Regulatory Impact Statement

6 NYCRR Part 496, Statewide Greenhouse Gas Emission Limits

On July 18, 2019 Governor Cuomo signed into law the Climate Leadership and Community Protection Act, Chapter 106 of the Laws of 2019 (CLCPA). The CLCPA is intended to "create a comprehensive regulatory program to reduce greenhouse gas emissions that corresponds with emission reduction goals as set forth in Executive Order 24, the State Energy Plan, and the [United States Global Change Research Program] and [Intergovernmental Panel on Climate Change] projections." CLCPA §1. Among other requirements, the CLCPA adds a new Article 75 to the Environmental Conservation Law (ECL), including ECL Section 75-0107. This section directs the Department of Environmental Conservation (the Department) to adopt regulations establishing statewide emission limits. Therefore, the Department is proposing 6 NYCRR Part 496, Statewide Greenhouse Gas Emission Limits (the "proposed rule" or "Part 496"). As called for in ECL Section 75-0107, the proposed rule will establish the two statewide greenhouse gas emission limits called for in the CLCPA: a limit for 2030 that is equal to 60% of 1990 greenhouse gas emission levels and a limit for 2050 that is equal to 15% of 1990 emission levels.[1] Part 496 will translate the statewide percentage emission reduction requirements, as set forth in the CLCPA, into tonnage limits based on carbon dioxide equivalents.

The statewide emission limits established by the proposed rule will be the foundation for multiple components of the CLCPA and are critically important for the successful implementation of the CLCPA. For example, the Scoping Plan to be developed by the Climate Action Council must outline recommendations regarding regulatory measures and other State actions to ensure attainment of the statewide greenhouse gas emission limits. Similarly, the statewide greenhouse gas emission limits established in Part 496 will serve as the

[1] The CLCPA also establishes a net zero emission reduction goal, which while not part of the proposed rule will be addressed by the Climate Action Council as part of its Scoping Plan. ECL Section 75-0103(11).

baseline for the promulgation of future regulations by the Department under the CLCPA, which the CLCPA requires to ensure compliance with the statewide emission reduction limits. ECL § 75-0109.

1. Statutory Authority

The statutory authority to promulgate this rulemaking is derived from ECL Section 75-0107, as added by the CLCPA. This section of the ECL directs the Department to promulgate a regulation that establishes statewide greenhouse gas emission limits as specified percentages of estimated 1990 emissions, expressed in tons of carbon dioxide equivalents. The adoption of Part 496 will fulfill this statutory directive.

Under the CLCPA, statewide greenhouse gas emissions include both greenhouse gas emissions from all sources located within the state and certain sources that are located outside of the state that are associated with in-state energy consumption. In particular, the statute requires that statewide greenhouse emissions include both: (1) "the total annual emissions of greenhouse gases produced within the state from anthropogenic sources," and (2) "greenhouse gases produced outside of the state that are associated with [a] the generation of electricity imported into the state and [b] the extraction and transmission of fossil fuels imported into the state." ECL § 75-0101(13). Moreover, the CLCPA defines "carbon dioxide equivalent" as a measurement of global warming potential based on a twenty-year timeframe. ECL § 75-0101(2).

2. Legislative Objectives

The CLCPA, as provided in ECL Section 75-0107, directs the Department to establish a statewide greenhouse gas emissions limit for the years 2030 and 2050 equal to sixty (60) percent and fifteen (15) percent of gross 1990 emissions, respectively. The proposed rule seeks to implement this requirement by establishing an estimate of total statewide greenhouse gas emissions in 1990, or a baseline, and then establishing emission limits

as a percent of that baseline. Both the 1990 baseline and the emission limits for 2030 and 2050 are expressed in millions of metric tons of carbon dioxide equivalent.

In determining the scope of the emission sources and gases to be included in the estimation of 1990 emissions, the Department followed the requirements in Section 75-0107 and other related provisions of the CLCPA. This includes other referenced sections of the ECL, specifically Sections 75-0101 (Definitions) and 75-0105 (statewide greenhouse gas emissions report), and other guiding language in the CLCPA. As an example, Section 1 of the CLCPA (Legislative findings and declaration) references the Intergovernmental Panel on Climate Change (IPCC), which is a scientific body convened to support the United Nations Framework Convention on Climate Change (UNFCCC). The Department used the IPCC protocol[2] for greenhouse gas accounting as foundational guidance, provided such protocols did not conflict with the requirements provided in the CLCPA. To the extent the CLCPA establishes requirements that differ from the IPCC protocol, the Department followed the CLCPA provisions, as discussed further below. Overall, the Department's objective in developing the proposed rule was to estimate 1990 emission levels using the best and most reliable information available.

Continued Improvements

The CLCPA directs the Department to provide "the most accurate determination possible" by "utiliz[ing] the best available scientific, technological, and economic information on greenhouse gas emissions and consult[ing] with the council, stakeholders, and the public." ECL § 75-0107(3). The UNFCCC and IPCC establish a similar requirement for national governments. To enable the use of the best-available science, the IPCC protocol provides guidance as to how to make improvements over time and to prioritize "key categories" of emissions. As in the case of the U.S. national greenhouse gas inventory[3], which is conducted in accordance with the IPCC protocol, the Department strives for the highest possible accuracy and intends to reduce uncertainty and improve

[2] e.g., IPCC 2019. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
[3] USEPA. 2020a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018.

accuracy through continued improvements. This will include through the statewide greenhouse emissions report that the Department will be required to issue annually. ECL § 75-0105. Additionally, although the statewide greenhouse gas emission limits proposed in this rule are based on an estimate of 1990 emission levels, under the CLCPA the statewide emission limits for 2030 and 2050 are not limited to the scope of sources and emissions that existed in 1990 that are the focus of this document. The statewide greenhouse gas limits encompass all emission sources described in the CLCPA. For purposes of the forthcoming annual statewide greenhouse gas emission reports and future regulations required by the CLCPA, the Department will continue to incorporate appropriate new information regarding all relevant sources, which may include additional or different methods for the accounting of net greenhouse gas emissions, sequestration, and removals.

Key Requirements of the 1990 Emission Baseline

The proposed rule applies certain key requirements specified in the CLCPA in the estimation of the statewide 1990 emission baseline. The first requirement is that the greenhouse gases subject to the statewide emission limit include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFC), hydrofluorocarbons (HFC), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). As the CLCPA references the IPCC, the IPCC protocol for national greenhouse gas inventories is used as a foundation for determining which sources of these gases are included in the 1990 baseline. That protocol applies a sectoral inventory, or a categorization of emission sources based on the broad economic sectors of energy, industry, waste, agriculture, and other land use.

The second key requirement of the CLCPA relevant to this proposed rule is that it directs the Department to set greenhouse gases on a common scale using the carbon dioxide equivalence metric (CO_2e) and the 20-year Global Warming Potential (GWP20) of each gas, which the Department derived from the IPCC Fifth Assessment

Report (AR5).[4] The IPCC protocol requires national governments apply a 100-year Global Warming Potential metric (GWP100) from the IPCC Fourth Assessment Report (AR4),[5] and thus other government inventories more frequently utilize the GWP100 metric rather than GWP20 metric set forth in the CLCPA. While Part 496 uses the GWP20 metric derived from AR5, the Department provides an estimate of the 1990 baseline using both metrics below. This is for the purposes of comparing 1990 emission estimates with those of the previous State inventory, the inventory reports of other governments, and other references that use the more standard GWP100 metrics.

The final two key requirements of the CLCPA set New York State apart from other governments in a way that makes it challenging to directly compare the statewide emission limits with the goals from other jurisdictions. For the third requirement, the CLCPA establishes that the statewide emission limit, and therein the emission reduction requirements of the CLCPA, include certain emission sources that are located outside of the State borders. As mentioned above, ECL § 75-0101(13) defines statewide greenhouse gas emissions as including emissions associated with imported electricity and fossil fuels. The IPCC protocol for national governments do not include similar requirements to incorporate emissions produced outside of the relevant jurisdiction associated with energy imported into the jurisdiction. If comparing the 1990 baseline to other jurisdictions' emission reports, the imported fuels and electricity sectors should be excluded. However, the statutory emission reduction requirements of the CLCPA include these sectors.

