2024 UPDATE
Greenhouse Gas Action Plan

Prepared for
Washington Suburban Sanitary Commission

WSSC WATER
DELIVERING THE ESSENTIAL

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Executive Summary

Background

Washington Suburban Sanitary Commission (WSSC) Water provides water and wastewater service to an estimated 1.9 million residents in Maryland's Montgomery and Prince George's counties. WSSC Water owns and operates two water filtration plants (WFPs), five water resource recovery facilities (WRRFs), more than 5,800 miles of freshwater pipeline, and more than 5,600 miles of sewer pipeline.

In 2023, WSSC Water adopted a goal of net zero emissions by 2050 and a 50% reduction from 2005 emissions by 2030. This is an annual reduction goal of around 3.5 percent. In 2011 – 2023, WSSC Water's emissions reduction goal aligned with the jurisdictions it serves. In 2010, the State of Maryland and the Metropolitan Washington Council of Governments (which includes Montgomery and Prince George's counties) adopted a greenhouse gas (GHG) emission reduction goal to achieve a 10 percent reduction in emissions every 5 years through 2050, for a total reduction of 80 percent less than the baseline year of 2005.

WSSC Water has developed inventories of annual GHG emissions for all Commission operations for the calendar years (CY) 2005 through 2024. The inventories quantify the GHG emissions that result from the energy-intensive processes required to treat and distribute potable water for public use and to collect and treat wastewater before discharge. Accounting protocols published by The Climate Registry, the Intergovernmental Panel on Climate Change (IPCC), and the International Council for Local Environmental Initiatives are used to complete the inventory with the most recently updated methodology and emissions factors. Methodologies are described in detail in WSSC Water's *GHG Inventory Development and Management Plan* (WSSC Water 2021). Based on the inventory results, a 40-year plan of action was developed with strategies to reduce future GHG emissions at WSSC Water by 10 percent every 5 years through the year 2050 (80 percent reduction by 2050), using demonstrated technologies and practices available at the present time. In November 2012, CH2M HILL, Inc., now Jacobs, and Shah & Associates prepared the *Greenhouse Gas Action Plan*, which summarized the findings of the inventory and outlined the proposed GHG emission reduction strategies to meet an initial reduction goal by 2030. The report also provided future considerations for additional strategies to meet the ultimate goal by 2050.

The 2012 report and supporting information have been evaluated and updated annually since 2012, to reflect current operations, projects, and inventory data and to track progress against the plan and updated the action strategies.

This report (dated July 2025) constitutes the 2024 update to the GHG Action Plan and includes the following:

- Summary of completed, in-progress, and new planned projects at WSSC Water that will impact the GHG inventory.
- Projected annual emissions through the year 2050, which are compared to the updated WSSC Water GHG reduction goal (100 percent reduction by 2050).

- Validation of the emission reduction strategies listed in the 2023 GHG Action Plan and annual updates through 2024 in terms of practicality, timing, GHG reduction potential and cost.

Greenhouse Gas Inventory Summary

The inventories include emissions from Scope 1, Scope 2, and Scope 3 sources. Scope 1 emissions, or ***direct emissions***, result from sources or processes owned or controlled by WSSC Water. Scope 2, ***indirect*** emissions, result from electricity purchases. Scope 3, ***other indirect***, emissions are from relevant outsourced or non-owned/controlled activities (for example, biosolids hauling, chemical manufacturing, and business travel). Figure ES-1 presents a representation of the annual GHG emission totals (including Scope 1, Scope 2, and Scope 3 emissions). Biogenic emissions are reported separately from these scopes and do not count toward the inventory.

In 2008, WSSC Water began a direct purchase of wind-generated electrical power. This resulted in an avoidance of Scope 2 emissions (resulting from electricity purchases) and a net reduction in GHG emissions. In 2018, WSSC Water purchased Renewable Energy Credits (RECs) to offset all the Scope 2 indirect emissions.

Greenhouse Gas Emissions Projections

Based on the results of the GHG inventory and the completed, in-progress, and planned projects at WSSC Water, projected annual emissions were developed and compared to the 2035 GHG reduction goal. The inventory results were used as the baseline from which the future GHG emissions could be projected. Future GHG emissions at WSSC Water will be mainly affected by the following factors:

- Population growth in the service area will increase the demand for potable water and the resulting wastewater flows.
- Regulatory drivers that require process upgrades to meet more advanced levels of treatment.
- Implementation of renewable energy programs such as wind, solar, and biogas (anaerobic digestion and combined heat and power).

