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2nd Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update

Regulatory Authority: MGL Chapter 21N, Section 3

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Introduction

The Massachusetts Global Warming Solutions Act (GWSA)[1] was signed into law in August of 2008 to address the challenge of climate change caused by the emissions of greenhouse gasses (GHG). GHGs accumulate in the atmosphere and trap heat that would otherwise be radiated back into space. This "greenhouse effect" is the primary cause of global climate change. There are a number of gases that are considered GHGs. The most prevalent GHG is carbon dioxide (CO_2), which is emitted when fuels are burned. Methane (CH_4), nitrous oxide (N_2O), and several other compounds primarily used as refrigerants are also GHGs of concern due to their potential to contribute to climate change.[2]

Given the emergence of improved information, MassDEP proposed in May 2021[3] and February 2022[4] to update the data sources and methodologies used to estimate Massachusetts' 1990 GHG emissions and asked for public comment on the updates. MassDEP has been considering the comments received. Please refer to these updates for additional background.

Two additional issues involving data sources and methodologies have developed and MassDEP now is proposing a second addendum to the May 2021 update. The data sources and methodologies for this *2nd Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* (2nd Addendum) are described below. As detailed below, the proposed 2nd Addendum approach to calculating 1990 emissions would result in a 22.4% emission reduction from 1990 to 2018. Note that complete 2019 emissions have recently become available and are included in the Figures and Appendix released with this 2nd Addendum. 2019 emissions were 71.6 million metric tons of carbon dioxide equivalent ($MMTCO_2e$), or 23.4% below the proposed 1990 emissions.

A public comment period is now open on this 2nd Addendum. MassDEP will accept written comments until 5:00 PM on August 1, 2022. Written comments must be submitted by email to climate.strategies@mass.gov or by mail to Sue Ann Richardson, MassDEP, One Winter Street, 6th Floor, Boston, MA 02108.

[1] See https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298

[2] Not all GHGs have the same heat-trapping capacity. For example, one ton of methane is equivalent to greater than 20 tons of CO_2 with respect to their heat trapping potentials. To account for these differences, a standard, known as the global warming potential (GWP), relating the heat trapping potential of each GHG to an equivalent quantity of CO_2 over a given time horizon, has been developed. Emissions shown in this document utilize this standard and are expressed in units of million metric tons of carbon dioxide equivalents ($MMTCO_2e$).

[3] *Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update*, May 2021 at https://www.mass.gov/lists/massdep-emissions-inventories#proposed-2021-update-of-statewide-greenhouse-gas-(ghg)-emissions-baseline-

[4] *Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update*, February 2022 at https://www.mass.gov/lists/massdep-emissions-inventories#proposed-2021-update-of-statewide-greenhouse-gas-(ghg)-emissions-baseline-

Updated Data Sources, Methodology Changes, and Improvements

The first update is to combustion and industrial process GHG emissions. Since the initial Massachusetts GHG inventory, MassDEP has relied on the United States Environmental Protection Agency (EPA)'s State GHG Inventory Tool (SGIT) and the U.S. Department of Energy's Energy Information Administration (EIA)'s State Energy Data System (SEDS) to calculate CO_2, CH_4 and N_2O emissions from fuel combustion. In March 2022, EPA published updates to its SGIT including changes to fuel combustion emission factors and changes to regional apportionment of ozone depleting substance (ODS) substitutes in the industrial processes sector.

The second update is the improvement to natural gas distribution system emissions estimates with inclusion of post-meter natural gas leaks. EPA updated its methodology in the *1990-2020 Inventory of U.S. Greenhouse Gas Emissions and Sinks*[5] to include post-meter natural gas emissions.[6] Post-meter emissions include natural gas leak emissions from residential and commercial appliances, industrial facilities and power plants, and natural gas fueled vehicles. MassDEP has used the EPA emission factors multiplied by the appropriate activity factor: number of residential natural gas meters (for 1990-2016) and natural gas households (starting in 2017); number of commercial customer meters; the cubic feet of gas used in the industrial and power plant sectors; and the number of natural gas vehicles in Massachusetts (0 for 1990 because SEDS reports no Massachusetts transportation natural gas use, and actual natural gas vehicle counts from the Massachusetts Vehicle Inspection Database starting with 2018). Post-meter natural gas emissions increase from 0.10 MMTCO2e in 1990 to 0.17 $MMTCO_2e$ in 2018.