The fourth and final key component of the CLCPA for purposes of this rulemaking is that the 100 percent net emission reduction goal,[6] or a goal of attaining net zero emissions, is not part of the Legislature's direction to the Department for promulgating the statewide emission limits. The directives to reduce statewide greenhouse gas emissions (1) 40 percent from 1990 levels by 2030, and (2) 85 percent from 1990 levels by 2050 (40x30 and

[4] IPCC. 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., et al. eds] Cambridge University Press. 1585pp.
[5] IPCC. 2007. Climate Change 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S.et al. eds] Cambridge University Press. 996 pp.
[6] CLCPA §1.4 states that "it shall therefore be the goal of the State of New York to reduce greenhouse gas emissions from all anthropogenic sources 100% over 1990 levels by the year 2050." See also ECL § 75-0103(11).

85x50) are set forth in ECL § 75-0107, which further directs the Department to establish these statewide greenhouse gas limits as a percentage of estimated 1990 emissions. The CLCPA includes specified definitions for multiple terms relevant to this requirement, including "greenhouse gas emission limit," "greenhouse gas emission source," "statewide greenhouse gas emissions," and "statewide greenhouse gas emission limit." [7]

Separate from the proposed rule, a third overall Statewide greenhouse gas emission reduction goal in the CLCPA is the requirement that the State also seek to achieve net zero emissions in all sectors of the economy by 2050. In addition to expressing the 100% emission reduction goal in Section 1.4, a separate provision in the ECL distinct from that which directs the Department to establish the 40x30 and 85x50 emission limit through this proposed rule – directs the Climate Action Council to prepare a Scoping Plan for meeting both "the statewide greenhouse gas emission limits . . . and for the reduction of emissions beyond eighty-five percent, net zero emissions in all sectors of the economy." ECL § 75-0103(11). In other words, the Scoping Plan to be developed by the Climate Action Council will need to achieve net zero emissions, in addition to reducing emissions 85% by 2050 from the 1990 estimated baseline provided in the proposed rule.

Additional statutory provisions in the CLCPA provide further support for this distinction between (1) the 40x30 and 85x50 requirements, as established in this proposed rule; and (2) the net zero emission goal to be addressed separately in the Scoping Plan. For example, the CLCPA provides that "the department may establish an alternative compliance mechanism to be used by sources subject to greenhouse gas emissions limits to achieve net zero emissions." ECL § 75-0109(4)(a). Furthermore, "the use of such mechanism shall account for not greater than fifteen percent of statewide greenhouse gas emissions estimated as a percentage of" 1990 emissions. ECL § 75-0109(4)(b). Any greenhouse emission offsets approved by the Department pursuant to the alternative compliance mechanism provision must meet certain requirements, and are defined as "a deduction representing one metric ton of carbon dioxide equivalent emissions, reduced, avoided, or sequestered by a greenhouse gas

[7] ECL §§ 75-0101(8), (11), (13), and (14).

emission offset project from a measured baseline of emissions." ECL § 75-0101(9).[8] Taken together, these provisions of the CLCPA provide that the 40x30 and 85x50 emission limits are to be measured based on an estimated baseline of gross 1990 statewide emissions, while the remaining 15 percent of emissions to achieve net zero may be accounted for on a net basis.

Given these statutory directives and definitions, the proposed rule includes statewide emission limits based on percentage reductions from estimated 1990 gross emissions, but does not directly address either the separate net zero emission requirement or other net accounting methods that may be updated through future annual reporting or otherwise. Hence, the proposed rule includes anthropogenic emissions, but not removals of these emissions, such as through carbon sequestration and storage in plants. In contrast, the IPCC protocol for national reporting is designed to include all anthropogenic emissions and removals. This has two implications for the 1990 baseline. First, this means that sources that represent net removals for New York State, such as land cover, are not considered in the proposed statewide emission limits, although they may be relevant to annual emissions reporting required by the CLCPA. ECL §75-0105. Specifically, due to the substantial amount of forest cover in the State, the land use sector in New York is a net sink of greenhouse gas emissions (See AFOLU, below).

The second implication of focusing on emissions to the exclusion of removals is that some sources of carbon dioxide are treated differently in the IPCC protocol to avoid double-counting across sources and sinks for carbon dioxide. This is the case for CO_2 associated with any organic materials, such as biomass and organic waste. These emissions are anthropogenic, but the IPCC protocol does not require that they be included in national totals because a global net emission inventory would count both the release of carbon dioxide at the location where the material was combusted (the emission source) and removal of carbon dioxide at the location where the plant was grown. To address this, the IPCC protocol does not require that CO_2 emissions be addressed by the country where the plant material was used (e.g., combusted for energy), but instead by the country where the plant material was

[8] "Greenhouse gas emission offset projects" are further defined as including natural carbon sinks, carbon capture and sequestration, and other types of projects. ECL § 75-0101(10).

harvested. In this way, if the demand for these materials was unsustainable, the result would be a loss of removals and an increase in net emissions. According to the IPCC:

"Carbon dioxide (CO_2) emissions from the combustion of biomass or biomass-based products are captured within the CO_2 emissions in the [Agriculture Forestry and Other Land Use] AFOLU sector through the estimated changes in carbon stocks from biomass harvest, even in cases where the emissions physically take place in other sectors (e.g., energy). This approach to estimate and report all CO_2 emissions from biomass or biomass-based products in the AFOLU sector was introduced in the first IPCC guidelines for national greenhouse gas emissions (IPCC 1995), reflecting close linkages with data on biomass harvesting, and for the pragmatic reason to avoid double counting. In the Energy sector, CO_2, methane (CH_4) and nitrous oxide (N_2O) emissions from combustion of biomass or biomass-based products for energy are estimated, but the CO_2 emissions are recorded as an information item that is not included in the sectoral total emissions for the Energy sector, as they are already included in AFOLU."[9]

As with biomass combustion for energy production, the IPCC considers it best practice for CO_2 emissions from the combustion of organic waste to be reported in the Energy sector, but not included in national totals. The other sources of CO_2 associated with waste management are neither reported nor included in national totals, including composting. "The CO_2 emissions from combustion of biomass materials (e.g., paper, food, and wood waste) contained in the waste are biogenic[10] emissions and should not be included in national total emission estimates. However, if incineration of waste is used for energy purposes, both fossil and biogenic CO_2 emissions should be estimated."[11] The United States reports CO_2 emissions from biomass combustion as a memo item to the UNFCCC, but does not report CO_2 emissions associated with organic waste in the Energy or Waste sectors.[12]

[9] IPCC. 2019. "2.3.3.4 Treatment of Biomass" in IPCC 2019 op. cit.
[10] The term "biogenic" refers to emissions from materials with a biological origin (versus of fossil or geologic origin), including crops and waste derived from crops. However, it is also commonly used as a counterpoint to "anthropogenic", which would not be consistent with the IPCC. In the IPCC framework almost all biogenic emissions are also anthropogenic. To avoid confusion, the term "biogenic" is not used in this rulemaking except in reference to the IPCC protocol.
[11] IPCC. 2019. "5.1 Introduction" in IPCC 2019 op. cit.
[12] UNFCCC. 2020. National Inventory Submissions. https://unfccc.int/ghg-inventories-annex-i-parties/2020

To meet the requirement of the CLCPA with respect to ECL § 75-0107, which is to establish regulatory limits based on a percentage of gross 1990 emissions as opposed to net emissions, the Department is proposing the approach described in the following paragraphs. As described above, in the proposed rule, "anthropogenic" is defined following the IPCC protocol as emissions resulting from human activity and "statewide greenhouse gas emission limit*"* is defined narrowly as a percentage of gross anthropogenic emissions from 1990. As such, the anthropogenic CO_2 emissions resulting from the combustion of biomass and biofuels are included in the 1990 baseline that defines the proposed rule. However, as the CLCPA also separately requires that the State achieve net zero emissions, the accounting of such emissions may be revaluated as part of net statewide greenhouse gas emissions in the annual report (ECL §75-0105) to avoid double-counting. The Department is specifically interested in evaluating the role of products grown within the State in support of maintaining net carbon sequestration, which is key to achieving the CLCPA net zero emissions goal, versus imported products that will not contribute to that goal. Notably, the annual rate at which the land use sector "removes" emissions has been declining in the United States since 1990, while CO_2 emissions from biomass combustion have increased, suggesting that land use has not been sustainable nationwide. However, the sustainable use of New York's agricultural and forested lands is necessary both to achieve the goals of the CLCPA and to support landowners, communities, and the environment. The Department anticipates working with stakeholders in a separate process from this proposed rulemaking to establish a net accounting framework that benefits long-term, sustainable land management in the state and informs future regulatory and policy action by the Department and the State.