Figure ES-2 illustrates how the projected growth of GHG emissions compares to WSSC Water's current goal of net zero by 2050 (previously 10 percent reduction every 5 years after 2010), and the impact of projects currently under implementation. The projection includes the wind contract that began June 1, 2020, all REC purchases, and reductions due to the solar contract beginning 2026.The red line on Figure ES-2 represents WSSC Water's reduction goals of 10 percent every 5 years from 2005 GHG emissions (2010 to 2023) and 100 percent reduction from 2023 emissions by 2050. The projection indicates that by 2050, WSSC Water would need to reduce annual emissions by 93,930 tonnes carbon dioxide equivalent (CO_2e) to meet the net zero goal.

Figure ES-1
Summary of Annual Greenhouse Gas Net Emissions by Source Category and Calendar Year

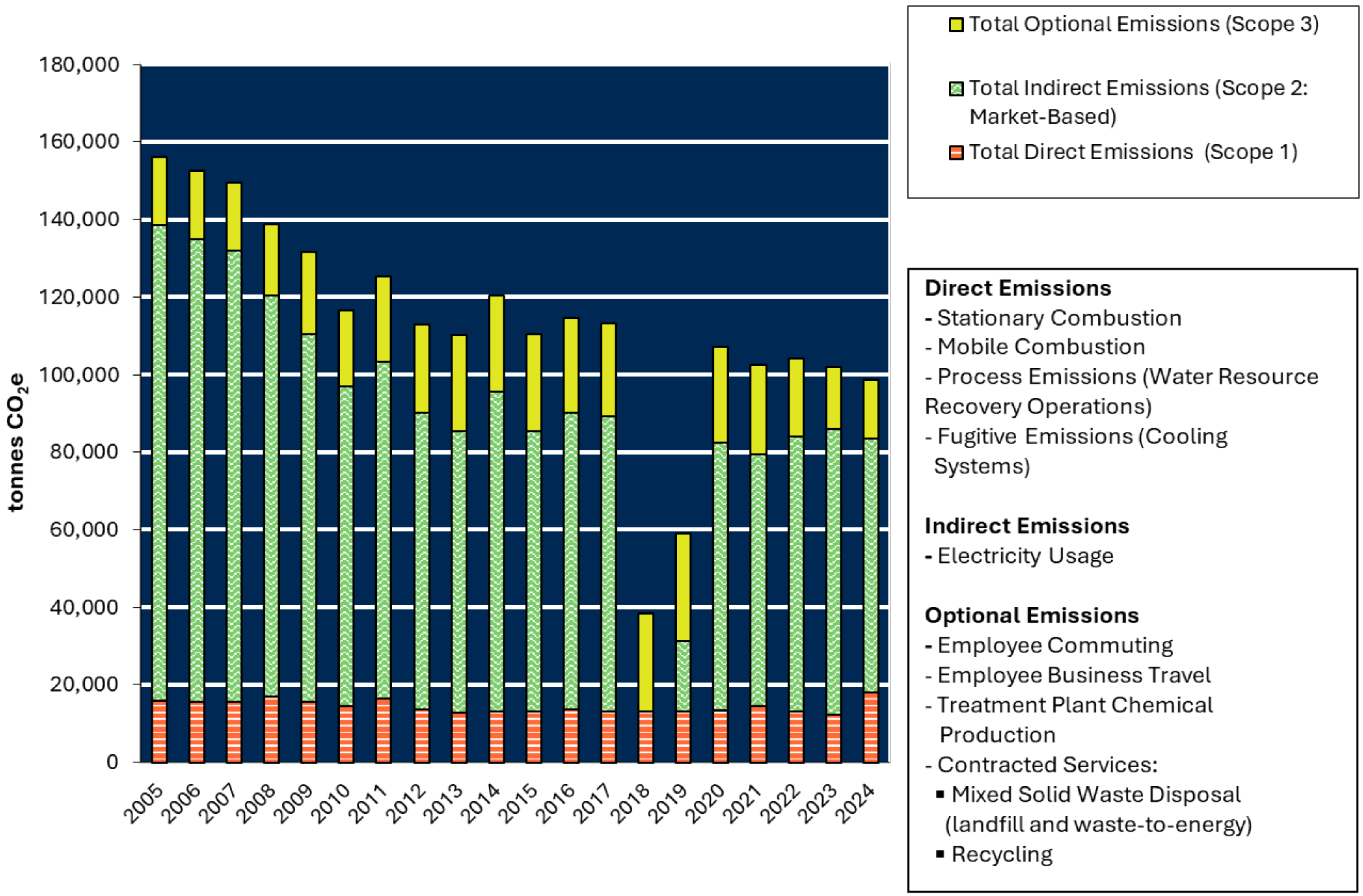
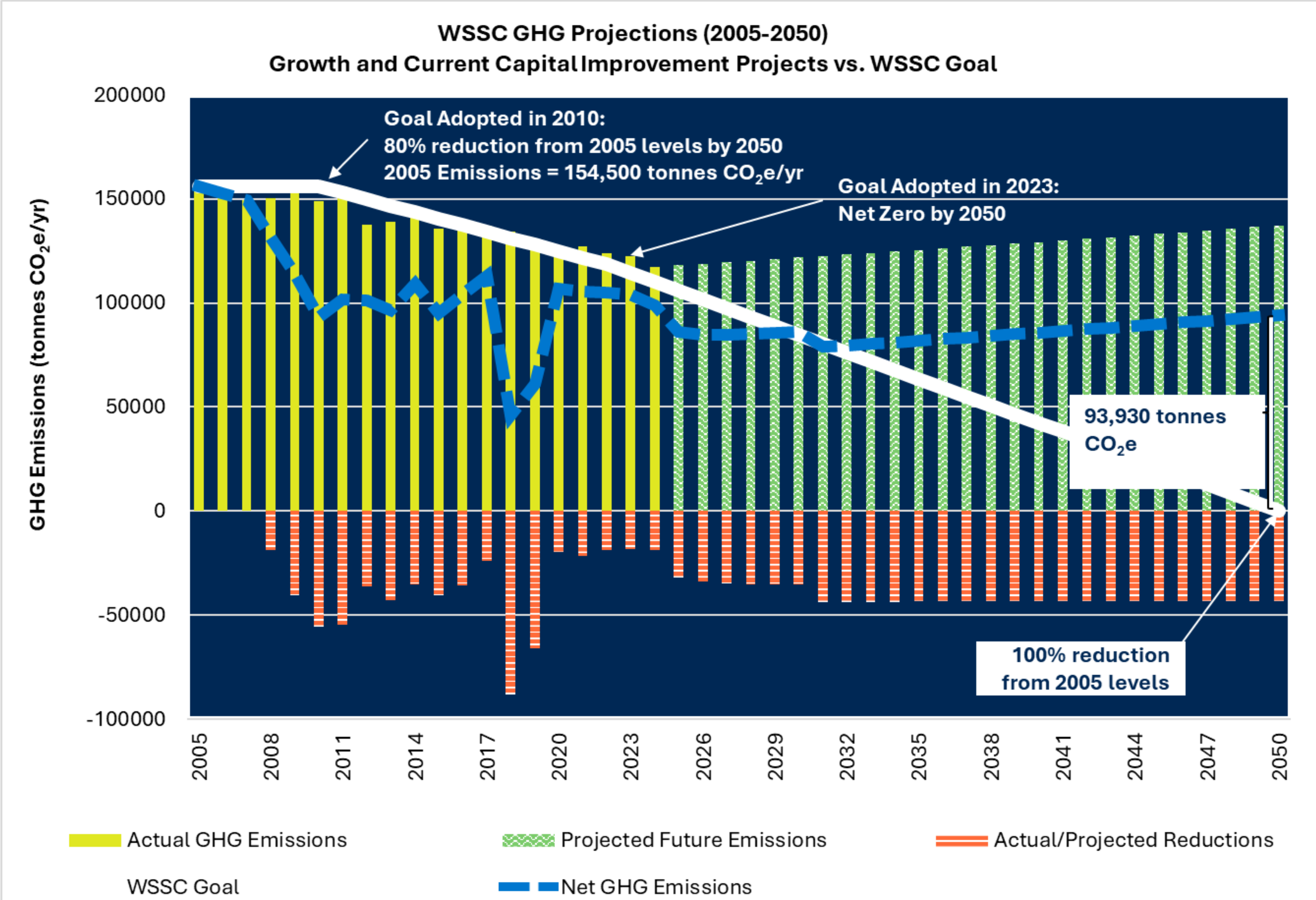


