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Response to Comments on the

Statewide Greenhouse Gas Emissions Level:

1990 Baseline Update, and Addendum and 2nd Addendum to the Update

December 2022

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 gases (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, nitrous oxide, and several other compounds primarily used as refrigerants are also GHGs of concern due to their potential to contribute to climate change.[2]

GWSA established the Climate Protection and Green Economy Act in Massachusetts General Law, which requires the Massachusetts Department of Environmental Protection (MassDEP) to, among other actions "*... triennially publish a state greenhouse gas emissions inventory that includes comprehensive estimates of the quantity of greenhouse gas emissions in the commonwealth for the last 3 years in which the data is available,*" and "*...determine the statewide greenhouse gas emissions level in calendar year 1990 and reasonably project what the emissions lever will be in calendar year 2020 if no measures are imposed to lower emissions other than those formally adopted and implemented as of January 1, 2009.*" [MGL chapter 21N, section 2, subsection (c) and section 3, subsection (a)]

Section 14 of GWSA further required MassDEP to establish the 1990 Baseline and 2020 Business as Usual (BAU) Projection by July 1, 2009. The 1990 Baseline and BAU Projection[3] were published on July 1, 2009 and presented actual emissions from 1990 through 2008 for most sectors, and projected emissions to 2020 for all sectors. The 1990 Baseline is the emissions level against which Massachusetts' future GHG emissions reductions limits will be planned and measured.

Updating the 1990 Baseline

The *Statewide Greenhouse Gas Emissions Level: 1990 Baseline and 2020 Business as Usual Projection* (July 2009)[4] states: "The Department recognizes that the science and practice of determining GHG emissions is changing rapidly and that Massachusetts, being at the cutting edge of this work, should avail itself of advancements in the science to the extent possible. Therefore, MassDEP will reevaluate the 1990 Baseline as needed (e.g., significant new data becomes available). If amendment is necessary, a full public review process will be used." By

[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 and 2020 Business As Usual Projection (2009)* at: https://www.mass.gov/doc/statewide-greenhouse-gas-emissions-level-1990-baseline-2020-business-as-usual-projection/download
[4] Ibid.

2016, significant new data had become available, so MassDEP sought public comment and subsequently published an updated 1990 Baseline in the *Statewide Greenhouse Gas Emissions Level: 1990 Baseline and 2020 Business as Usual Projection Update* (July 2016).[5]

In May 2021, MassDEP drafted a second update to the methodologies and data used to estimate Massachusetts' 1990 GHG emissions. These updates were described in *Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* (2021 draft update). MassDEP did not propose to update the *2020 Business as Usual Projection* since 2020 is now in the past. Additional methodology and data changes were proposed in a February 2022 *Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* (addendum) and a June 2022 *2nd Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* (2nd addendum).

Public Comment Process

The *Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* was posted for public comment on the MassDEP public notice webpage on May 28, 2021. An email announcement was also sent to GHG stakeholders on that date. The 30-day public comment period closed on June 28, 2021. The *Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* was posted for comment on the MassDEP public notice webpage on February 22, 2022, with an email announcement sent to GHG stakeholders on that date. The 30-day public comment period closed on March 24, 2022. The *2nd Addendum to the Statewide Greenhouse Gas Emissions Level: 1990 Baseline Update* was posted for comment on the MassDEP public notice webpage on June 30, 2022, with an email announcement sent to GHG stakeholders on that date. The 30-day public comment period closed on August 1, 2022.

In these documents, MassDEP sought comment on the methodologies and data that were used to estimate Massachusetts' 1990 GHG emissions. A summary of public comments received and responses to those comments are presented here.

Comments were provided by:

1. The Nature Conservancy (TNC) on the May 2021 update,
2. Conservation Law Foundation (CLF) on the May 2021 update and the February 2022 addendum,
3. National Grid (NGrid) on the June 2022 2nd addendum, and
4. RENEW Energy on the May 2021 update.

Comments

1. Comment: Commenters support MassDEP's commitment to revising the 1990 Baseline GHG emissions level as new data becomes available, consistent with the GWSA. (TNC, CLF)

Response: MassDEP thanks the commenters for their support.

