuel volumes that the EIA SEDS dataset allocates to neighboring states as well as distinguish between domestic and international flights. As described above, emissions from international flights were excluded from emission totals, but were provided as an informational item. Additionally, it is not possible at this time to determine the portion of marine residual and distillate fuels that are not bunker fuels, i.e., not used for ocean-going trips. So, these fuels were all treated as bunker fuels and excluded from the analysis (a total of 0.78mmt CO<sub>2</sub>e). This may be reassessed in future reports if new data are made available (see Planned Improvements).

Road Transportation: Road transportation emissions include two additional layers of complexity compared to other types of fuel combustion. The first is that the actual tailpipe emissions of methane and nitrous oxide from vehicles depends on the control technology used in those vehicles, which varies widely among vehicle makes and model years. Secondly, motor vehicles move easily across state borders and may contain fuels purchased in other states. The EIA SEDS dataset provides an estimate of fuels sold in New York, but not fuels purchased elsewhere that were combusted in New York. Given these complexities, it is not appropriate to use the EIA SEDS fuel volumes alone to estimate emissions from road transportation.

The U.S. EPA requires states to use the Motor Vehicle Emissions Simulator (MOVES) model for estimating air pollution emissions from “on-road” transportation. This model is also ideal for estimating statewide greenhouse gas emissions as it estimates tailpipe emissions based on total vehicle miles travelled (VMT), rather than fuel sales. DEC’s MOVES modeling inputs are provided to the EPA’s National Emissions Inventory (or “NEI”, EPA 2021b). EPA then publishes emission estimates based on these inputs. These published emissions were used as the emission estimates for 2011 and 2014 while the emissions for 2017, 2019 and 2020 were from DEC modeling of inputs. Emissions for years without modelling in this period estimated with interpolation. Emission estimates for 1990 through 2010 were conducted by the NYSDERA contractor, ERG, and are further described in NYSERDA (2022a) except that MOVES version 3 was used rather than the previous MOVES version 2014B.

## *Results*

Transportation is the largest source of fuel combustion emissions, which on average for the 2016-2019 period has increased substantially since 1990. In 2020, road transportation emissions decreased nearly 7.2mmt CO<sub>2</sub>e since 1990 or 12% (Table 8), and represented 84% of transportation fuel combustion emissions and 17% of statewide total emissions. Non-road source emissions declined 0.15mmt or 38% since 1990. All non-road sources increased since 1990 except for aviation, which declined 2.26mmt. However, this does not include emissions associated with international aviation (Table 10) that were excluded from this analysis.

**Table 8. Transportation Emissions, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
<b>Road</b>	<b>60.17</b>	<b>74.55</b>	<b>66.30</b>	<b>64.51</b>	<b>64.51</b>	<b>64.33</b>	<b>52.99</b>
<b>Non-Road</b>	<b>9.92</b>	<b>11.69</b>	<b>13.01</b>	<b>12.92</b>	<b>12.92</b>	<b>13.71</b>	<b>9.77</b>
Aviation	5.90	6.69	7.15	7.29	7.12	7.33	3.64
Rail	0.12	0.85	0.66	0.37	0.50	0.58	0.47
Marine	0.45	0.61	0.83	0.83	0.74	0.80	0.88
Other Transportation	3.19	2.98	3.05	3.07	3.10	3.37	3.32
Pipeline	0.26	0.57	1.31	1.37	1.45	1.64	1.47
<b>Gross Total</b>	<b>70.09</b>	<b>86.24</b>	<b>79.31</b>	<b>77.44</b>	<b>77.43</b>	<b>78.04</b>	<b>62.76</b>

Given that the largest source of emissions is road transportation, it is not surprising that gasoline is also the fuel type associated with the highest level of emissions, or 55% of transportation fuel combustion emissions in 2020 (Table 9). Diesel emissions have increased 3.9mmt CO<sub>2</sub>e since 1990 and accounted for 20% of transportation emissions in 2020. Gasoline and jet fuel experienced sharp declines in emissions as compared to 2019 as an effect of the response to the COVID19 pandemic.