Figure ES-2

Projected Future Emissions Because of Growth and Current Projects Compared Against Greenhouse Gas Reduction Goal



Emission Reduction Strategies

The GHG inventory results and the future emissions projections were used to develop strategies to reduce GHG emissions and meet the reduction goal.

The following are the main focus areas of the GHG reduction strategies:

- Optimizing the efficiency of the water distribution system.
- Improving equipment efficiency for water and wastewater.
- Reducing residuals and optimizing processes.
- Reducing GHGs associated with vehicles and transportation.
- Optimizing building services (lighting and heating, ventilating, and air conditioning [HVAC]).
- Implementing renewable energy.

Table ES-1 summarizes the strategies developed; the projected GHG emissions reduction impact; and the estimated capital, annual, and life cycle costs.

In 2024, the impact of the strategies was reevaluated based on the latest emissions factors and updated information about each project. The changes are noted in the description of the strategies. Strategies removed from consideration or moved into implementation phase (actual projects) were removed from this table.

The annual cost and life cycle cost for the strategies were updated to reflect the new implementation year. The unit cost of electricity used was $0.10 per kilowatt-hour per the latest cost information from WSSC Water.

Table ES-1

Proposed Greenhouse Gas Reduction Strategies

No. (Group)	Strategy Name	Description	2050 GHG Reduction (tonnes CO_2e/yr)	Year Implemented	Capital Cost (2025 $)	Annual Cost (+) or Savings (-)	Life Cycle Cost (through 2050)
1.6 (System Efficiency)	Optimize water distribution system pumping efficiency	Smart metering on pumps over 500 hp	-1,400	2026	$534,000	-$322,000	-$4,921,000
2.13 (Equipment Efficiency)	Aeration Efficiency at Parkway WRRF	Replace the existing process aeration blowers with more efficient units and implement electrical upgrades.	-300	2029	$1,530,000	-$60,000	$605,000
3.3 (Residuals/ Process)	Phosphorus Recovery at the Bioenergy Plant	Implement phosphorus recovery from the digested sludge flow stream. The process converts the phosphate to a commercial-grade fertilizer which then reduces WSSC Water's GHG footprint because it offsets GHGs produced in industrial fertilizer manufacture.	-1,500	2028	$10,199,000	-$14,000	$9,976,000

3.4 (Residuals/ Process)	Green Carbon Sources for Denitrification	Replace methanol at WB and Piscataway with "green" sources of carbon such as MicroC-3000 for the denitrification process. Reduce GHGs in the production of methanol (Scope 3) and the consumption of methanol in the process (Scope 1).	-4,800	Ongoing	$0	$348,000	$6,217,000
3.5 (Residuals/ Process)	Recycling	Uniform recycling strategy (paper, cans, bottles, light bulbs). Assume a 10 percent reduction in GHGs associated with garbage landfilling and incineration.	-14	Ongoing	$0	$0	$0
3.6A (Residuals/ Process)	Increased Nutrient Removal Process Efficiency	Implement innovative ammonia-based aeration control to promote innovative nutrient removal processes (Nite/Denite) at Seneca and WB that can potentially reduce aeration by 20 percent.	-1,800	2027	$6,200,000	-$362,000	$255,000
3.6B (Residuals/ Process)	Mainstream Anammox at Piscataway	Implement innovative biological nutrient removal process (mainstream Anammox or Nite/Denite) at Piscataway that can potentially reduce aeration by 20 percent and methanol by 50 percent.	-700	2029	$6,768,000	-$187,000	$3,878,000

4.1 (Transportation)	Electric Vehicles and Biodiesel	Reductions in fuel use due to replacing five SUVs annually with electric vehicles and replacing diesel with biodiesel	-60	Ongoing	$2,057,000	-$4,000	$1,981,000
5.7 (Lighting/ HVAC)	Anacostia Depot Sewer Thermal	Implement sewer thermal technology to replace natural gas use for heating and electricity use for cooling at three buildings at Anacostia Depot: the Administration Building, Heavy Equipment Shop, and Warehouse.	-63	2027	$4,170,000	-$15,900	$3,909,000
6.2 (Renewable Resources)	Additional Solar Installation (11.8 MW)	Install additional solar panels. This PPA is assumed to extend through 2050.	-9,400	2026	$0	$1,854,000	$31,403,000
6.3 (Renewable Resources)	Wind Energy	Current wind contract ends June 1, 2030. Assumed contract is extended through 2050 at 70,000 MWh/yr.	-28,000	2030	$0	TBD	TBD
6.4 (Renewable Resources)	Renewable Energy Purchase	Purchase renewable energy to achieve WSSC Water reduction goal of 93,930 tonnes in 2050. WSSC Water will have to begin purchasing additional renewable energy (likely through RECs) in 2041, to start meeting its reduction goals. WSSC Water will also have to purchase carbon credits in 2050.	-44,000	2042	$0	$870,000	$8,680,000

6.5 (Renewable Resources)	Potomac Carbon Recovery	Onsite carbon capture at Potomac WFP for future Microgrid system with offsite sequestration.	-22,000	2028	$26,000,000	$6,000,000	$121,621,000
6.6 (Renewable Resources)	Piscataway Bioenergy Carbon Recovery	Convert CO_2 to methanol using electro catalytic process.	-12,000	2033	$3,000,000	To be determined following planned pilot study.	To be determined following planned pilot study.
6.7 (Renewable Resources)	Anacostia Depot Solar (0.13 MW)	Install solar panels on roof of admin building and parking lot canopy.	-470	2027	$1,497,000	-$175,000	-$1,381,000
6.8 (Renewable Resources)	Hydro Block	10-year contract for hydro power will reduce electricity demand annually by 13,000 MWh. Contract is assumed to extend through 2050.	-5,000	2025	To be determined	-$1,300,000	To be determined