[5] *Statewide Greenhouse Gas Emissions Leve: 1990 Baseline and 2020 Business As Usual Projection Update (2016)* see: https://www.mass.gov/doc/statewide-greenhouse-gas-ghg-emissions-baseline-projection-update-including-appendices-a-b/download

2. Comment: MassDEP should accurately track progress toward the GWSA goals by accounting for emissions from the combustion of biogenic fuels. (CLF)

Response: MassDEP calculates all GHG emissions from the combustion of biogenic fuels in the Massachusetts GHG Inventory (MA GHG Inventory), as the available data allows. Biogenic CO_2 emissions are tracked separately following the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories.[6, 7] Methane and nitrous oxide emissions from the combustion of biogenic fuels are included in the 1990 Baseline and subsequent annual emissions and are therefore accounted for in tracking progress towards GWSA limits. See also Response 7 below.

3. Comment: MassDEP should take further steps to better understand the historic and current levels of methane emissions in the Commonwealth. Such an endeavor is consistent with the Interim Clean Energy and Climate Plan for 2030's (Interim 2030 CECP)[8] emphasis on stabilizing and limiting the growth of non-energy emissions. Specifically, MassDEP should perform an analysis to compare the most recent emissions results to previous results (dating back to 1990) to transparently measure progress towards GWSA goals. When new emissions factors were adopted in 2015, the dramatic "reduction" in methane leaks was not accurately presented, including in Figure 9 of the Interim 2030 CECP. In addition, MassDEP should endeavor to measure and monitor atmospheric methane levels to account for all methane leaks, including those independent of the natural gas distribution system, to correctly assess whether the Commonwealth is in fact making progress towards its goals under the GWSA. The 1990 Baseline Update presents an ideal opportunity for MassDEP to undertake these improvements. (CLF)

Response: MassDEP has made and will continue to make improvements to its estimates of methane emissions. Emission inventories are not based on measured or monitored atmospheric emission levels; rather, inventories are derived from activity factors and emissions factors. The U.S. Environmental Protection Agency (EPA) is continually making improvements to EPA's national GHG Inventory (GHGI) methodologies and data sources. MassDEP actively follows EPA's progress and incorporates improvements into the MA GHG Inventory. As EPA indicates on its website, "It is EPA's standard process to update the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (GHG Inventory) when relevant new and improved data are available. In recent years, as improved data have become available, EPA has updated methods and data sources for calculating greenhouse gas emissions for several sources in the natural gas and petroleum sectors."[9]

The 2016, 2021 and 2022 updates significantly improve the accuracy of methane emissions in the MA GHG Inventory, particularly from the three largest sources of methane in the Commonwealth: natural gas systems, wastewater, and landfills. The initial 1990 Baseline relied heavily on EPA's State Greenhouse Gas Inventory Tool (SGIT) for almost all sectors. However,

[6] https://www.ipcc-nggip.iges.or.jp/public/2006gl/
[7] https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html
[8] https://www.mass.gov/doc/interim-clean-energy-and-climate-plan-for-2030-december-30-2020/download
[9] https://www.epa.gov/ghgemissions/natural-gas-and-petroleum-systems

SGIT's highly aggregated (for natural gas systems), limited (for wastewater) and sometimes negative (for landfills) emissions calculations, combined with SGIT not allowing state-specific inputs, prompted MassDEP to transition to more accurate calculations and data sources.

By the 2016 update, MassDEP was able to rely on EPA's Greenhouse Gas Reporting Program (GHGRP) and Facility Level Information on GreenHouse Gases Tool (FLIGHT)[10], which contained several years of Massachusetts facility-specific landfill emissions data (for leakage and flaring combustion) reflecting the effect of landfill gas-to-energy (LFGTE) programs that reduce landfill emissions of methane. The MA GHG Inventory also includes methane emissions from the combustion of LFGTE based on heat input from federal Energy Information Administration (EIA) Forms 867 and 923. For wastewater, MassDEP utilized data provided by the Massachusetts Water Resources Authority (MWRA) and EIA to modify the SGIT Wastewater calculations to account for the methane that is captured and diverted to the anaerobic digester "eggs" on Deer Island and to calculate emissions from the combustion and flaring of this biogas. A 2015 study[11] allowed the MA GHG Inventory to include natural gas emissions from metering and regulating stations, customer meters, venting, and a wider range of natural gas distribution system pipeline and service material types than SGIT includes.