These changes will affect progress toward the reduction target under GWSA (i.e., 25% below 1990 emissions by 2020). The inventory the Commonwealth posted with the May 2021 update indicated a 2018 statewide reduction of 22.0% from 1990 and this 2nd Addendum shows a reduction of 22.4%.

Table 1 presents a comparison of GHG emissions by year. GHG emissions are shown for: 1990, 2013 (the last year for which a complete inventory was developed in the 2016 update), and the 2020 limit (25% below 1990).[7] The columns in the table show GHG emissions published by MassDEP at the time of the 1990 Baseline update in 2016, the May 2021 proposed update, the February 2022 proposed Addendum, and this 2nd Addendum.

[5] https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-main-text.pdf
[6] https://www.epa.gov/system/files/documents/2022-04/2022_ghgi_update_-_meter.pdf
[7] 2025 and 2030 interim statewide GHG limits and sector-based GHG emissions sublimits must be adopted and published no later than July 1, 2022.

Table 1: Comparison of Massachusetts 1990 and 2013 GHG Emissions, and the 2020 Limit (MMTCO2e)

Year	2016 Published Values	May 2021 Published Values	Addendum Published Values	2nd Addendum Published Values
1990 (Baseline)	94.4	94.3	94.0	93.5
2013 (Actual)	75.5	75.6	76.3	76.1
2020 Limit (25% below 1990)	70.8	70.7	70.5	70.1

Using the revised data sources and methodologies described above, MassDEP estimates that statewide GHG emissions in 1990 were 93.5 $MMTCO_2e$. Table 2 compares 1990 Baseline GHG emissions by sector from the May 2021 update, the Addendum and this 2nd Addendum. Figures 1 and 2 present annual GHG emissions consistent with this 2nd Addendum. An accompanying revised Appendix C spreadsheet contains the calculations that the tables and figures in this 2nd Addendum are based on.

Table 2: 1990 Baseline Update, Addendum and 2nd Addendum GHG Emissions ($MMTCO_2e$)

Sector	1990 Emissions		
	May 2021 Update	Addendum	2nd Addendum
CO_2e from Energy	88.008	87.763	87.113
Residential CO_2e from Fuel Combustion	15.306	unchanged	15.314
Residential - CO_2	15.084	unchanged	15.092
Residential - CH_4 & N_2O	0.221	unchanged	unchanged
Commercial CO_2e from Fuel Combustion	8.450	unchanged	unchanged
Commercial - CO_2	8.393	unchanged	unchanged
Commercial - CH_4 & N_2O	0.057	unchanged	unchanged
Industrial CO_2e from Fuel Combustion	5.773	unchanged	5.606
Industrial - CO_2	5.570	unchanged	5.403
Industrial - CH_4 & N_2O	0.022	unchanged	unchanged
Industrial - MSW (CO_2, CH_4 & N_2O)	0.113	unchanged	unchanged
Industrial - Nat Gas System (CO_2, CH_4 & N_2O)	0.068	unchanged	unchanged
Transportation CO_2e from Fuel Combustion	30.468	30.224	29.582
Transportation - CO_2	28.867	29.204	28.506
Transportation - CH_4 & N_2O	1.601	1.020	1.075
Electricity Total CO_2e from Fuel Combustion	28.011	unchanged	28.162
Electric Generation - CO_2	25.105	unchanged	25.257
Electric Generation - CH_4 & N_2O	0.094	unchanged	unchanged
Electric Generation - MSW (CO_2, CH_4 & N_2O)	0.926	unchanged	unchanged
Electricity Imports (CO_2, CH_4 & N_2O)	1.886	unchanged	unchanged
Natural Gas Systems (CO_2 and CH_4)	2.265	unchanged	2.365
Natural Gas Distribution System	2.096	unchanged	2.196
Natural Gas Transmission and Storage System	0.170	unchanged	unchanged
Industrial Processes	0.656	unchanged	unchanged
Lime, Dolomite, Soda Ash, Urea (CO_2)	0.175	unchanged	unchanged
ODS Substitutes, Semiconductor Manufacturing, Electricity Transmission (HFCs, PFCs, NF_3, SF_6)	0.481	unchanged	unchanged
Agriculture & Land Use (CO_2, CH_4 & N_2O)	0.446	unchanged	unchanged
Waste	2.918	unchanged	2.922
Wastewater (CH_4 & N_2O)	0.658	unchanged	0.662
Municipal Solid Waste - Landfills Only (CO_2, CH_4 & N_2O)	2.260	unchanged	unchanged
Gross Emissions	*94.3*	*94.0*	*93.5*