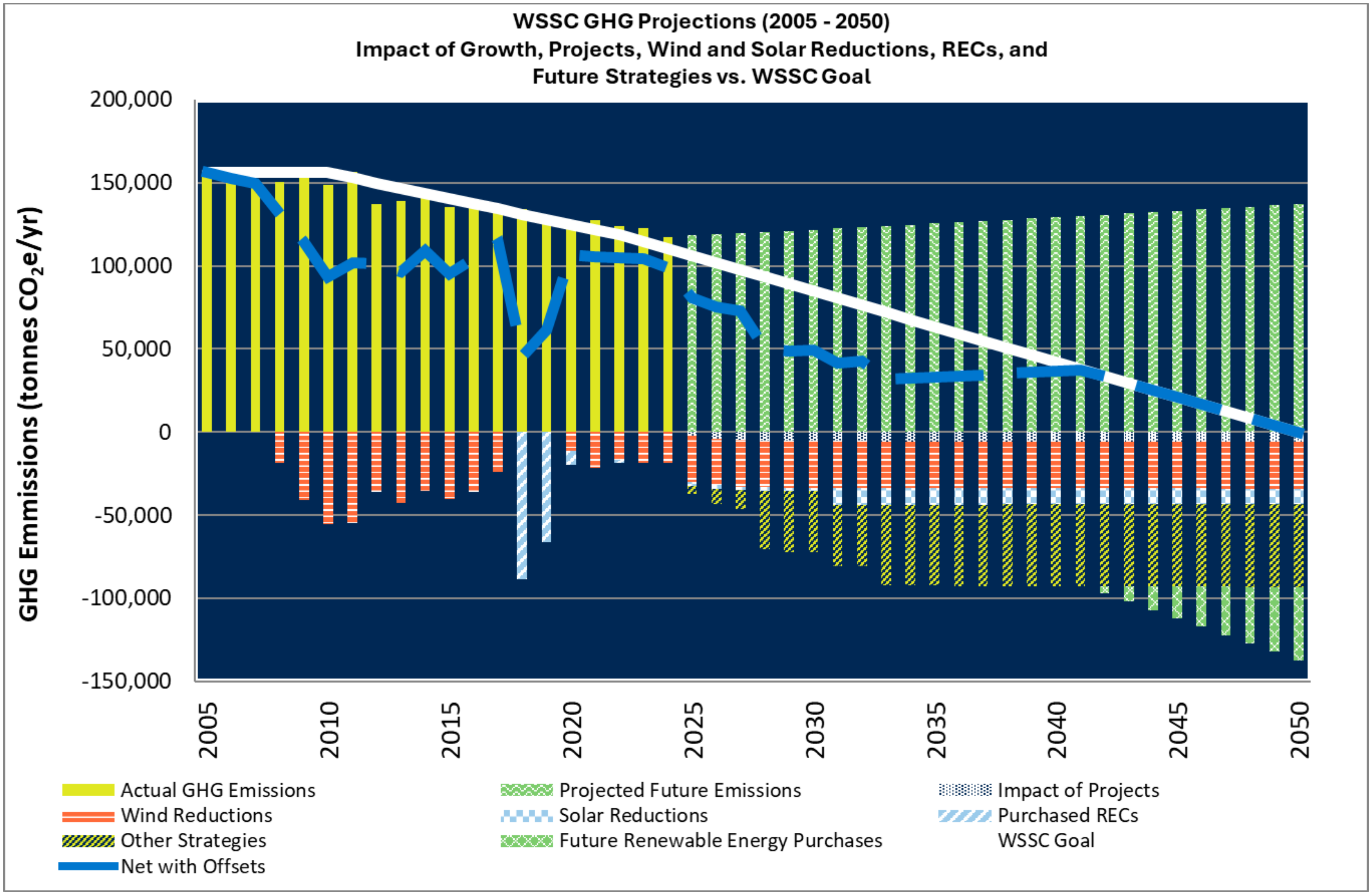
CO2 = carbon dioxide
CO_2e = carbon dioxide equivalents
GHG = greenhouse gas
hp = horsepower
MW = megawatt(s)
MWh = megawatt-hour
PPA = Power Purchase Agreement
REC = renewable energy credit
SUV = sports utility vehicle
WB = Western Branch
WFP = water filtration plant
yr = year