By the May 2021 update, the inventory accounted for additional digesters built in response to Commonwealth incentive programs[12] and added methane emissions from septic systems which are not accounted for in the EPA SGIT Wastewater methodology.

The May 2021 update proposed improvements to estimating emissions from the natural gas transmission system, customer meters in the distribution system, and added estimates of fugitive CO_2 emissions from the natural gas distribution and transmission systems. For transmission, EPA's national GHGI provides fugitive emission factors that correspond to the specific infrastructure and equipment in Massachusetts as determined using data available from the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration,[13] EPA's FLIGHT, and individual natural gas companies. For example, one improvement is to use EPA's national GHGI fugitive emission factors that differentiate between reciprocating compressors and wet- and dry-seal centrifugal compressors. This was a significant improvement over the decades old, highly aggregated fugitive emission factors of the SGIT Natural Gas Systems calculations previously used for the MA GHG Inventory.

An improvement with the June 2022 2nd addendum was the inclusion of post-meter leaks of natural gas from residential and commercial buildings and appliances, electric and industrial facilities, and natural gas vehicles using methane leak emission factors from EPA's 2022 GHGI.[14] For post-meter leaks:

[10] https://www.epa.gov/ghgreporting
[11] Direct Measurements Show Decreasing Methane Emissions from Natural Gas Local Distribution Systems in the United States, April 13, 2015 see: http://pubs.acs.org/doi/abs/10.1021/es505116p.
[12] https://www.mass.gov/lists/anaerobic-digestion-organics-diversion
[13] https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids
[14] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2020

- EIA's number of residential customers was used as a proxy for the number of residential buildings and appliances from 1990 to 2016 and American Housing Survey data was used beginning with 2017;
- EIA's number of commercial customers was used as a proxy for the number of commercial buildings and appliances;
- gas consumption data for the electric and industrial facilities was obtained from EIA's State Energy Data System (SEDS)[15]; and
- the number of natural gas vehicles in Massachusetts was provided by vehicle inspection data, beginning with 2018 (since EIA data shows that consumption of natural gas by vehicles was zero in Massachusetts in 1990, it is assumed that there were no natural gas vehicles in Massachusetts in 1990).

An improvement added with the publication of this 1990 update is adoption of EPA GHGI methane emission factors for the natural gas distribution system, including pipeline miles and services, metering and regulating stations, and routine maintenance and upsets, for consistency with EPA.

The net result of the above improvements is that the MA GHG Inventory now shows a decrease in methane emissions from 5.2 $MMTCO_2e$ in 1990 (as compared to 5.8 MMTCO2e posted in October 2020, prior to the proposed May 2021, February 2022 and June 2022 updates) to 1.7 $MMTCO_2e$ in 2017 (the same value posted in October 2020) and 1.6 MMTCO2e in 2019.

4. Comment: MassDEP should regularly assess the accuracy and reliability of the third-party data sources it uses to determine whether it should discontinue use of any source. The inventory relies on the EPA's national GHG inventory[16] for the emission factors within the natural gas systems sector. Researchers have demonstrated that the 2020 GHGI's revised methodology significantly underestimates methane emissions from oil and gas.[17] MassDEP should be vigilant in preventing the underreporting of emissions, as accurate tracking is essential to achieving the emissions reductions mandated by the GWSA and Climate Act (Chapter 8 of the Acts of 2021). (CLF)

Response: MassDEP continues to review opportunities to improve emission factors and activity data in all sectors of the MA GHG Inventory. The article referenced by the commenter specifically states "Our best estimate for mean 2010–2015 US anthropogenic emissions is 30.6 (range: 29.4–31.3) [Teragrams per acre] Tg a^{-1}, slightly higher than the gridded EPA inventory (28.7 (26.4–36.2) Tg a^{-1}). The main discrepancy is for the oil and gas production sectors, where we find higher emissions than the GHGI by 35% and 22%, respectively." Massachusetts has no oil or gas production facilities; therefore, no oil or gas production emission factors from EPA's national GHGI are used in the MA GHG Inventory. The study did not identify problems with EPA's national GHGI natural gas transmission and distribution sector emissions.

