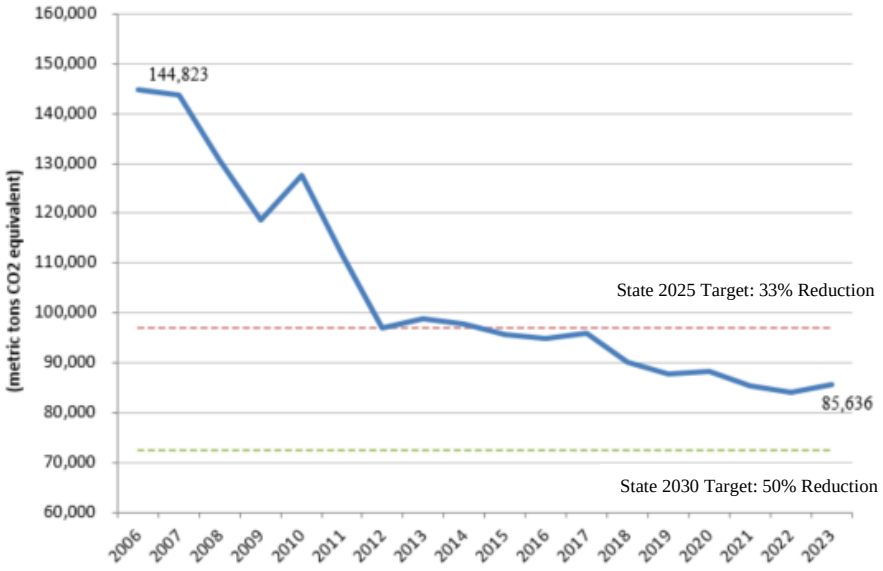
Greenhouse Gas Emissions Inventory Update for 2023

Massachusetts Water Resources Authority

I. Summary

MWRA is committed to being a leader in environmental stewardship. In addition to our primary responsibility of protecting public health and waterways by providing safe drinking water and high quality wastewater treatment to member communities, we continue to focus on reducing our greenhouse gas (GHG) emissions. MWRA is making good 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 Emissions 2006-2023



As of 2023, **MWRA reduced emissions by 41%** compared to a baseline of 2006, already meeting the State's 2025 target. However, there was a slight rise in emissions from 2022 (less than 2%) due to a significant increase in precipitation in 2023, which led to almost 30% higher flows to the Deer Island Wastewater Treatment Plant. When there are high flows, more wastewater needs to be pumped throughout MWRA's collection system and processed at Deer Island, resulting in increased electricity purchases and associated emissions. Consequently, GHG emissions from electricity rose by 7% in 2023 compared to 2022. These higher emissions from electricity were partially offset by an 8% decrease in MWRA's direct emissions from consumption of fuel oil due to a milder winter in 2023.

Electricity is MWRA's largest source of emissions, accounting for roughly 45% of the total and over 80% of MWRA's emissions reductions since 2006. Other major sources of emissions include wastewater treatment processes and fugitive gases, as well as natural gas, diesel, and fuel oil combustion used to run standby generators and heat facilities – see Table 1 below.

MWRA plans to continue reducing emissions through energy efficiency improvements, electrification of heating systems, the expansion of renewable energy assets, and fleet electrification. The most impactful of these future projects is the construction of a new combined heat and power (CHP) system at Deer Island, which is currently in design. The new CHP is projected to generate twice as much renewable electricity from the combustion of digester gas as the existing CHP system, reduce fuel oil use, and therefore significantly reduce GHG emissions.

II. Accounting Methodology

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.

III. GHG Inventory

MWRA's GHG emissions are **41%** lower than the baseline year of 2006, achieving the Commonwealth's target of 33% by 2025. This equates to a reduction of approximately 60,000 $MTCO_2e$[2], comparable to taking more than 13,000 passenger vehicles off the road each year. 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 the grid continues to get greener, MWRA's emissions from electricity will continue to decrease, emphasizing the importance of electrifying facilities and moving away from fossil fuels as a heating source.