Impact of Selected Strategies

The strategies selected will result in a reduction of 43,000 tonnes of CO_2e in annual GHG emissions by the year 2035. In conjunction with ongoing projects, wind and solar agreements, and REC purchases, reductions can be reduced from 2005 levels by 117,500 tonnes in 2035. Only a reduction of 92,524 tonnes CO_2e is required to meet WSSC Water's goal in 2035. WSSC Water will meet its annual reduction goals until 2041, when they will have to purchase RECs annually through 2050. RECs can only offset Scope 2 emissions. In 2050, the number of RECs WSSC Water will need to purchase to meet their reduction goal will exceed their Scope 2 emissions, thus, they will need to purchase carbon credits. Figure ES-3 identifies, in various categories, the impact of the solar contract, renewed wind contract, the REC purchases (Strategies 6.2, 6.3, and 6.4 listed in Table ES-1). All the other strategies combined are shown under the "Other Strategies" category.

Figure ES-3

Projected Future Greenhouse Gas Emissions and Impact of Selected Strategies on Washington Suburban Sanitary Commission Goal Attainment



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Section 1

Introduction

Washington Suburban Sanitary Commission (WSSC) Water provides water and wastewater service to an estimated 1.9 million residents in Maryland's Montgomery and Prince George's counties. WSSC Water owns and operates two water filtration plants (WFPs), five water resource recovery facilities (WRRFs), more than 5,800 miles of freshwater pipeline, and more than 5,600 miles of sewer pipeline.

In 2023, WSSC Water adopted a goal of net zero emissions by 2050 and a 50% reduction from 2005 emissions by 2030. This is an annual reduction goal of around 3.5 percent. In 2011 – 2023, WSSC Water's emissions reduction goal aligned with the jurisdictions it serves. In 2010, the State of Maryland and the Metropolitan Washington Council of Governments (which includes Montgomery and Prince George's counties) adopted a greenhouse gas (GHG) emission reduction goal to achieve a 10 percent reduction in emissions every 5 years through 2050, for a total reduction of 80 percent less than the baseline year of 2005. WSSC WATER

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- Projected annual emissions through the year 2050, which are compared to the updated WSSC Water GHG reduction goal (100 percent reduction by 2050).
- Validation of the emission reduction strategies listed in the 2023 GHG Action Plan and annual updates through 2024 in terms of practicality, timing, GHG reduction potential and cost.

Section 2

GHG Inventory Summary

This section updates the GHG inventory summary that was included in Section 2 of the November 2012 *Greenhouse Gas Action Plan* (CH2M and Shah & Associates 2012).