[15] https://www.eia.gov/state/seds/
[16] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
[17] Maasakkers, J. D., Jacob, D. J., Sulprizio, M. P., Scarpelli, T. R., Nesser, H., Sheng, J., Zhang, Y., Lu, X., Bloom, A. A., Bowman, K. W., Worden, J. R., and Parker, R. J.: 2010–2015 North American methane emissions, sectoral contributions, and trends: a high-resolution inversion of GOSAT observations of atmospheric methane, Atmos. Chem. Phys., 21, 4339–4356, https://doi.org/10.5194/acp-21-4339-2021, 2021.

MassDEP regularly assesses the strength of available data sources and methodologies for the MA GHG Inventory and incorporates improvements.

5. Comment: MassDEP should not include post-meter emissions sources in the local gas distribution companies' (LDCs') distribution system segment of the natural gas system GHG emissions. Instead, MassDEP should group these emissions estimates in a category for "other" emissions sources, as the EPA did in the *Draft 2022 Inventory of U.S. GHG Emissions and Sinks (1990-2020)* (2022 GHGI). MassDEP should wait to include post-meter emissions until more reliable data is available as noted in attached American Gas Association comments to EPA on the Draft 2022 GHGI, which included an extensive analysis of the studies EPA relied on for its post-meter leak emission factors. (NGrid)

Response: MassDEP has changed the category label in the Appendix C inventory spreadsheet to read 'Distribution and Post-Meter' parallel to the related category of 'Transmission and Storage.' However, because post-meter and customer meter emissions both use the number of customer meters in their calculations, the post-meter leak calculations remain on the same tab as the distribution emissions. MassDEP has included post-meter emissions using EPA's calculation approach and will continue to review the post-meter leak emission factor information as it evolves, along with any other related data.

6. Comment: MassDEP should explain why it chose to divide EIA's SEDS biodiesel consumption data equally between the transportation and residential sectors within the GHG inventory. Are these amounts consistent with an estimate of actual biodiesel use within the respective sectors? MassDEP should assign biodiesel consumption to the transportation and residential sectors based on a good faith estimate of each sector's actual use of biodiesel fuels, recognizing that this proportionate split may change from year to year. (CLF)

Response: EIA's SEDS now provides an annual biodiesel consumption value, assigning it solely as a transportation fuel. The SEDS Technical Notes[18] state that beginning with 2011, SEDS calculates state estimates by apportioning EIA's U.S. total biodiesel consumption using various district- and state-level values. From 2001 to 2010, to estimate state-level consumption, SEDS uses the 2011 state shares applied to the U.S. total biodiesel consumption for each year. The Technical Notes also state that while EIA is aware that other sectors consume some amount of biodiesel, SEDS "assigns all biodiesel consumption to the transportation sector because there is not enough information to allocate consumption to the other sectors."

However, in Massachusetts biodiesel is consumed as a heating fuel, which is encouraged through the Massachusetts Department of Energy Resources' (DOER) Alternative Energy Portfolio Standard (APS),[19] which has been offering incentives for eligible liquid biofuel to be used as a heating fuel since 2015, largely for residential customers, with a small number of commercial customers, such as schools.

[18] https://www.eia.gov/state/seds/seds-technical-notes-complete.php?sid=US#Consumption
[19] https://www.mass.gov/alternative-energy-portfolio-standard

MassDEP indicated in the 2021 draft update that state-level biodiesel consumption data became available from SEDS extending back to 2010, which was a typographical error, as the data is available back to 2001, as was included in the draft Appendix C spreadsheet. MassDEP will update the year in which it begins dividing the SEDS biodiesel consumption evenly between the residential and transportation sectors to 2015, to match the start of eligibility under the DOER APS program. All biodiesel consumption prior to 2015 has been assigned to the transportation sector. Based on the limited data available, MassDEP believes this is a reasonable starting point for the inclusion of biodiesel in the MA GHG Inventory. MassDEP expects to see future refinements to biofuel data that will allow a more accurate division of biodiesel, and the inclusion of the commercial sector, as data sources become more established.