For waste emissions, the Department proposes a separate approach to the issue of accounting for gross and net emissions and a separate approach for anthropogenic versus non-anthropogenic emissions. First, the Department's waste management strategy includes all emission sources associated with waste, including for energy production. As such, all organic waste emissions will be included in the Waste sector of the proposed rule and subsequent reporting under the CLCPA, rather than split between Energy and Waste. Organic waste is usually managed by either incineration, which would release the CO_2 more quickly than natural decomposition, or

through storage in a landfill, which places the waste in an anaerobic environment that will generate additional anthropogenic methane. The Department proposes treating emissions from waste combustion and methane combustion the same as for bioenergy. That is, in Part 496 both forms of combustion emissions are included in the 1990 baseline as gross emissions. But, because of the distinction described above between considering gross emissions in the proposed rule and net emissions to achieve the separate net zero emissions goal, accounting for such emissions on a net basis may be reconsidered in annual reporting or subsequent Department rulemaking to avoid double counting both in terms of land use and net emissions in the waste management system. In accordance with IPCC protocol, the Department proposes omitting CO_2 released from composting, anaerobic digestion, and methane oxidation at a landfill from the proposed rule baseline, as these are equivalent to natural processes of decomposition. In order to ensure that the emissions of CO_2 in the Waste sector are balanced against total waste emissions, they will be monitored and accounted for as appropriate as an information item in the annual report. Importantly, all other greenhouse gases and other pollutants associated with waste management will continue to be subject to controls as needed to protect public health and the environment.

3. Needs and Benefits

The CLCPA includes multiple actions that reference the statewide greenhouse gas emission limits established by this rule and therefore will rely on the data and content herein. This includes, but is not limited to, the development of a scoping plan by the Climate Action Council, the issuance of an annual statewide greenhouse gas emissions report, the promulgation of regulations, and the publishing of an implementation report by the Department. ECL §§ 75-0103, 75-0105, 75-0109, and 75-0119. The CLCPA also requires that all State agencies, offices, authorities, and divisions consider the attainment of the statewide greenhouse gas emission limits established in ECL Article 75 in considering and issuing permits, licenses, and other administrative approvals and decisions. CLCPA § 7(2).

Description of Sectoral Methods and Results

The New York State Energy Research and Development Authority (NYSERDA) has provided a regularly-updated inventory of greenhouse gas emissions in the state that follows standard IPCC protocol.[13] As discussed, the CLCPA established certain key requirements that differ from the IPCC protocol. Hence, the Department worked with NYSERDA in 2020 to evaluate the 1990 baseline and conduct new analyses as needed for this rulemaking. Some of these analyses were also assisted by a NYSERDA consultant (Eastern Research Group, Inc) and subcontractor (Synapse Energy Economics, Inc) and initial draft analyses were reviewed by subject matter experts from the US Environmental Protection Agency, the US Department of Energy, the Environmental Defense Fund, and university partners. Additional stakeholder input is described later in this document. New analyses were not required in all cases, as the new requirements of the CLCPA do not completely differ from the methodology historically used by NYSERDA. As such, many components of the estimates provided here are the same or similar to the previous State inventory.

Analytic methods, data sources, and results are described below for each of four major IPCC sectors[14]: Energy, Industrial Processes and Product Use (IPPU), Agriculture Forestry and Other Land Use (AFOLU), and Waste. As is typical for an IPCC-based inventory of greenhouse gas emissions, each emission source is estimated using the best-available method and data for that source. As such, each section below represents a separate set of analyses and results that together form the 1990 baseline (summarized in Table 1), which is used to establish the statewide greenhouse gas emission limits. Unless otherwise stated, all emission values provided are shown as millions of metric tons (MMT) of carbon dioxide equivalent (CO_2e), using either the 20-year Global Warming Potential from the IPCC Fifth Assessment Report (GWP20) or the 100-year Global Warming Potential from the IPCC Fourth Assessment Report (GWP100), as described above in the Legislative Objectives. Table 2 is provided

[13] NYSERDA. 2019a. New York State Greenhouse Gas Inventory: 1990-2016.
[14] IPCC. 2019. op. cit.

below for informational purposes, but because it utilizes the IPCC approach of employing the GWP100 metric based on AR4, the values in Table 2 are not included in Part 496.

Table 1. Total Statewide Greenhouse Gas Emissions in 1990 by IPCC Sector and Gas, in GWP20. Totals may not sum due to independent rounding.

Sector	MMTCO2e (AR5 - 20 year GWP)								
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6	NF_3		Total
Energy	259.96	71.76	1.32	-	-	4.00	-		337.04
IPPU	1.76	0.00	0.00	0.90	0.05	0.01	0.00		2.72
AFOLU	0.05	13.07	4.01	-	-	-	-		17.13
Waste	3.03	49.35	0.50	-	-	-	-		52.88
Total	264.80	134.19	5.83	0.90	0.05	4.01	0.00		409.78

Table 2. Total Statewide Greenhouse Gas Emissions in 1990 by IPCC Sector and Gas, in GWP100. Totals may not sum due to independent rounding.

Sector	MMTCO2e (AR4 - 100 year GWP)								
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6	NF3		Total
Energy	259.96	21.36	1.49	-	-	5.22	-		288.02
IPPU	1.76	0.00	0.00	1.36	0.02	0.01	0.00		3.15
AFOLU	0.05	3.89	4.53	-	-	-	-		8.47
Waste	3.03	14.69	0.57	-	-	-	-		18.28
Total	264.80	39.94	6.59	1.36	0.02	5.22	0.00		317.92

1. Energy

The Energy sector includes five (5) main categories: (a) Fuel Combustion, (b) Fugitive Emissions, (c) Electricity Transmission, (d) Imported Fuels, and (e) Imported Electricity. The latter two categories are not included in IPCC protocol or other governmental greenhouse gas inventories, but as described above are two key distinct requirements of the CLCPA for this rulemaking. These two categories represent an estimate of what may be referred to as the lifecycle, fuel cycle, or out-of-state upstream emissions associated with in-state energy demand and consumption. The third category, Electricity Transmission, is categorized by the IPCC under the

Industrial Processes and Product Use category. The vast majority of SF_6 in New York State is found in electricity applications. As these emissions are directly linked to energy demand and infrastructure, the Department proposes that they be addressed alongside other energy emissions in the CLCPA. Table 3 below provides a summary of the estimated 1990 emissions in each of these five categories of the energy sector, using the GWP20 metric.

Table 3. Energy Sector Greenhouse Gas Emissions in 1990, by Category and Gas, in GWP 20 (MMT CO_2e). Totals may not sum due to independent rounding.

