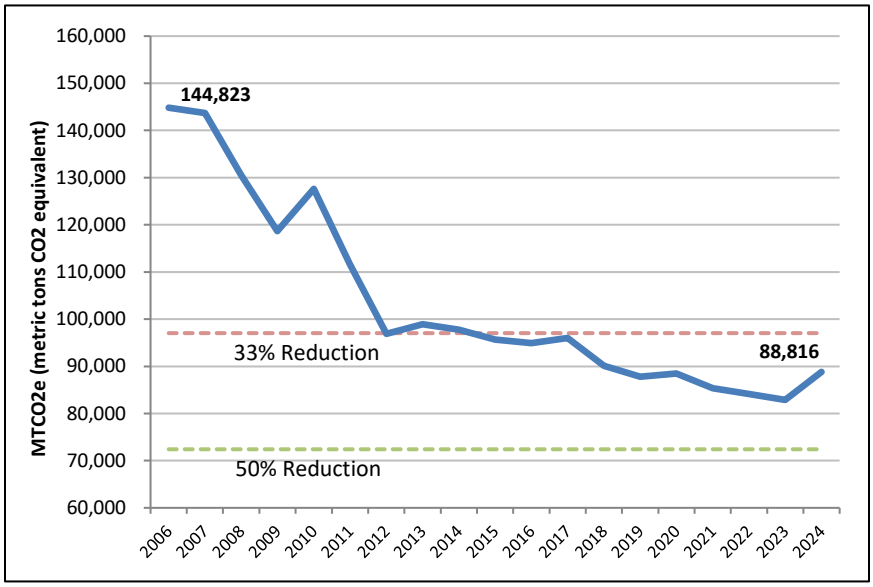
Greenhouse Gas Emissions Inventory Update for 2024

Massachusetts Water Resources Authority

I. Summary

In addition to its primary mission of protecting public health and waterways by providing safe drinking water and high quality wastewater treatment to member communities, MWRA is committed to reducing greenhouse gas (GHG) emissions. MWRA has made steady progress towards meeting the goals of the Commonwealth's Clean Energy and Climate Plan for 2050, which commits Massachusetts to net zero GHG emissions by 2050 with intermediate reduction targets of 33% by 2025 and 50% by 2030.

Figure 1: MWRA GHG Emissions 2006-2024



As of 2024, **MWRA has reduced emissions by 39%** compared to 2006 levels, exceeding an intermediate state target of 33% by 2025. However, there was a notable (7.2%) increase in 2024 overall emissions compared to 2023 largely due to fuel oil demand for boilers at the Deer Island Treatment Plant. GHG emissions from natural gas use also increased by 10%, primarily a result of higher heating demand at several facilities, including the Quincy Biosolids Processing Facility, due to the cold winter in 2024.

Indirect emissions from purchases of grid electricity remain MWRA's largest source of emissions, accounting for 42% of the Calendar Year (CY) 24 total. Overall electricity purchases increased for the second consecutive year to their highest value since 2011, driven at least partially by increased pumping demand at Deer Island during intense storms in 2024. Even with the increased demand, emissions from electricity purchased increased only slightly due to ongoing buildout of non-emitting sources within the regional power grid. Other major sources of emissions include wastewater treatment processes and fugitive gases, and MWRA's vehicle fleet – see Table 1 below.

MWRA plans to continue reducing emissions through energy efficiency improvements, electrification of heating systems, the expansion of renewable energy assets, a new combined heat and power (CHP) plant at Deer Island (see more details in Looking Ahead section below), and vehicle fleet electrification.

MWRA's inventory mainly measures GHGs according to the Local Government Operations Protocol (LGOP), but also utilizes several other methods as appropriate to our specific

activities.[1] The emission factors (EF) used to generate values for the GHG emissions from energy consumption for most stationary combustion sources are based on data from EPA and from MassDEP for emissions from grid electricity purchases.

II. GHG Inventory

MWRA's GHG emissions are **38.7%** lower than the baseline year of 2006, achieving the Commonwealth's target of a 33% reduction by 2025. This reduction of approximately 56,000 of metric tons of carbon dioxide equivalent ($MTCO_2e$), is comparable[2] to taking more than 13,000 gasoline-powered passenger vehicles off the road each year.[3] Most of the decrease, more than 80%, was achieved by reducing electricity purchases and the ongoing de-carbonization of New England's electric grid. As more renewable sources are added to the grid, MWRA's emissions per unit of electricity will further decrease, emphasizing the importance of electrifying facilities and moving away from fossil fuels as a heating source.