Note: subsectors shown to 3 decimal places so small changes can be seen. Due to rounding, some totals appear higher or lower than the simple sum of the sectors.
GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Figure 1: Massachusetts 1990-2019 GHG Emissions with Updated 1990 Baseline

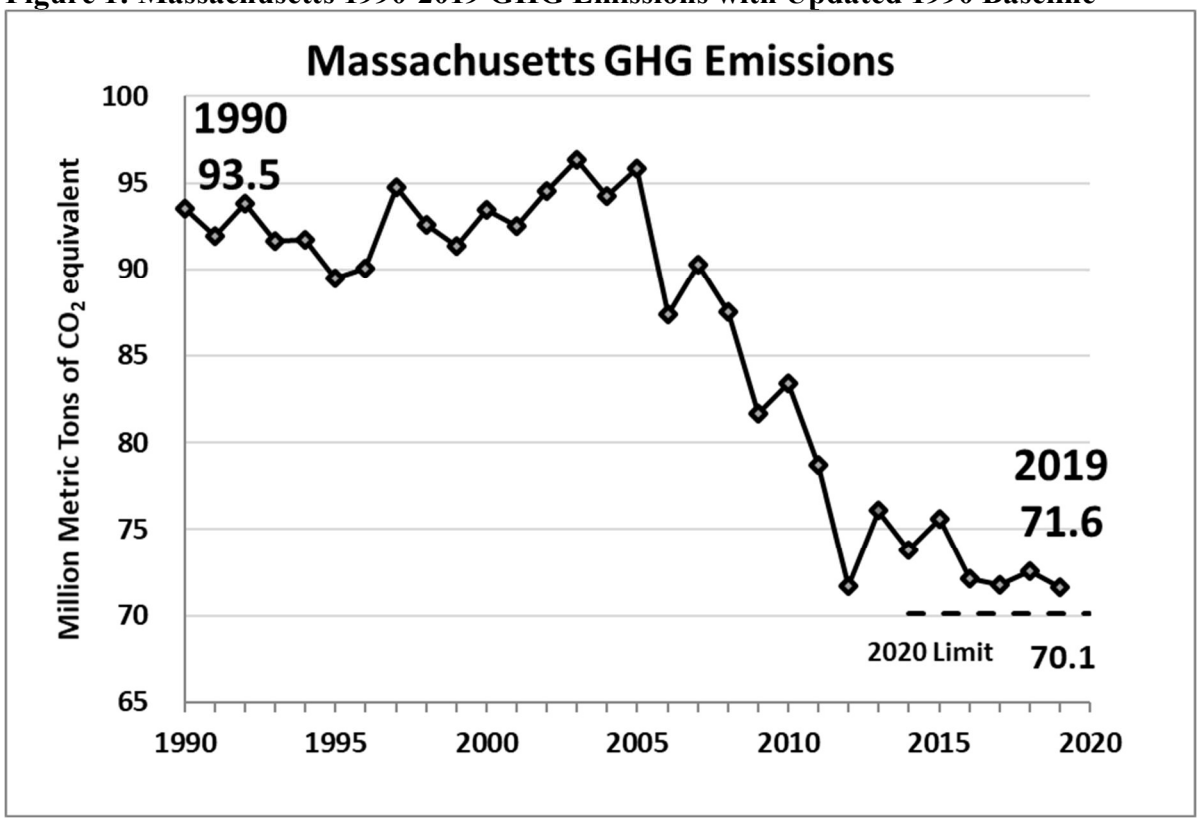

Figure 2: Massachusetts 1990-2019 Fuel Combustion GHG Emissions by Sector