Energy Sector	MMTCO_2e (AR5 - 20 year GWP)								
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6	NF_3		Total
Fuel Combustion	218.86	2.99	1.19	-	-	-	-		223.04
Fugitive Emissions	0.02	9.22	0.00	-	-	-	-		9.24
Electricity Transmission	-	-	-	-	-	4.00	-		4.00
Imported Electricity	0.91	0.00	0.00	-	-	-	-		0.91
Imported Fuels	40.17	59.56	0.12	-	-	-	-		99.85
Total	259.96	71.76	1.32	-	-	4.00	-		337.04

Fuel Combustion

The Fuel Combustion category encompasses emissions of carbon dioxide, methane, and nitrous oxide that are released when fossil fuels or biomass fuels are combusted at sources within the State to produce energy. Within this category there are six broad subcategories from the IPCC that are relevant to New York State in 1990: fuel combustion in the residential, commercial, and industrial sectors, electricity generation, petroleum refining, and transportation. For the purposes of this assessment, fuel combustion associated with petroleum refining is included within industrial emissions. One petroleum refining facility operated in New York State in 1990 and 1991. Note that other industrial emissions that are not associated with fossil fuel use are covered in the Industrial Process and Product Use (IPPU) sector.

Table 4. Fuel Combustion Greenhouse Gas Emissions in 1990, by Category and Gas, in GWP 20 (MMT CO_2e) . Totals may not sum due to independent rounding.

Fuel Combustion	MMTCO_2e (AR5 - 20 year GWP)								
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6	NF_3		Total
Electricity	63.26	0.06	0.31	-	-	-	-		63.63
Industrial	20.54	0.13	0.06	-	-	-	-		20.74
Transportation	70.55	1.03	0.69	-	-	-	-		72.26
Commercial	26.81	0.38	0.05	-	-	-	-		27.24
Residential	37.70	1.38	0.09	-	-	-	-		39.16
Total	218.86	2.99	1.19	-	-	-	-		223.04

In general, fuel combustion emissions are estimated by multiplying activity data (volume of fuel) by an emission factor (volume of gas released when that fuel is combusted), with exceptions noted below. Fuel combustion emissions in the residential, commercial, and industrial sectors as well as for electricity generation were estimated for the 1990 baseline using standard U.S. Environmental Protection Agency (USEPA) emission factors for each fuel type, and fuel volumes from the U.S. Department of Energy's Energy Information Administration (EIA),[15] the data sources also used in the NYSERDA "Patterns and Trends" report.[16] The fuels included are coal, distillate fuel oil, residual fuel oil, natural gas, kerosene, asphalt and road oil, lubricants, special naphthas, liquefied petroleum gas (LPG), petroleum coke, waxes, and wood.

Fuel combustion can also be estimated for sources in the transportation sector by applying standard USEPA emission factors and EIA activity data on the volume of fuels sold in the state for use in these sources. In 1990, transportation fuels were gasoline, diesel, compressed natural gas (CNG), residual fuel oil, and jet fuel. This approach was applied to all non-road sources of fuel combustion including aviation, marine, rail, and off-road vehicles such as those used in commercial or industrial applications, lawn care, or personal use. Note, not all EIA data related to distillate fuel sales are published in the state data portal but are published by the EIA as

[15] Unless otherwise noted EIA data were collected from the EIA State Energy Data System. http://www.eia.gov/state/seds
[16] NYSERDA's Patterns and Trends report can be accessed on the NYSERDA website. http://www.nyserda.ny.gov

distillate fuel oil and kerosene sales.[17] One adjustment was also made to EIA's published data related to aviation. Based on a review of aviation fuel volumes, NYSERDA has concluded that some amount of New York fuels have been erroneously assigned to New Jersey. As such, NYSERDA has suggested these volumes be re-apportioned based on the revenue passenger miles reported for each state from the earliest year for which data are available, or 2003.[18] Specifically, NYSERDA estimates that New York represented 67% of total aviation miles between the two states in 2003. However, if the EIA data were used, 10% of jet fuel sales in the two states would be attributed to New York. Finally, the IPCC protocol excludes international aviation and maritime transport emissions (otherwise known as international bunker fuels) from national greenhouse gas reduction goals and, hence, the total emissions reported in national inventories. Since the EIA does not disaggregate marine "vessel bunkering" fuels, it's not possible to determine the volume of marine distillate and residual fuel that should be included in the 1990 baseline at this time. Some portion of the emissions from these fuels may be subject to the CLCPA. The Department will seek to estimate these emissions in the future as a part of continued improvements. .

As in the previous State inventory released by NYSERDA,[19] the estimation of on-road vehicle emissions, including from passenger cars and trucks, commercial light-duty trucks, motorcycles, buses, and heavy-duty trucks, was conducted separately from non-road transportation to include all fuels combusted in the state, rather than just fuels sold within the state. This is primarily because, under the latter approach of only accounting for fuels sold within the state, "fuel tourism" could lead to a significant underestimation of motor vehicle emissions that could otherwise be reduced through State policy. For the estimation of the 1990 baseline, on-road transportation emissions were calculated using the USEPA Motor Vehicle Emission Simulator (MOVES) model,[20] which is used by the Department to comply with federal air quality reporting requirements. Total vehicle

[17] https://www.eia.gov/dnav/pet/pet_cons_821use_dcu_SNY_a.htm
[18] To be provided in an updated Pattern and Trends report.
[19] NYSERDA 2019a op. cit.
[20] USEPA. 2020b. Latest Version of Motor Vehicle Emission Simulator (MOVES). https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

miles traveled[21] (VMT) for functional classes of vehicles in New York State in 1990 were disaggregated into vehicle types and then input along with an estimate of vehicle population into the model (Tables 5 and 6). MOVES then provides an estimate of CO_2 based on the carbon content of the fuel, CH_4 as a fraction of hydrocarbon exhaust emissions, and N_2O based on the emission rates for vehicle models and model years as derived from USEPA vehicle testing. Note, if fuel sales rather than VMT were used to estimate emissions, an analysis of the vehicle fleet may still be needed to estimate CH_4 and N_2O as these emissions reflect vehicle emission standards that have changed over time.

Table 5. Vehicle Miles Traveled by Vehicle Type in 1990 (million miles)

Vehicle Type	Millions of miles traveled in 1990
10 - Motorcycles	107
25 - Light Duty Vehicles	102,532
40 - Buses	540
50 - Single Unit Trucks	1,974
60 - Combination Trucks	1,748

Table 6. Vehicle Population by MOVES Source Type in 1990

MOVES Source Type	Number in 1990
11 - Motorcycle	40,167
21 - Passenger Car	7,655,860
31 - Passenger Truck	1,461,418
32 - Light Commercial Truck	522,476
41 - Intercity Bus	3,169
42 - Transit Bus	3,099
43 - School Bus	26,830
51 - Refuse Truck	1,858
52 - Single Unit Short-haul Truck	107,824
53 - Single Unit Long-haul Truck	4,052
54 - Motor Home	25,835
61 - Combination Short-haul Truck	18,945
62 - Combination Long-haul Truck	11,336

[21] Federal Highway Administration's (FHWA) Highway Statistics Table VM-2

Fugitive Emissions

The Fugitive Emissions category in the IPCC protocol includes all releases of methane, as well as some amount of carbon dioxide and nitrous oxide, that are related to the energy system but are not associated with fuel combustion. In New York, this would result from intentional or unintentional releases during the exploration, production, transportation or transmission and distribution, and storage of natural gas and oil as well as at abandoned wells. The basis of the 1990 baseline estimation for the proposed rule is the NYSERDA Oil and Gas Sector Methane Emissions Inventory,[22] which represents a thorough bottom-up inventory of each component of the system in New York up to customer meters, based on the best available data at this time. One exception is the estimation of fugitive emissions associated with oil refining, which was estimated separately, as described below. The proposal utilizes this bottom-up approach for estimating 1990 levels of fugitive methane emissions, recognizing that a different approach may be more appropriate for estimating such emissions for more recent time periods, as described further below. Carbon dioxide and nitrous oxide emissions were estimated by applying the ratio of each gas to the NYSERDA methane estimates for each of the individual segments of the oil or natural gas system in the national inventory for 1990.[23] One petroleum refining facility operated in New York State in 1990 and 1991. Fugitive emissions and methane flaring at that facility were estimated by scaling US total refinery emissions, as reported in the US national greenhouse gas inventory, to New York State based on the ratio of state to national crude oil distillation capacity, as reported by the EIA.[24]

While Part 496 relies upon a bottom-up inventory approach, there is a growing body of scientific literature based on remote-sensing data (sometimes referred to as top-down) that suggests that standard, bottom-up analyses of methane from oil and natural gas systems, landfills, and livestock operations may be systematically underestimating actual methane emissions. These top-down analyses capture emissions that are not easily incorporated into a bottom-up approach, including emissions from unknown sources, sources for which there is

[22] NYSERDA 2019b. New York State Oil and Gas Sector Methane Emissions Inventory.
[23] USEPA. 2020a. op. cit.
[24] EIA. 2019. Annual Refinery Report. Form EIA-820 (1982-2019). https://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_SNY_a.htm

too little data to accurately measure, and events, whether intentional or unintentional, that result in higher-than-average emissions at known sources. For example, individual emission sources with an extremely high emission rate may represent a significant source of methane in all sectors.