7. Comment: MassDEP should revise the GHG inventory to fully account for the lifecycle emissions associated with biomass fuels. Such a framework is necessary to allow for an accurate and transparent evaluation of the Commonwealth's progress towards its GWSA goals. The Massachusetts 2050 Decarbonization Roadmap (2050 Roadmap)[20] stresses that the Commonwealth will need to transition from a gross emissions accounting framework to a net accounting framework that might consider accounting for "leakage" if the rise in biofuel use incentivizes deforestation in other states and reduces sequestration. Given the amount of biofuel feedstock needed for building use in a heavy blending scenario and the current location of biofuel feedstocks in the short term, it is highly likely that most of the Commonwealth's biofuel use would result from such leakage. Additionally, the 2050 Roadmap's modeling assumes that biogenic fuels have a GHG emissions value of zero, which is incompatible with the science on biogenic carbon accounting. For these reasons, improving the emissions assumptions around solid and gaseous biomass will help set the Commonwealth on a path to truly reach Net Zero emissions by 2050. As the Commonwealth makes progress toward Net Zero, it should invest immediately in strategies for the Commonwealth's natural and working lands (NWL) that include carbon sequestration and storage, offsets, and early and genuine representation from environmental justice communities. Stakeholders should help develop requirements and ranking criteria relating to additionality, verification, leakage, permanence, and co-benefits, and preferential criteria and funding for offsets that have climate mitigation and adaptation benefits. Without early and genuine representation from environmental justice communities in this discussion, there is the risk of creating a regional market that allows pollution in underserved communities while co-benefits from carbon offsets accrue elsewhere. (CLF, TNC)

Response: The October 2022 GWSA Public Hearings on the Clean Energy and Climate Plan for 2050 slides[21] present the Executive Office of Energy and Environmental Affairs' (EEA) plans for discussions on the development of the 2050 Clean Energy and Climate Plan and its net zero accounting framework, which include biomass emissions. MassDEP will update its GHG inventory as needed as the net zero accounting framework is developed. As required by GWSA, if MassDEP proposes to amend the 1990 Baseline emission level, it will seek public input.

8. Comment: Massachusetts must accurately account for emissions and sequestration from the current NWL with the goals of maintaining carbon stocks, increasing the size of our carbon sink from forests, farms, and wetlands, and reducing emissions from our NWL. While there remain

[20] https://www.mass.gov/doc/ma-2050-decarbonization-roadmap/download
[21] https://www.mass.gov/doc/2050-cecppublic-hearingpresentationenglish/download

some aspects of NWL carbon that require additional data, there exists reliable, accurate and precise data that can be used across New England. Regionally consistent sequestration measurement, accounting, and market frameworks are needed. (TNC, CLF)

Response: EEA began holding a series of stakeholder meetings in Fall 2021 providing updates and soliciting feedback on its new NWL methodology,[22] culminating in *Appendix C: Natural and Working Lands Greenhouse Gas Assessment and Inventory* of the *Appendices to the Massachusetts Clean Energy and Climate Plan 2025 and 2030*.[23] The GHG inventory spreadsheet accompanying this 1990 Baseline Update integrates EEA's NWL methodology.

9. Comment: The 1990 baseline review process should provide stakeholders with information that documents whether pre-2011 clean energy generators in the New England region are appropriately recognized in the baseline that informed the current Clean Energy Standard for Clean Existing Generation Units (CES-E) requirement. This information can help in the program review of 310 CMR 7.74 and 7.75 to support increasing the CES-E to the proposed 25 percent or even higher, to ensure that new clean generation replaces fossil fuels, not existing clean energy. (RENEW)

Response: MassDEP proposed amendments to 310 CMR 7.75 *Clean Energy Standard* on April 29, 2022 to increase the CES-E to 25%. On October 14, 2022 MassDEP finalized amendments to 310 CMR 7.75 increasing the CES-E to 25%.[24]

[22] https://www.mass.gov/service-details/the-global-warming-solutions-act-gwsa-public-meetings
[23] https://www.mass.gov/doc/appendices-to-the-clean-energy-and-climate-plan-for-2025-and-2030/download
[24] https://www.mass.gov/guides/clean-energy-standard-310-cmr-775#-news-&-updates-