Table 1: MWRA GHG Emissions by Source

$MTCO_2e$ by Source	2006 (Baseline)	2019	2020	2021	2022	2023	2024
Electricity	87,590	33,094	40,529	38,600	36,334	36,894	37,281
Natural Gas	20,964	17,729	17,483	16,504	17,137	17,345	19,068
Diesel/Fuel Oil/Propane	15,243	16,959	10,647	11,472	10,985	9,532	14,414
Process & Fugitive	18,886	17,991	18,038	16,793	17,898	17,489	16,283
Fleet	2,142	1,990	1,804	1,982	1,806	1,617	1,770
Total	**144,823**	**87,763**	**88,500**	**85,350**	**84,160**	**82,878**	**88,816**

As shown in Table 1 above, in 2024 the major sources of GHG emissions in MWRA's operations (as a percentage of total emissions) included:

- Electricity (water and wastewater treatment plants, pump stations, headworks, and other facilities), **42.0%**
- Natural gas (sludge dryers at the pelletizing plant and building space heating), **21.5%**
- Diesel, fuel oil, and propane (backup generators and building space heating), **16.2%**
- Process and fugitive (emissions at wastewater treatment plants, landfills, and the pelletizing plant, **18.3%**
    - Process emissions result from biochemical reactions during wastewater treatment. Fugitive emissions result from unintentional releases of GHGs from piping, incomplete combustion of digester gas, and decomposition from landfill disposals
- Vehicle Fleet, **2.0%**

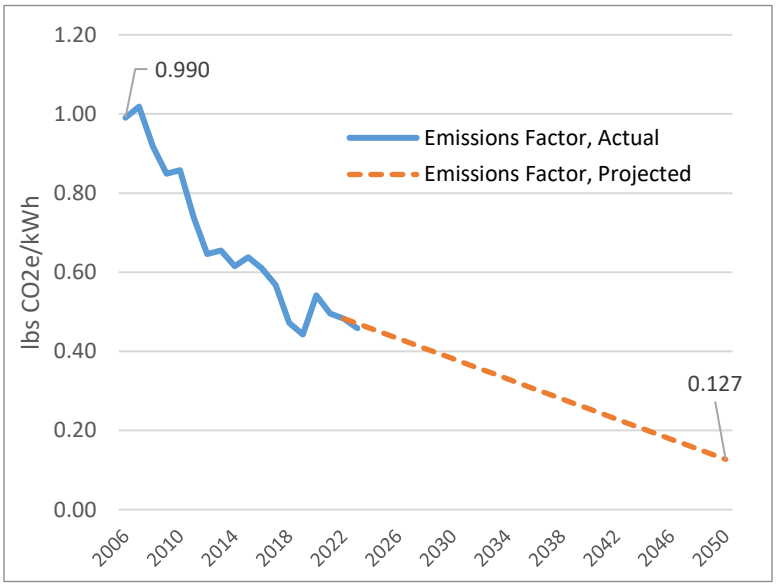
[1] See MWRA's GHG Inventory Update 2006-2022 for more details on accounting methodology.
[2] All emissions are expressed in metric tons of carbon dioxide equivalent, $MTCO_2e$. This unit allows for the inclusion of other, more potent GHGs, such as methane and nitrous oxide, into a single inventory.
[3] EPA Greenhouse Gas Equivalencies Calculator

Annual precipitation is often closely correlated with MWRA's total energy demand. During high precipitation years, flows to Deer Island are increased due to large volumes of inflow and infiltration into the sewer system, increasing energy demand at the plant. However, an overall decrease in annual flow to the plant in 2024 did not result in a decrease in electricity demand. This was likely due to a combination of factors including size and duration of specific storms, periods of drought, and temperature variations. Plant flow in 2024 averaged 316 million gallons per day (MGD), a decrease of 7.2% compared to 341 MGD in 2023. Total purchased electricity demand increased to 179.3 gigawatt-hour (GWh), a roughly 1% increase compared to 177.4 GWh in 2023.