Currently, there are notable challenges to reconciling bottom-up and top-down estimates, such as the limited number of studies, the small geographic area covered by each analysis, and the lack of data for many types of sources.[25] These challenges are compounded when attempting to estimate and validate a 1990 baseline, as all top-down data were collected very recently. Some top-down analyses address emission sources that are also not relevant to the New York 1990 baseline, such as the unconventional recovery of natural gas from Marcellus Shale formations using high-volume hydraulic fracturing which began in 2003 outside of New York. Other data are not sufficiently resolved to be incorporated at this time. For example, the top-down analysis of Plant et al. (2019)[26] suggests that there are additional emissions in urban areas like New York City that are not yet accounted for in the bottom-up analyses. However, there are multiple components of the transmission and distribution systems that could be the source of these emissions.

Particularly when estimating fugitive methane emissions that occurred 30 years ago, there is uncertainty in both the standard, bottom-up approach (in which there has been no top-down validation) and in the newer alternative approach that would apply recent but limited top-down data to 1990. As the 1990 baseline defines the statewide greenhouse gas emission limits under the CLCPA, inadvertently underestimating or overestimating these emissions is a key consideration, since this would have a corresponding effect on the applicable emission limits. This topic is an example of opportunities for ongoing continued improvement, as described above. While the proposal relies on the standard bottom-up approach, the Department believes validation of various top-down analyses is more likely for recent and future years of emissions. Therefore, this information may be included in the annual reporting that the Department will maintain, per ECL § 75-0105. For the purposes of comparison,

[25] NYSERDA. 2019b. op. cit.
[26] Plant, G., et al. 2019. Large fugitive methane emissions from urban centers along the U.S. East Coast. Geophysical Research Letters. 46:8500-8507.

Table 7 provides a comparison of methane loss, as a function of emissions per consumption volume, based on the bottom-up analyses used in the 1990 baseline with an equivalent estimate based on the top-down analyses summarized in Alvarez et al. (2018)[27] and Plant et al. (2019).[28]

Table 7. Comparison of Methane Loss Rates in the Natural Gas System

Source Category	Description	Bottom-up 1990 Baseline (Proposed Part 496 Approach)		Top-Down Analyses	
		Methane (mt)	% of Gas Consumption	Alvarez (2018) as % Consumption	Plant et al. (2019) as % Consumption
Imported Fuels	Out of state production and transmission emissions	395,600	2.57	2.27	-
Fugitive Emissions	In state production emissions	20,776	0.13		-
	In state midstream emissions (for NY consumption)	41,662	0.27		-
	In state distribution	25,860	0.17	-	0.86
Total Loss Rate			3.14	3.13	

Electricity Transmission

The IPCC protocol includes a category under the IPPU sector for "other product manufacture and use," which includes the leakage of sulfur hexafluoride (SF_6) during the manufacture, use, and disposal of equipment used in the transmission and distribution of electricity. The gas is specifically used as an insulating and arc-quenching medium. To estimate the 1990 baseline emissions for this source, the Department refined the method provided in the USEPA State Inventory Tool[29] (SIT), which is commonly used as a guiding framework for states that aligns with the national inventory (see IPPU for more detail). The SIT method for Electricity Transmission allocates total US emissions from the national inventory from this source category to each state based on data for retail sales of electricity in megawatt hours from EIA. However, the USEPA has recommended that the

[27] Alvarez, R.A., et al. 2018. Assessment of methane emissions from the U.S. oil and gas supply chain. Science. 361: 186-188.
[28] Plant et al. 2019. op. cit.
[29] e.g., USEPA. 2019. State Inventory and Projection Tool

Department first account for reported SF_6 emissions from the Consolidated Edison utility service territory, as the company has been a key participant in a voluntary program to reduce emissions.[30] Recently, Consolidated Edison reported that it had reduced SF_6 from 1999 to 2016 by "about 96 percent."[31] This estimate was confirmed by other public reports[32] and was used to establish the percentage of national SF_6 emissions that could be attributed to Consolidated Edison in the 1990-1999 period (or 20%). The remaining emissions for other regions of New York were estimated using the SIT method, after correcting for the emissions and retail electricity sales of Consolidated Edison.

Imported Electricity

Although not typically included in IPCC-based greenhouse gas inventories, NYSERDA has included estimates of emissions from imported electricity in past versions of the State inventory.[33] As in the previous reports, for Part 496 the net volume of electricity imports for 1990 was estimated by subtracting the amount of electricity generated in the state (from EIA)[34] from the total amount of electricity demand as reported in Patterns and Trends based on archived New York Power Pool data.[35] The source of imported electricity was further apportioned to the adjacent power control areas based on the average ratio across a multiyear period of available data, or the 2005-2009. Rather than apply an average emission factor to all imported electricity, separate emission factors were derived for each region[36] by dividing EIA state-specific CO_2 emissions (or CH_4 and N_2O associated

[30] e.g., USEPA. 2018. Overview of SF6 Emissions Sources and Reduction Options in Electric Power Systems. EPA 430-R-18-004. https://www.epa.gov/f-gas-partnership-programs/electric-power-systems-partnership
[31] Consolidated Edison. 2016. GHG Emission Reductions. 2016 Sustainability Report. https://www.conedison.com/ehs/2016-sustainability-report/safety-and-environment/gng-emissions-reductions-introduction/
[32] Consolidated Edison. 2006. SF6 Leak Detection and Mitigation Techniques [Slide Presentation] https://www.epa.gov/sites/production/files/2016-02/documents/conf06_di_lillo.pdf
[33] NYSERDA 2019a op. cit.
[34] https://www.eia.gov/electricity/data/state/annual_generation_state.xls
[35] NYSERDA. 2019. Patterns and Trends - New York State Energy Profiles: 2002-2016.
[36] PJM region included DE, MD, NJ, PA, and Washington D.C.; ISO New England included CT, ME, MA, NH, RI, and VT.

with state-specific fuel consumption) by generation. For Canada, emission factors were those reported for Ontario and Quebec in that national inventory.[37]

Imported Fuels

The most significant difference between the 1990 baseline, as set forth in the CLCPA and developed for the proposed rule, and other governmental greenhouse gas inventories is the inclusion of emissions associated with "the extraction and transmission" of imported fossil fuels. Because of the novel nature of this CLCPA requirement, as compared to other standard governmental inventories following the IPCC protocol, the Department undertook an analysis of these emissions in collaboration with NYSERDA. This analysis considered emissions from extraction and processing (production) through transmission or transportation to the New York border, but did not include emissions from infrastructure construction and maintenance outside of the state or from the manufacture of equipment or facilities outside of the state. The fuels included are the same as those addressed in the in-state analysis, or coal, natural gas, distillate, diesel, residual fuel, jet fuel, kerosene, LPG, motor gasoline, and other petroleum fuels (lubricants, petroleum coke, and unspecified napthas).