As shown in Table 1 below, in 2023 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), 45.4%
- Natural gas (dryers at the pelletizing plant and building space heating), 20.2%
- Diesel, fuel oil, and propane (backup generators and building space heating), 12.1%
- Process and fugitive (emissions at wastewater treatment plants, landfills, and the pelletizing plant – see MWRA's 2022 GHG Inventory for more detail), 20.4%
- Fleet, 1.9%

Table 1: MWRA GHG Emissions by Source[3]

$MTCO_2e$ by Source	**2006 (Baseline)**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Electricity	87,590	40,327	36,243	33,094	40,529	38,600	36,334	38,860
Natural Gas	20,964	16,984	17,435	17,618	17,358	16,403	17,096	17,299
Diesel/Fuel/Propane	15,242	17,833	17,108	17,263	10,911	11,470	11,241	10,336
Process & Fugitive	18,885	18,818	17,227	17,688	17,773	16,792	17,641	17,499
Fleet	2,142	2,060	2,053	1,990	1,804	1,982	1,806	1,642
Total	**144,823**	**96,022**	**90,066**	**87,653**	**88,375**	**85,247**	**84,118[4]**	**85,636**

[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] The 2022 inventory included an 'other' category that included incomplete combustion of digester gas, propane, fleet, and refrigerants. For 2023 we put these sources in more specific categories and adjusted previous years.
[4] The total emissions for 2022 are lower than those reported in MWRA's 2022 Inventory (85,079 $MTCO_2e$) due to an updated EF for electricity. At the time of the previous report's release, a 2022 EF was not available from MassDEP so the 2021 EF was used. Now that a 2022 EF is available, that is being applied to both 2022 and 2023.

Overall, emissions slightly increased in 2023 due to MWRA's service area experiencing much higher precipitation compared to the relatively dry conditions of 2022, leading to a significant increase in flow to Deer Island. The amount of wastewater pumped to and treated at Deer Island in 2023 was 341 million gallons a day (MGD), an increase of 27% over the 268 MGD in 2022.

Figure 2: Relationship between Deer Island WWTP flow and electricity purchased

Additional pumping demands throughout the system caused by the nearly 30% increase in flow required a significant rise in electricity usage, leading to higher emissions. As a result, GHG from electricity rose by 7% in 2023 compared to 2022. The close relationship between wastewater flow to Deer Island and total MWRA electrical purchases is reflected in Figure 2. As flow (blue) fluctuates year to year, electricity purchases (red) mirror these changes. While MWRA's efforts over the past two decades to mitigate emissions have largely been successful, energy use and GHGs will always be linked to fluctuations in precipitation. MWRA's priority is to protect the environment and public health by collecting and treating wastewater, regardless of fluctuations in flow, despite the higher emissions that result.

Fuel oil and diesel emissions decreased by 8% in 2023 compared to 2022, while all other emission sources remained relatively stable. The main driver for this decrease was the considerable reduction in fuel used to heat MWRA's facilities, especially Deer Island, due to a warmer winter. The winter of 2022 was colder, with an average January-March temperature of 34°F, compared to 2023, which had an average temperature of 38°F over the same period[5]. With reduced heating needs, MWRA burned 32% less fuel in 2023 to heat Deer Island.

IV. 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: 1-2MW canopy and roof mounted solar at Deer Island; 4-5MW ground

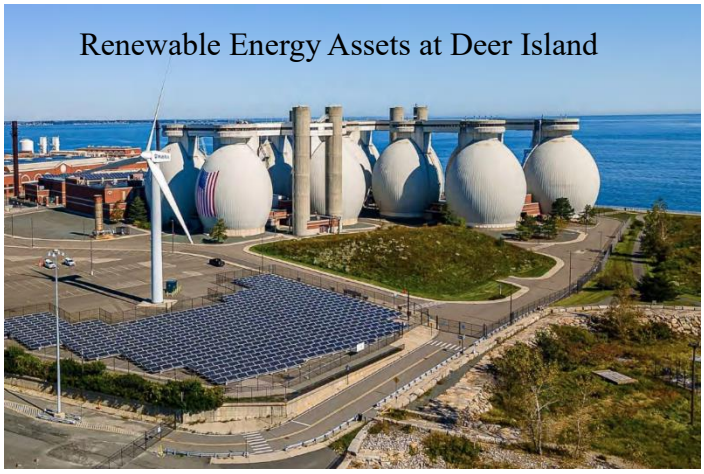
[5] National Oceanic and Atmospheric Administration data

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 is also being electrified. The installation of an additional 60 electric vehicle charging ports at major facilities is planned over the next several years, with work currently in progress at the Chelsea administration building. These chargers will support the continued expansion of electric vehicles in the MWRA fleet, while also providing charging to employees and guests.

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. If practical, this battery would significantly reduce MWRA's fuel oil use.


Renewable Energy Assets at Deer Island

The most impactful emissions reduction project currently underway at MWRA is a new combined heat and power (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 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.

To expand on the information and accounting provided in this update, MWRA is developing a broader GHG Reduction Plan, which is expected to be published in early 2026. In addition to providing an update for the 2024 inventory, this plan will include projections of future GHG emissions and pathways for achieving additional reductions.