**Table 9. Transportation Emissions by Fuel Type, 1990-2019 (mmt CO<sub>2</sub>e GWP20)**

<b>Fuel Type</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Aviation Gasoline	0.06	0.10	0.03	0.03	0.03	0.03	0.03
CNG	+	0.20	0.32	0.17	0.18	0.23	0.20
Diesel	9.66	15.18	15.37	15.14	15.45	14.87	13.56
Gasoline	54.15	63.61	55.16	53.48	53.23	53.98	43.90
Jet Fuel	5.84	6.59	7.12	7.26	7.09	7.29	3.61
Natural Gas	0.26	0.57	1.31	1.37	1.45	1.64	1.47
Residual Fuel	0.12	na	na	na	na	na	na
<b>Gross Total</b>	<b>70.09</b>	<b>86.24</b>	<b>79.31</b>	<b>77.44</b>	<b>77.43</b>	<b>78.04</b>	<b>62.76</b>

“+” less than 0.01mmt

“na” not applicable

As described above, IPCC approach omits fuels used for international transport and these emissions were excluded from this analysis as well (Table 10). As New York State receives a significant volume of the United States international travel and shipping, these emissions are significant.

**Table 10. Excluded Transportation Emissions, 1990-2019 (mmt CO<sub>2</sub>e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Bunker (Aircraft)	11.58	8.25	13.48	14.11	13.64	13.63	6.14
Bunker (Marine Vessel)	0.60	2.63	1.97	1.32	1.33	0.72	0.78
<b>Excluded Total</b>	<b>12.18</b>	<b>10.89</b>	<b>15.45</b>	<b>15.43</b>	<b>14.97</b>	<b>14.36</b>	<b>6.92</b>

## Petroleum Refining

The EIA SEDS dataset suggests that one refinery operated in New York in 1990 and ceased operations in 1991. Emissions for this facility were calculated for 1990 and 1991 by scaling national refinery emissions for those years to New York based on the state’s crude oil distillation capacity. Emissions were estimated as 0.01mmt CO<sub>2</sub>e for both 1990 and 1991.

## Other Fossil Fuel Use

While the majority of emissions from fossil fuels are the result of fuel combustion or leakage, there are also emissions associated with other non-energy uses of fossil fuels. This includes emissions that might occur during the manufacturing or use of plastics, asphalt, or lubricants. Some of these uses result in longer term storage of carbon, rather than emissions. Nationwide, the EPA estimates that 38% of the carbon consumed in these uses is emitted as CO<sub>2</sub>.<sup>3</sup> The IPCC approach include these other uses of fossil fuels in the Industrial Process and Product Use sector. This report follows the national greenhouse gas inventory, which includes these emissions in the energy sector (EPA 2022b).

## Methodology

The EIA SEDS dataset provides total fuel volumes, but an additional step is needed to determine how much fuel was likely to be used in New York for different products. The U.S. national inventory was used to determine the percentage of each type of fuel that was either combusted, used for other reasons that resulted in emissions, or not associated with emissions (i.e., stored) for each year in the time series (NYSERDA 2022a). For those fuel volumes that were determined to be used for other reasons that resulted in emissions, it is assumed that 100% of the carbon content was oxidized and released as CO<sub>2</sub>, and no CH<sub>4</sub> or N<sub>2</sub>O emissions were produced.

## Results

Although these non-combustion activities are not a major source of annual emissions, emissions declined 42% from 1990 to 2020, suggesting a reduction in the use of these fuels in New York State (Table 11). Emissions estimates for this category changed substantially from those presented in last year’s report due to methodology changes to the apportionment of fuels by EIA in their SEDS data. Notable changes from the 2021 Statewide GHG Emissions Report include a 60% reduction in special naphtha emissions and a doubling of natural gas emissions for years 2018 and 2019 as a result of the changes in SEDS data.