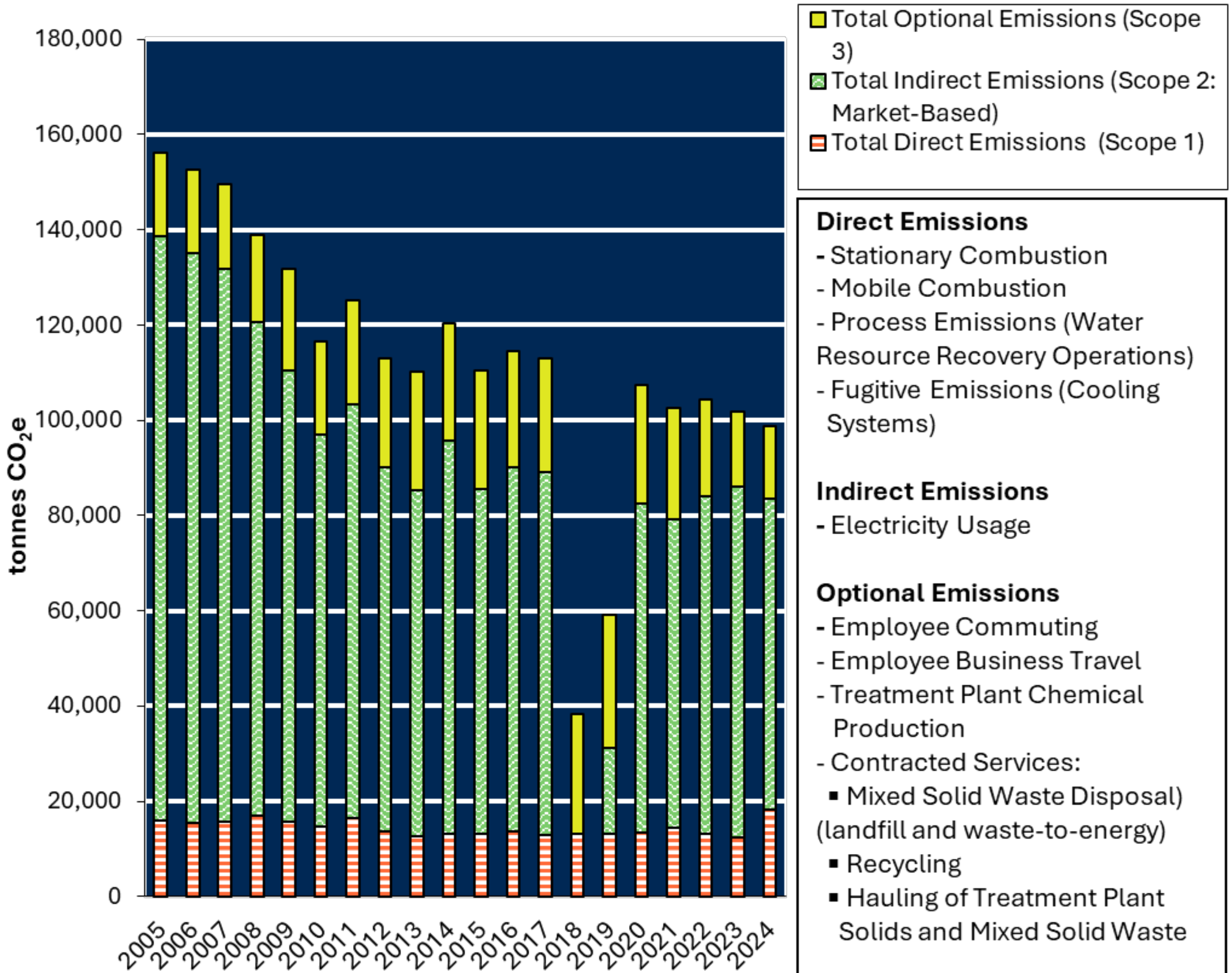
The table and figure numbers in this document have been kept identical to those in Section 2 of the November 2012 GHG Action Plan document for ease of reference. They have been updated with the annual inventory results from 2012 through 2024, which are available on the Energy Information System.

Greenhouse Gas Inventory Summary (2005 to 2024)

For the baseline year, 2005, WSSC Water operations produced a total of 156,065 tonnes carbon dioxide equivalent (CO_2e) in GHG emissions. Subsequent years (2006 through 2024) have seen a slight decrease in the GHG emissions at WSSC Water despite an increase in several aspects of operations, including water resource recovery chemical use, energy use, and number of employees. To aid in achieving emissions reduction targets, WSSC Water began a direct purchase of wind-generated electrical power in 2008. These purchases resulted in a net reduction in total GHG emissions in the inventories since the baseline year. In 2018, WSSC Water purchased Renewable Energy Credits (RECs) to offset all their Scope 2 indirect emissions. Figure 2-1 presents a representation of the annual GHG emission totals (including Scope 1, Scope 2, and Scope 3 emissions). Table 2-1 summarizes the net emissions totals by scope.

Figure 2-1

Summary of Annual Greenhouse Gas Net Emissions by Source Category and Calendar Year



Direct Emissions
- Stationary Combustion
- Mobile Combustion
- Process Emissions (Water Resource Recovery Operations)
- Fugitive Emissions (Cooling Systems)

Indirect Emissions
- Electricity Usage

Optional Emissions
- Employee Commuting
- Employee Business Travel
- Treatment Plant Chemical Production
- Contracted Services:
  - Mixed Solid Waste Disposal) (landfill and waste-to-energy)
  - Recycling
  - Hauling of Treatment Plant Solids and Mixed Solid Waste

Table 2-1

Summary of Annual Greenhouse Gas Emissions by Scope and Calendar Year

Source	2005 (Baseline)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Direct Emissions – Scope 1 (tonnes CO_2e)	15,887	13,044	13,628	12,957	13,081	13,181	13,411	14,474	13,149	12,306	18,109
Indirect Emissions – Market-based Scope 2 (tonnes CO_2e)	122,673	97,534	102,029	100,413	96,003	86,212	88,381	89,481	90,544	94,386	84,273
Optional Emissions – Scope 3 (tonnes CO_2e)	17,506	25,009	24,327	23,886	25,195	28,007	24,798	23,274	20,233	15,744	15,087
Offsets due to Wind and REC Purchases (tonnes CO_2e)	0	(25,018)	(25,508)	(24,165)	(96,003)	(68,281)	(19,293)	(24,687)	(19,697)	(20,581)	(18,744)
Total Net Entity-wide GHG Emissions (tonnes CO_2e)	156,065	110,568	114,476	113,091	38,277	59,119	107,296	102,542	104,229	101,855	98,726
Increase/Decrease from the Baseline (2005)	--	-29.2%	-26.6%	-27.5%	-75.5%	-62.1%	-31.2%	-34.3%	-33.2%	-34.7%	-36.7%
Reduction Goal	--	-20.0%	-22.0%	-24.0%	-26.0%	-28.0%	-30.0%	-32.0%	-34.0%	-37.5%	-40.9%