For this analysis, NYSERDA utilized consultant support to run federal life cycle models to derive emission factors that could be applied to EIA fuel data for New York, as modified to address historical emissions. For imported petroleum products, the Argonne National Laboratory's "Greenhouse gases, Regulated Emissions, and Energy use in Transportation" (GREET) model[38] was used with adjustments, for example to include refinery products not included in GREET (waxes and lubricants)[39] and to include state-specific data on the transportation

[37] Environment and Climate Change Canada . 2019. National Inventory Report 1990-2017: Greenhouse Gas Sources and Sinks in Canada.
[38] ANL. 2019. The Greenhouse gases, Regulated Emissions, and Energy use in Transportation Model. https://greet.es.anl.gov
[39] Sun, P. et al (2019) Criteria air pollutant and greenhouse gas emissions from U.S. refineries allocated to refinery products. Environmental Science & Technology 53(11), 6556-6569.

of fuel from EIA.[40] The transport of fuels within New York is not included in the GREET analysis as this is accounted for in the analysis of fuel combustion above. Although potentially relevant in later years, the emissions associated with fuels imported and combusted in New York in 1990 would not include those from unconventional oil sources or biofuels.

For imported coal and natural gas, the National Energy Technology Laboratory (NETL) life cycle models were applied.[41] The NETL model for coal includes extraction and processing and was scaled to 1990 using data from the Federal Energy Regulatory Commission (FERC) regarding the source of coal used by utilities[42] and EIA regarding coal transport modes.[43] Methane emission rates from the national inventory were also used to develop emission factors for underground mines in specific basins for 1990. For methane emissions from surface mines as well as CO_2 and N_2O, an average emission factor from the EPA national inventory was applied.

The NETL model for natural gas was used to model the supply chain from the Gulf Coast, East Texas, Anadarko, and Arkoma basins, including production, gathering, and boosting through processing, storage, and transmission up to the state border. The current model was scaled to the 1990 baseline using the U.S. national inventory.[44] However, the NETL model does not have the same level of process granularity considered in the U.S. national inventory. So, rather than adjust individual parameters such as equipment counts, the NETL was adjusted at the stage-level, e.g., emissions from gathering and boosting were compared in 1990 versus 2016 for the same unit of gas produced. For natural gas imported from Canadian sources, emission factors from the U.S. mix were applied to the total imports and adjusted for transmission distance.

[40] EIA. 2020. Petroleum & Other Liquids. https://www.eia.gov/petroleum. Including PAD District Imports by County of Origin, Movements by Pipeline between PAD Districts, Movements by Tanker and Barge between PAD Districts, Refinery and Blender Net Production.
[41] https://www.netl.doe.gov/LCA
[42] FERC. 2011. Electricity: Historic Form EIA-423 & FERC-423 Detailed Data (1972-2011). https://www.eia.gov/electricity/data/eia423/
[43] EIA. 2019. Annual Coal Distribution Report. https://www.eia.gov/coal/distribution/annual/
[44] i.e., information as described in Annex 3.6 of EPA 2020a. op cit.

The GREET and NETL models are standards for conducting life cycle analyses and, as in the case of all such models, are a bottom-up accounting of emissions. Table 7, as discussed in the Fugitive Emissions section, provides a comparison of the emission or methane loss rate from the 1990 baseline as analyzed using the bottom-up life cycle models with top-down analyses as summarized by Alvarez et al (2018).[45] As in the case of fugitive methane from sources within the state, the top-down analyses were conducted in recent years and provide a more appropriate source of data validation for annual reporting rather than contributing to this 1990 baseline.

2. Industrial Processes and Product Use (IPPU)

The Industrial Process and Product Use (IPPU) sources assessed for the 1990 baseline are organized into five (5) categories: Mineral Industry, Chemical Industry, Metal Industry, Electronics Industry, and Product Uses. This sector represents emissions from the manufacturing process or from a manufactured product and are separate from the combustion of fossil fuels by industries, which is accounted for in the Energy sector. One specific difference from the IPCC protocol is that the Department is proposing to categorize emissions associated with Electricity Transmission into the Energy sector instead of IPPU. Additionally, the IPCC includes multiple categories of product use, but these are combined for this analysis.

For almost all categories within this sector, the Department used the USEPA SIT as a foundation for estimating the 1990 baseline.[46] The USEPA SIT applies standard emission factors to activity data, wherever state-level data are available, or scales emissions from the national inventory using factors such as the proportion of U.S. production or sales. However, in some cases, there is not sufficient data available to estimate historical emissions at this time. All IPCC emission categories are covered in Table 8 to indicate the full scope of the statewide greenhouse gas emission limits. Although historical data are limited, recent and future years of reporting

[45] Op. cit.
[46] USEPA 2019. op cit. SIT 2019 version

may be improved with emissions data from the USEPA Greenhouse Gas Reporting Program GHGRP (for years after 2010) or otherwise.

Table 8. IPPU Sector Greenhouse Gas Emissions in 1990, by Category and Gas, in GWP 20. Totals may not sum due to independent rounding.

IPPU Sector									
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6	NF_3		Total
Mineral Industry	1.01	-	-	-	-	-	-		1.01
Chemical Industry	-	-	-	-	-	-	-		-
Metals Industry	0.75	0.00	-	0.88	-	-	-		1.63
Electronics Industry	-	-	0.00	0.03	0.00	0.01	0.00		0.03
Product Use	-	-	-	-	0.04	-	-		0.04
Total	1.76	0.00	0.00	0.90	0.05	0.01	0.00		2.72

In the Minerals Industry, the predominant emission source is the release of carbon dioxide associated with the use of carbonate minerals (soda ash, limestone and dolomite) in the production processes of cement, glass, and other materials.[47] The U.S. Geological Survey (USGS) National Minerals Information Center provides information on cement as well as limestone and dolomite consumption in New York. For cement, the SIT disaggregates clinker production for New York and Maine, then the New York production total is multiplied by a standard emissions factor, and then this was added to an estimate of kiln dust production. For all other uses of limestone and dolomite, the remaining consumption in New York was apportioned to industrial sources using the ratio of industrial to non-industrial consumption at the national level for the closest year available, or 1989. Soda ash is not produced in New York, but it is used to produce other products. The SIT scales national soda ash consumption to states based on population[48] and applies a standard emissions factor.

[47] For an explanation of applications in the United States; USEPA 2020a. op. cit.
[48] The Department used the most up-to-date population estimates from the U.S. Census

For the Metals Industry, there is limited public information regarding historical emission drivers. For iron and steel, ferroalloy, and secondary lead production, there are no public data regarding production or capacity in New York in 1990. The 1990 baseline was estimated using the 9-year average of recent emissions data as reported to the GHGRP. In the case of ferroalloys, one of the two facilities in New York was closed shortly after 1990, but the other was in operation until 2018. For aluminum, the USGS provides information on the production capacity for each of the two facilities in New York. Total U.S. production in 1990 was approximately 99% of capacity and this rate was applied to each facility to estimate production. The standard, technology-specific IPCC emission factor for carbon dioxide was then applied to production.[49] For PFCs, the emission rate has declined over time and can fluctuate annually. The SIT provides a fluctuating, annual emission rate in which the two relevant gases are combined. However, in order to transition from a 100-year GWP used in the SIT to a 20-year GWP per the CLCPA, these gases must be disaggregated. As the actual volume of each gas is reported separately in the national inventory, it is possible to determine the average annual emission rate for each gas and this emission rate was applied to New York production.