<sup>3</sup> EPA (2021) 3.2 Carbon Emitted from Non-Energy Uses of Fossil Fuels (CRF Source Category 1A)

**Table 11. Emissions from Other Uses by Fuel Type, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

<b>Fuel Type</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Lubricants	0.87	0.75	0.60	0.55	0.52	0.48	0.43
Special Naphthas	0.08	0.04	0.06	0.06	0.06	0.06	0.05
Miscellaneous Petroleum Products	0.23	0.12	0.13	0.16	0.16	0.15	0.14
Natural Gas	0.09	0.06	0.08	0.10	0.13	0.12	0.12
Coal	0.02	0.76	0.29	0.29	0.22	0.02	0.01
Other Fuels	0.14	0.48	0.08	0.07	0.08	0.08	0.09
<b>Gross Total</b>	<b>1.44</b>	<b>2.21</b>	<b>1.23</b>	<b>1.23</b>	<b>1.17</b>	<b>0.90</b>	<b>0.83</b>

### Fugitive Emissions from Fossil Fuels

This IPCC category represents emissions associated with the intentional venting or unintentional leakage of emissions from oil and natural gas infrastructure in New York. This includes many individual sources from extraction, through the transmission and distribution system, and at the “customer side” or the final delivery location. As described in the *Summary Report*, governmental greenhouse gas inventories are “bottom-up” and attempt to catalogue annual emissions from all sources across a wide geographic area. The analysis of fugitive emissions in this section and in the Imported Fossil Fuels section below also considers “top-down” information, or data collected from sensors that are not associated with any specific emission source. Top-down information can complement bottom-up inventories and provide valuable points of comparison. Notably, the primary source of information for this report is NYSERDA (2021b), which is an updated version of the NYS Oil and Gas Methane Inventory from 2019. The estimate of current CH<sub>4</sub> emissions increased 44% as that analysis was updated to reflect improved methodologies. This report applies a further consideration of potential fugitive emissions and higher emission rates for in-state natural gas wells, as described in NYSERDA (2021a).

### *Methodology*

The underlying data and methodology used in this report are described in the NYS Oil and Gas Methane Inventory (NYSERDA 2021b) as supplemented by methods described in NYSERDA (2021a). These analyses will continue to be updated as new information is made available, which is likely to result in higher estimates of fugitive CH<sub>4</sub> (see Planned Improvements). For these analyses, NYSERDA contracted with researchers at Abt Associates Inc. and Eastern Research Group and received technical support from DEC and other State agencies as well as from outside experts. DEC also hosted a public hearing in March 2021 to describe the analyses and take feedback on data sources and methodology. DEC continues to welcome feedback on this and any part of the current analyses.

### *Results*

Based on the analysis provided by NYSERDA (2021a, b) emissions in the oil and gas industry within New York has declined 19% since 1990 (Table 12). However, emissions from this industry remain high, and were 4.1% of total emissions in 2020 despite providing a very small

portion of fuel used in the state. This analysis was also used to generate upstream and downstream emission factors by fuel type for use by State agencies, as provided in the accompanying *Summary Report*.

**Table 12. Oil and Gas Fugitive Emissions, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

Gas	1990	2005	2016	2017	2018	2019	2020
Carbon dioxide	0.08	0.16	0.14	0.15	0.16	0.23	0.15
Methane	17.41	20.73	15.19	14.70	14.20	14.34	14.10
Nitrous oxide	+	+	+	+	+	+	+
<b>Gross Total</b>	<b>17.49</b>	<b>20.88</b>	<b>15.33</b>	<b>14.85</b>	<b>14.36</b>	<b>14.57</b>	<b>14.25</b>

“+” less than 0.01mmt

### Electricity Transmission

This IPCC category is typically included in the Industrial Process and Product Use sector but represents an emission source associated with energy systems. Emissions of sulfur hexafluoride (SF<sub>6</sub>) are primarily the result of leaks emitted from electric system substations and switchgear. In addition to leaks, SF<sub>6</sub> can also be emitted during installation, servicing, and disposal of substations and switchgear. To address the high rate of SF<sub>6</sub> emissions in the 1990’s, EPA established the Electric Power Systems Partnership, which resulted in a significant decline in annual emission rates nationwide.<sup>4</sup> However, these systems are still the industry standard and new SF<sub>6</sub> equipment continues to be installed. SF<sub>6</sub> is one of the strongest known greenhouse gases and has an extremely stable molecular structure. This stability also means that SF<sub>6</sub> degrades slowly in the atmosphere, affecting the earth’s climate for thousands of years.