Electricity Emissions Factor

A significant factor in MWRA's GHG emissions reduction has been the decreasing share of coal-fired generators and increase of non-emitting generators within the regional electricity grid, and therefore fewer carbon emissions per unit of energy generated. This value is referred to as the "emissions factor." In 2006, the average kilowatt-hour (kWh) purchased resulted in emissions of roughly one (1) pound of CO2e. As of the most recent estimate of this value from 2023[4], that emissions factor has been reduced by more than half to approximately 0.47 lbs CO2e/kWh. If targets set by the Commonwealth of Massachusetts for renewable energy buildout established by the Clean Energy Standard (CES) are met, MWRA estimates that an average grid kWh will be just over 12.5% as emissions intensive in 2050 as in 2006 (see Figure 2). Since grid electricity accounts for the largest share of MWRA's emissions, the actual rate that this factor decreases could significantly affect reduction efforts.

Figure 2: Grid Emissions Factor, MassDEP & Projected



Fuel Oil Increase at Deer Island Wastewater Treatment Plant Drives Higher Emissions

MWRA's GHG emissions from fuel oil combustion at the Deer Island Treatment Plant increased (+146%) in 2024 compared to 2023, driven by higher fuel demand for facility boilers. This increased fuel demand resulted in additional emissions of roughly 5,000 $MTCO_2e$, or more than 80% of the overall emissions increase compared to 2023. In addition to the colder winter, initial analysis by MWRA staff suggests that this may be influenced by recent decrease in the solids and nutrient loading of the influent wastewater. This can reduce the quantity of beneficial digester gas produced per unit of wastewater, thereby impacting the requirement for supplemental boiler fuel oil to meet the full plant heating demand. The quantity of digester gas

[4] The latest electricity emissions factor from MassDEP is based on 2023, which is applied to both 2023 and 2024 in MWRA's inventory. When 2024 GHG emissions are updated with the updated 2024 electricity emissions factor, overall emissions will be less than shown in this report.

produced at Deer Island had decreased substantially beginning in 2020, but has gradually recovered to near long-term average levels. However, the average thermal content of the digester gas (measured in British Thermal Units (BTUs)/ft^3) has continued to fall over this same period. Even though the quantity of gas is similar to historic levels, combusting the gas is producing less heat per unit.

Staff will continue to evaluate whether these changes could be the result of dynamics such as the growth of remote work in the Boston Metro area post pandemic or historically low wastewater flows resulting in longer detention times and solids degradation in the collection system.

III. Looking Ahead

MWRA continues to advance projects that reduce GHGs while providing high quality and reliable water and wastewater services to our communities.

In October 2024, MassDEP awarded MWRA a $20 million Climate Protection and Mitigation Trust grant to fund the construction of several decarbonization projects that will be initiated over the next five years: canopy and roof mounted solar at Deer Island; ground mounted solar at the Norumbega covered water storage facility; wind turbine replacement on Deer Island; and electric heat pump installations at several MWRA facilities.

Deer Island Solar Canopy Mock-up



Though they contribute only a small portion of the total MWRA GHG emissions, the vehicle fleet also continues to be electrified. MWRA installed 20 new dual port Level 2 chargers, and five Level 3 at the Chelsea Administrative Facility in 2025, with plans for additional charging stations at other facilities in 2026. These chargers will support the continued expansion of electric vehicles in the MWRA fleet, while also providing charging to employees and guests.

Another project currently underway at MWRA is a new CHP system at Deer Island, which commenced design in October 2024. The current combined heat and power system produces 30.5 GWh/year from methane derived from the digested wastewater residuals. Once completed, the new system is expected to produce approximately 69.3 GWh/year, more than doubling the renewable electricity produced. This increase in production will mean that roughly 75% of the energy required to run the Deer Island facility will be

Renewable Energy Assets at Deer Island



produced on site, significantly lowering the amount of energy purchased from the regional grid. The new CHP system will also optimize thermal production to meet process heating demands while using 75% less fuel oil.

MWRA is also studying the feasibility of installing a large-scale battery at Deer Island that could reduce the use of the combustion turbine generators, which operate as standby power sources when the facility is operating close to peak flow during major storms. Besides reducing fossil fuel demand and related GHGs, such a system could also provide financial benefit to the Authority through incentive programs and reductions in peak demand for energy bill management.

Finally, the Authority is participating in multiple projects led by the Water Research Foundation that will produce new guidance for water and wastewater utilities to measure and reduce GHG emissions. Examples include an effort to create a new GHG inventory template, and another project that will provide a framework for direct measurement of process and fugitive emissions from wastewater treatment, as opposed to the population-based methods that are currently used.