The last two categories of IPPU emissions are the key sources of fluorinated greenhouse gases. As in the cases above, some of the same electronics manufacturing facilities that exist now also operated in New York in 1990, but detailed information is not available. The USEPA GHGRP requires reporting by these manufacturers, but these data are unlikely to represent either the full scope of emission sources or reflect historical emissions as the manufacturing processes have changed. Some of the HFCs and PFCs that may be subject to the CLCPA did not exist in 1990 and some may not be listed in this rule because the IPCC has not yet determined their carbon dioxide equivalence.[50] Similar to the method used in the SIT, the Department scaled national emissions to New York based on semiconductor manufacturing in the U.S. Census, specifically the "value of product shipments"

[49] Alcoa used center-worked prebake; Reynolds used horizontal-stud Soderberg; USEPA 1996. Primary Aluminum Industry: Technical Support Document for Proposed MACT Standards.
[50] e.g. Facilities have reported using substances that contain the PFC, perfluorotributylamine, which is not yet listed by the IPCC; Hong et al. 2013. Perfluorotributylamine: A novel long-lived greenhouse gas. Geophysical Research Letters. 40: 6010– 6015.

for 1992 as reported in the 1997 economic census.[51] Only the major, known gases are included as these can be disaggregated to estimate both the 20 and 100-year Global Warming Potential. In the final rule, the Department has added NF_3 to this emission category and to the definition of "greenhouse gas" as requested by commenters, but this does not affect the 1990 baseline. According to the US national inventory, nationwide emissions of NF_3 in 1990 were less than 3 metric tons, or equivalent to 0.036mmt CO2e (GWP20). Following the methodology above, estimated state-level emissions would then be less than 0.04mt, or equivalent to 0.0005mmt CO2e (GWP20).

The remaining category, Product Use, may include a variety of manufactured products that are associated with greenhouse gas emissions throughout the life of the product and after disposal. For the purposes of this rulemaking, the sources included in the 1990 baseline are limited to the use of fluorinated greenhouse gases as substitutes for ozone-depleting substances. Other emission sources may include medical uses of nitrous oxide (N_2O) or sulfur hexafluoride (SF_6), but historical data are not available at this time.

The IPCC protocol includes a specific category for products containing refrigerants, aerosol propellants, or foam. Prior to the 1990s, many of these sources used ozone-depleting substances (ODS), or substances made of gases that can deplete the ozone layer. The ODS gases are also powerful greenhouse gases that are not required to be reported in governmental greenhouse gas inventories.[52] ODS gases were already subject to the Montreal Protocol prior to the adoption of the UNFCCC treaty. As such, the IPCC protocol focuses instead on the greenhouse gases that replaced the gases prohibited by the Montreal Protocol. The IPCC and USEPA refer to these as "ozone depleting substance substitutes," or ODS substitutes, and they are the primary source of HFCs and a nominal amount of PFCs. Importantly, as the Montreal Protocol went into effect in 1987, the transition to

[51] U.S. Census Bureau. 1999. Table 6b Product Class Shipments for Selected States: 1997 and 1992. In "Semiconductor and Related Device Manufacturing". 1997 Economic Census. EC97M-3344C. Note: The 1992 census is not directly comparable to later reports as it used the Standard Industrial Classification (SIC) system, which was replaced by the North American Industry Classification System (NAICS) in 1997. Only NAICS # 3344131 is used. Unlike the "value of shipments" used in the SIT, the "value of product shipments" is focused on the primary product, rather than all activities conducted by the relevant industry.

[52] U.S. emissions are reported in the national inventory, but not included in total emissions. Annex 6.2 USEPA 2020a. op. cit.

ODS substitutes had just begun in 1990 and so HFC emissions in this category were much lower in the United States compared to current levels. For the 1990 baseline, the Department scaled national emissions of aerosol propellants to the state level based on population, which is a primary driver of product use. For refrigerants, emissions were reassessed using information about equipment stocks. In both cases, the Department has reconsidered its assessment of HFC emissions in 1990 and now considers these to be entirely comprised of HFC-134a as other substances were not yet in use.

3. Agriculture Forestry and Other Land Use (AFOLU)

Under the IPCC protocol, the Agriculture Forestry and Other Land Use sector includes emission sources and removals associated with land management in four (4) categories: Livestock, Land Use, Aggregated Sources, and Other. As discussed in the Legislative Objectives, anthropogenic emissions are included in the proposed rulemaking, but not removals. Removals in New York are associated with the net sink categories of Land Use and the Harvested Wood Products categorized as Other, so these categories are not included in the 1990 baseline. Information on these categories will be included in annual reporting per ECL §75-0105. Note, the US Forest Service provides estimates of net removals in forest-related Land Use at the state-level (Domke et al. 2020)[53]; net CO_2 removals in 1990 were roughly equivalent to thirty million metric tons of carbon dioxide in New York according to that assessment.

[53] Domke, G.M., et al. 2020. "Appendix 1. National Scale Estimates for Individual States, 1990-2018." Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. https://www.nrs.fs.fed.us/pubs/59852

Table 9. AFOLU Sector Greenhouse Gas Emissions in 1990, by Category and Gas, in GWP 20 (MMT CO_2e). Totals may not sum due to independent rounding.

AFOLU									
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6	NF3		Total
Livestock	-	13.07	0.39	-	-	-	-		13.46
Land	-	-	-	-	-	-	-		-
Aggregated Sources	0.05	-	3.63	-	-	-	-		3.67
Other	-	-	-	-	-	-	-		-
Total	0.05	13.07	4.01	-	-	-	-		17.13

The emissions estimates used for the 1990 baseline are the same as those previously provided in the annual greenhouse gas inventories for New York issued by NYSERDA,[54] with the exception of additional sources included under Aggregated Sources. These estimates were calculated using the methods and data established by the USEPA as part of the national greenhouse gases inventory.[55] The two Livestock emission sources are Enteric Fermentation, or the production of methane as a result of feed management, and Manure Management, which represents the production of methane in a manure storage system. Information to estimate both sources are derived from the US Department of Agriculture Natural Resources Conservation Service (NRCS). The USEPA applies standard emission factors to these data based on animal numbers, climatic information, and information regarding management practices. State governments are able to access recent state-level emission estimates in the appendices to the national greenhouse gas inventory for recent years. For historical years, the USEPA SIT applies the methods from the national inventory to data accessed directly from the NRCS.

The IPCC Aggregated Sources category assesses emissions associated with the use of soil amendments. The primary sources within this category are also the largest sources of N_2O globally, or the use of nitrogen-based

[54] NYSERDA 2019a op. cit.
[55] USEPA. Annex 3 Part B: Methodological Descriptions for Additional Source or Sink Categories. USEPA 2020 op. cit.

fertilizers on agricultural soils and settlement soils. The most recent version of the State inventory issued by NYSERDA[56] reported emissions from agricultural soil management as provided by the USEPA, and the same estimates are included in the 1990 baseline as proposed here. Importantly, the USEPA revised the methodology for this source in recent years and currently employs a proprietary model,[57] rather than emission factors. As such, it is not possible to use the SIT to calculate emissions from this source that will match the national inventory.

Although not included in the previous State inventory, the SIT was used to estimate emissions for the remaining sources in the Aggregated Sources category that are relevant to New York: urea fertilization, agricultural liming (or the use of carbonates as a soil amendment; see IPPU above for industrial uses of carbonates), and settlement soil management. Urea fertilization is estimated in the SIT using activity data (fertilizer sales) from the Tennessee Valley Authority for the earliest year available, or 1991. Agricultural liming, or the application of limestone and dolomite to agricultural soils, was estimated using the SIT method and using data from the USGS regarding uses by states for agricultural purposes for the closest year available, or 1989.[58]

The Department plans to make continued improvements to the estimation of emissions in AFOLU over time for purposes of its annual reporting and to inform subsequent rulemaking, as discussed above, particularly to validate estimates for recent years and in the monitoring of emissions in future years. One area of focus will be the emission factors applied to livestock emissions, to ensure that the improvements made in management are captured accurately for New York, and to more closely align with greenhouse gas accounting at the farm level. Another area of focus will be to identify alternative approaches for measuring emissions from fertilizer use so to better inform, and reflect, patterns of usage and their impacts in New York.

4. Waste

[56] NYSERDA 2019a op. cit.
[57] Ibid.
[58] The Department found errors in the data as applied in the SIT and used the original report from the US Bureau of Mines. The SIT also assigns each state an additional and proportional share of the remaining, unassigned uses of limestone and dolomite, but this has been omitted here.