### Methodology

Per the U.S. EPA SIT (2022a), national emissions estimates were scaled to New York State using the ratio of New York State to U.S. electricity sales (MWh), with one notable adjustment. Based on feedback from EPA, SF<sub>6</sub> emissions were calculated separately for Consolidated Edison Inc. (ConEd), which historically represented a large share of U.S. emissions. Electricity sales attributable to ConEd were deducted from national and state totals and SF<sub>6</sub> was estimated separately for ConEd. Publicly reported ConEd SF<sub>6</sub> emissions were used, where available. For the earlier years of 1990-1995, the 1996 ratio of ConEd to total national emissions was applied to the annual U.S. emissions estimate.

### Results

Based on this assessment, emissions of SF<sub>6</sub> were greatest in the early years of the time series and declined substantially (Table 13). The emission rate has remained relatively stable with a slight downward trend in recent years, likely due to the servicing of existing equipment and the continuing installation of new SF<sub>6</sub> equipment across the state.

<sup>4</sup> <https://www.epa.gov/eps-partnership/eps-partnership-accomplishments>

**Table 13. Electricity Transmission SF6 Emissions, 1990-2020 (mmt CO2e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Electricity Transmission	4.02	1.61	0.15	0.14	0.13	0.13	0.11
<b>Gross Total</b>	<b>4.02</b>	<b>1.61</b>	<b>0.15</b>	<b>0.14</b>	<b>0.13</b>	<b>0.13</b>	<b>0.11</b>

### Out of State Energy Emissions

The CLCPA requires that this emissions report include two categories of emissions that occur outside of the State’s jurisdictional boundaries and that are not typically included in governmental greenhouse gas accounting. These are emissions associated with imported electricity and with the “extraction and transmission” of imported fossil fuels (Table 14). The IPCC approach do not include these emission categories and DEC is unaware of similar analyses in any governmental greenhouse gas report. However, the emission sources covered here may be included in reporting by the states in which they are located. National emission reports will not attribute these emissions to New York State or to facilities located in New York.

The data and methods used for these two analyses are described at a high level below and in greater detail in NYSERDA (2022a). In general, this analysis seeks to calculate the “upstream”, out-of-state emissions associated with imported electricity and the fossil fuel volumes described in other sections of this report.

This report follows IPCC approach and excludes emissions from bunker fuels, or fuels used for international transport (“Excluded Transportation Emissions”, Table 14). This is explained in more detail in the Fuel Combustion section above. For this section, this means that this report excludes the upstream, out-of-state emissions for the volume of fuel that was used as a bunker fuel in New York.

**Table 14. Out of State Energy Emissions, 1990-2020 (mmt CO2e GWP20)**

<b>Emission Category</b>	<b>1990</b>	<b>2005</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Imported Electricity	0.91	7.87	7.22	6.67	8.26	7.81	6.50
Imported Fossil Fuels	100.69	121.15	102.91	93.09	95.40	94.08	81.91
<b>Gross Total</b>	<b>101.61</b>	<b>133.97</b>	<b>114.35</b>	<b>103.31</b>	<b>107.93</b>	<b>101.90</b>	<b>91.79</b>
Excluded Transportation Emissions	<b>3.17</b>	<b>2.99</b>	<b>4.28</b>	<b>4.24</b>	<b>3.96</b>	<b>3.64</b>	<b>1.77</b>

### Imported Electricity

This emission category relates to the importing of electricity into New York that was generated at facilities outside of New York. The amount of power imported into New York in any given year is determined by a variety of factors that are beyond the scope of this report.

### Methodology

The data and methodology used in this report are described in the accompanying report from NYSERDA (2021a). For this analysis, NYSERDA contracted with researchers at Eastern

Research Group Inc. (ERG) and received technical support from DEC and other State agencies as well as from outside experts. DEC continues to welcome feedback on this and any part of the current analysis. This analysis included both net electricity imports from the surrounding regional electricity grids as well as imports from specific electricity generation units in New Jersey that are directly connected to New York's electricity grid.

### *Results*

Emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from imported electricity were very low in 1990 but have been greater than 6.5mmt per year since 2002. In other words, although emissions were higher in 2020 compared to 1990, this is not a new trend. Instead, emissions from imported electricity have stayed between 6.5 and 10.52mmt CO<sub>2</sub>e for almost twenty years, and below 8.3mmt CO<sub>2</sub>e for the last five years.

### *Imported Fossil Fuels*

This category of emissions encompasses a wide variety of individual emission sources including those associated with the extraction of fuels, transport to refineries, the processing and blending of finished fuels, and then the transport of those fuels to the New York State border. This category does not include emission sources within New York State, as these are described in the other sections of this report. For comparison, the Fuel Combustion section above assessed the emissions resulting from the combustion of a certain volume of fuel. This Imported Fuels analysis estimated the emissions that occurred during extraction, production, and transmission or distribution of those fuels to New York. Just as the Fuel Combustion analysis applied a combustion emission factor to fuel volumes, this analysis calculated and then applied emission factors related to the upstream fuel cycle.

### *Methodology*

The data and methodology used in this section of the report are described in the accompanying technical documentation from NYSERDA (2022a). For that analysis, NYSERDA contracted with ERG and received technical support from DEC and other State agencies as well as from outside experts. DEC also hosted a public hearing in March 2021 to describe the analysis and take feedback on data sources and methodology. DEC continues to welcome feedback on this and any part of the current analysis.

The methodology used in this section of the report is unique because it encompasses a large, complex set of infrastructures that are not located in New York and are not currently subject to New York State laws or reporting requirements. There is also no comprehensive federal data source that can provide all of the necessary information. The closest source of information are lifecycle models, which attempt to estimate emissions associated with a product across all stages, from the extraction of raw materials through the final end-use of the product. However, lifecycle models are not updated annually and they may utilize information collected across multiple years. There is also no lifecycle analysis tool that will provide information specific to New York State. Instead, the research team used a combination of lifecycle models, historical emission and fuel data, and spatial information to reconstruct the full time series. NYSERDA (2022a) also describes approaches to assess sensitivities and address specific sources of

uncertainty. For this report, DEC uses emission outputs from the “high sensitivity” approach, which represented the most precautionary approach and applies the highest emission factors.

## Results

Emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from imported fossil fuels declined 15% since 1990 (Table 15). The statewide demand for fossil fuel will determine the level of emissions in this category. The COVID19 global pandemic drove a significant reduction in energy and fuel demand in 2020, which also affects imported fossil fuels emissions. The previous sections of this report described a trend away from fuels with higher combustion emissions such as coal towards those with lower combustion emissions such as natural gas. That trend in fuel use is also apparent in the emissions associated with imported fossil fuels, as upstream, out-of-state emissions associated with coal were reduced 88% while natural gas increased 30%. NYSERDA (2022a) provides additional background and supplemental information, including comparisons of aggregate emission rates associated with different fuel basins that provided fuel to New York. This analysis was also used to generate upstream emission factors by fuel type for use by State agencies, as provided in the accompanying *Summary Report*.

**Table 15. Imported Fossil Fuel Emissions by Fuel Type, 1990-2020 (mmt CO<sub>2</sub>e GWP20)**

Fuel Type	1990	2005	2016	2017	2018	2019	2020
CNG	+	0.17	0.22	0.05	0.05	0.05	0.04
Coal	9.24	5.97	2.17	1.68	1.76	1.41	1.08
Diesel/Distillate	11.07	14.32	9.13	8.82	9.36	8.76	7.39
Gasoline	22.74	27.77	22.69	21.89	21.18	20.89	16.98
Jet Fuel	1.51	1.77	1.95	1.98	1.86	1.84	0.91
Natural Gas	43.66	66.25	68.44	59.85	62.95	58.88	56.77
Other Fuels	12.48	9.86	2.53	2.37	2.51	2.27	2.13
<b>Gross Total</b>	<b>100.69</b>	<b>126.11</b>	<b>107.13</b>	<b>96.64</b>	<b>99.67</b>	<b>94.08</b>	<b>85.29</b>

“+” less than 0.01mmt

As discussed in the sections above, the IPCC approach omit fuels used for international transport, so the associated upstream, out of state emissions from those fuels has also been excluded from this analysis (Table 16).