The Waste sector includes four (4) categories of emission sources: Solid Waste Disposal, Biological Treatment of Solid Waste, Waste Combustion, and Wastewater. As discussed in the Legislative Objectives section, the Department has taken special consideration in the treatment of organic materials. The IPCC protocol does not require that national inventories report CO_2 associated with the treatment of solid waste derived from organic waste as it is assumed that the emission impact is already observable in the AFOLU sector. However, the IPCC approach would only be appropriate for net accounting across all regions where such material had been produced. The statewide greenhouse gas emissions limits as described in the CLCPA are neither intended to be a net accounting (i.e., emissions and removals) or to apply to land management practices outside of New York. Additionally, the IPCC also excludes emissions associated with respiration, decomposition, or natural disturbances. In applying the IPCC framework to the requirements of the CLCPA, for purposes of this rulemaking to establish the 1990 baseline, the Department is proposing to exclude CO_2 associated with organic waste except in the case of combustion. Additionally, these emissions may also be reconsidered in the net accounting framework applied in annual reporting, per ECL §75-0105.

Table 10. Waste Sector Greenhouse Gas Emissions in 1990, by Category and Gas, in GWP 20. Totals may not sum due to independent rounding.

Waste Sector	MMTCO_2e (AR5 - 20 year GWP)							
	CO_2	CH_4	N_2O	PFCs	HFCs	SF_6		Total
Solid Waste Disposal	0.05	43.32	-	-	-	-		43.38
Biological Treatment of Solid Waste	-	-	-	-	-	-		-
Waste Combustion	2.98	0.09	0.04	-	-	-		3.10
Wastewater	-	5.94	0.47	-	-	-		6.40
Total	3.03	49.35	0.50	-	-	-		52.88

The IPCC protocol refers to managed and unmanaged solid waste disposal, however all solid waste disposal in the United States is managed within municipal solid waste landfills or industrial landfills, if it is not otherwise diverted. Landfilled waste has the potential to produce greenhouse gases as the organic component of

the waste decomposes over time in an anaerobic environment (i.e., lacking available oxygen). The preferred method for estimating these emissions in the IPCC protocol is to apply a model of decomposition, which estimates the gases generated over multiple decades based on the volume and composition of waste placed into the landfill. If the resulting methane is oxidized, flared, or used to produce energy at the site, the resulting carbon dioxide is included in the estimated emissions total. In applying the requirements of the CLCPA, the Department is proposing that the CO_2 released from the combustion of methane be included as an anthropogenic source of emissions. At this time, there is not sufficient data to estimate emissions from industrial waste. The USEPA SIT provides a means for states to apply the decay model to state-level municipal waste tonnage data (1960-1990). The SIT also uses vendor-supplied EPA data on the rate of methane flaring in 1990 to estimate CO_2 production, which is included in the 1990 baseline.[59] The CO_2 associated with decay in the landfill or with the Biological Treatment of Solid Waste, or as a result of solid waste diverted to a compost or anaerobic digestion facility, is omitted. Anaerobic digestion is also a potential source of additional methane, however neither source of biological treatment was used commonly for solid waste management in 1990. Finally, organic waste may also be incinerated, or combusted, in lieu of disposal in a landfill. As it is also used to produce energy, waste combustion is also referred to as waste-to-energy and commonly treated as an energy-related emission source. As the SIT omits CO_2 from the combustion of organic waste, it cannot be used to estimate waste combustion emissions for the 1990 baseline. The Department instead applied the USEPA standard emission factor for municipal solid waste,[60] which accounts for the average composition of such waste, to the volume of waste combusted.

Wastewater management systems include inputs from households as well as potential commercial or industrial sources. However, there are no publicly available sources of information regarding these sources in 1990. The Department used the method established in the USEPA SIT, which estimates state-level emissions

[59] This rate was increased in recent versions, but no longer matches expectations as it is assumed that most landfills in 1990 passively vented the methane that was generated at the facility. The SIT version 2017 was used to access this rate instead.
[60] EPA. 2020c. op. cit.

from wastewater by applying standard emission factors to the volume of waste generated by the state population not on a septic system. A separate emissions factor derived from the U.S. national greenhouse gas inventory[61] was applied to the state population that utilize septic systems.

Stakeholder Outreach

The Department conducted pre-proposal, stakeholder outreach starting the date on which the CLCPA went into effect, or January 1, 2020, through May 2020. This included two public webinars held on February 14 and 28, 2020 to discuss the scope and key considerations of this rulemaking as well as other presentations and meetings with various stakeholders, including members of the Climate Action Council, by request. For example, the Department presented to the Manufacturers Association of Central New York and the Air and Water Managers Association in May 2020 and participated in meetings with Covanta, National Fuel Gas, and natural gas transmission pipeline companies[62] in April 2020. The Department also consulted with other State agencies and authorities, including NYSERDA, the Department of Transportation, the Department of Public Service, and the Department of Agriculture and Markets. The Department reviewed the feedback received in this stakeholder outreach as part of further developing Part 496.

4. Costs

The proposed rule does not impose a compliance requirement on any entity, and therefore does not directly impose any costs on any regulated entities. As explained above, the proposed rule establishes a tonnage limit on statewide greenhouse gas emissions from across the New York economy, consistent with the statutory percentage reduction limits set forth in the CLCPA. Moreover, as discussed above, Part 496 is a foundational regulation that will serve as the basis of or inform future regulatory and non-regulatory actions to implement the CLCPA. This

[61] USEPA. 2020a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018.
[62] Innovative Environmental Solution, Inc requested and facilitated a meeting with Dominion Resources Services, Enbridge, Iroquois Pipeline Operating Company, Kinder Morgan, National Fuel Gas Company, TC Energy, and The Williams Companies

includes recommendations to be made by the Climate Action Council as part of the Scoping Plan as well as subsequent rulemaking by the Department or other State agencies. Other regulatory and non-regulatory policies will be required to ensure that these emission limits are met, as contemplated in the CLCPA. As such, while this rule does not itself impose a cost on any entity, future actions by the Department and other State agencies to implement the CLCPA will consider costs as necessary and appropriate. This includes as part of any Department rulemaking actions pursuant to the State Administrative Procedure Act.

5. Paperwork

The proposed rule does not itself impose any paperwork or reporting requirements. However, additional and separate policies may be adopted at a later date that are related to this rule. Any paperwork or reporting requirements will be assessed as part of any such future actions.

6. Local Government Mandates

The proposed rule will not create any mandates for local governments as compared to other entities. In fact, as described above, the proposed rule does not itself create any binding or mandatory requirements on either local governments or any other entities.

7. Duplication

This proposal does not duplicate, overlap, or conflict with any other existing federal or State regulations or statutes. Instead, as described above, Part 496 places into regulation requirements of the CLCPA by translating the statewide emission reduction requirements into tonnage limits for 2030 and 2050.

8. Alternatives

The Department is required to adopt statewide greenhouse gas limits in regulation per the CLCPA as set forth in ECL Section 75-0107, so it is not viable to take a no-action alternative. Alternatives to the specific methodology for estimating 1990 greenhouse gas emission levels for particular sectors, categories, or subcategories were considered by the Department on a case-by-case basis. Many of these alternative methodologies are discussed above in the relevant section, along with the Department's reasons for proposing the chosen methodology. The Department did not consider other alternatives, such as to adopt statewide emission limits for additional years or to expand the scope of the emission sectors or gases beyond those expressly defined in the CLCPA.

9. Federal Standards

There are no enforced federal rules or other restrictions for the adoption of statewide limits on greenhouse gases, regardless of whether such statewide emission limit also includes certain out-of-state emissions associated with in-state consumption. Therefore, this proposal does not result in the imposition of requirements that exceed any minimum standards of the federal government for the same or similar subject areas.

10. Compliance Schedule

The proposed rule will be effective immediately upon publication of the final rule in the State Register. However, there is no compliance schedule required by the establishment of the proposed rule because, as discussed above, the rule does not itself impose any compliance obligations on any entity. Finally, the 2030 and 2050 dates for the applicable statewide greenhouse gas emission limits in the rule are specifically set forth in the CLCPA.