**Table 16. Excluded Emissions by Fuel Type, 1990-2020 (mmt CO<sub>2</sub>e GWP20)  
Informational Purposes Only**

Emission Category	1990	2005	2016	2017	2018	2019	2020
Diesel/Distillate	0.03	0.03	0.10	0.09	0.09	0.09	0.08
Jet Fuel	3.00	2.22	3.70	3.85	3.58	3.44	1.55
Residual Fuel	0.14	0.74	0.49	0.30	0.29	0.11	0.14
<b>Gross Total</b>	<b>3.17</b>	<b>2.99</b>	<b>4.28</b>	<b>4.24</b>	<b>3.96</b>	<b>3.64</b>	<b>1.77</b>

“+” less than 0.01mmt

## Planned Improvements

### Fuel Combustion

The apportionment of SEDS fuel data to excluded bunker fuels is an area for future improvement. Fuel combustion emissions were estimated using SEDS data, but these data do not provide the share of fuels for international (bunker) trip use. Two areas of specific interest for improvement are marine diesel/distillate and airline jet fuel. Due to lack of information, marine diesel/distillate use is currently assigned entirely to bunker fuels. Information will be sought to determine the share of this fuel use being used domestically and include these emissions in the State gross total. Additional approaches to the apportionment of aviation jet fuel use will be evaluated. One of these approaches is the use Bureau of Transportation Statistics T-100 segment data to estimate emissions and fuel use.

### Fugitive Emissions from Fossil Fuels

DEC and partners will continue to research and evaluate methods for reconciling bottom-up and top-down estimates of fugitive emissions. Some of the areas of potential future analysis are summarized in NYSERDA (2022b), including further evaluations of top-down measurements taken in New York State, as they become available, and expanding the scope of potential emission sources in commercial and industrial buildings. Further refinements to the analyses conducted in NYSERDA (2022) may also result in improvements to the estimate of in-state fugitive emissions (Out of State Emissions, below).

### Electricity Transmission

Current methodology relies on apportioning national electricity transmission SF<sub>6</sub> emissions to New York State. DEC may seek additional data on SF<sub>6</sub> use in electricity transmission equipment in New York State. Improved data will help refine emissions estimates for this category, as well as be more reactive to actions or policies designed to mitigate emissions.

### Out of State Emissions

DEC will continue to refine the methodologies used to estimate upstream energy emissions, particularly from imported fossil fuels. This report represents the best available data and methods that could be used to produce an annualized inventory of sources relevant to New York State for the 1990-2020 time period. However, the measurement of emissions from the fuel system is an active area of research and any new and relevant information will be incorporated whenever possible. DEC welcomes feedback on alternative data and methods that may improve the accuracy of this assessment and the ability to identify and characterize emission sources outside of New York.

## Abbreviations

btu	British thermal unit
CH <sub>4</sub>	Methane
CHP	Combined heat and power
CLCPA	NYS Climate Leadership and Community Protection Act
CNG	Compressed natural gas
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> e	Carbon dioxide equivalent
DEC	NYS Department of Environmental Conservation
EIA	Energy Information Administration, U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
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
LPG	Liquefied petroleum gas(es)
mmt	Million metric tons
MOVES	Motor Vehicle Emission Simulator model
N <sub>2</sub> O	Nitrous oxide
NA	Not applicable
NEI	National Emissions Inventory
NYCRR	New York Codes, Rules and Regulations
NYISO	New York Independent System Operator
NYS	New York State
NYSERDA	NYS Energy Research and Development Authority
RCI	Residential, Commercial, Industrial
SEDS	EIA State Energy Data System
SF <sub>6</sub>	Sulfur hexafluoride
SIT	EPA State Inventory Tool

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