The annual results of each emissions category for the past 5 years (2020 to 2024) are detailed in the following sections

Direct Emissions (Scope 1)

Scope 1 emissions, or direct emissions, result from sources, processes, or facilities owned or controlled by WSSC Water. The WSSC Water GHG inventory contains the following source categories for direct emissions: stationary combustion, mobile combustion, process-related, and fugitive (refrigerant usage).

Stationary Combustion Sources

Stationary source emissions result from combustion of fossil fuels in equipment such as boilers, heaters, generators, pumps, and incinerators in a fixed location. Table 2-2 summarizes the annual use of each fuel by type and the corresponding GHG emissions.

Table 2-2

Stationary Source Fuel Usage and Greenhouse Gas Emissions by Calendar Year

Fuel Type	2005 (Baseline)	2020	2021	2022	2023	2024
Natural Gas (therms)	742,413	338,372	364,424	345,593	333,711	1,263,691
Propane (gal)	4,670	3,650	3,609	3,361	1,503	1,834
Fuel oil (gal)	23,133	11,167	11,684	14,901	9,714	11,778
Diesel (gal)	15,847	74,612	53,244	52,408	66,260	66,260[a]
WRRF Sludge (dry tons)	4,520	0	0	0	0	0
Total Stationary Source Emissions (tonnes CO_2e)	6,168	2,821	2,586	2,509	2,333	7,303

2023 diesel usage was used for 2024 because 2024 diesel usage data were not available.
gal = gallon(s)

Natural gas is used for heating in most WSSC Water facilities. The Piscataway WRRF Bioenergy Project started up in summer of 2024, which resulted in an increase in natural gas usage in the Cogen system. Propane use and fuel oil use did not have a notable change from 2023 to 2024. WSSC Water was not able to provide data on diesel usage for 2024, thus 2023 totals were reported.

Mobile Combustion Sources

A summary of annual fuel usage in the WSSC Water vehicle fleet and the related GHG emissions are provided in Table 2-3.

Table 2-3

Mobile Source Fuel Usage and Greenhouse Gas Emissions by Calendar Year

Fuel Type	2005 (Baseline)	2020	2021	2022	2023	2024
Diesel (gal)	262,035	246,176	269,138	248,516	270,922	245,023
Gasoline (gal)	377,680	307,142	320,275	337,416	331,369	339,097
Total Mobile Source Emissions (tonnes CO_2e)	6,082	5,229	5,601	5,518	5,686	5,433

Diesel and gasoline use for equipment and vehicles did not see a notable change from 2023 to 2024. The GHG emissions generated by mobile combustion sources decreased 11 percent in 2024 compared to the baseline year 2005.

Water Resource Recovery Process Emissions

Table 2-4 summarizes process parameters for each WRRF and the overall process related GHG emissions by calendar year.

Table 2-4

Annual Water Resource Recovery Process Parameters and Greenhouse Gas Emissions by Calendar Year

Facility	2005 (Baseline)	2020	2021	2022	2023	2024
Western Branch (MGD)	19.0	24.9	23.6	21.8	21.3	23.1
Piscataway (MGD)	21.7	29.5	24.5	24.5	21.0	21.5
Parkway (MGD)	5.90	7.15	6.33	6.24	6.03	6.57
Seneca (MGD)	14.3	15.3	14.7	13.7	13.3	13.7
Damascus (MGD)	0.82	0.85	0.82	0.78	0.76	0.88
Hyattstown (MGD)	0.0042	0.0060	0.0054	0.0056	0.0065	0.0046
Total AADF Treated (MGD)	**62**	**78**	**70**	**67**	**62**	**66**
Average Effluent TN Conc. (mg/L)	3.33	2.19	3.25	1.35	1.48	1.67
Total Methanol Use (gal)	404,732	838,551	1,017,358	846,140	641,432	857,034
Total MicroC-3000 Use (gal)	0	177,099	136,662	390,437	343,001	432,171
Total Wastewater Process Emissions (tonnes CO_2e)	**3,637**	**5,285**	**6,205**	**5,046**	**4,219**	**5,157**

AADF = annual average daily flow
mg/L = milligram(s) per liter
MGD = million gallon(s) per day

TN = total nitrogen

Table 2-4 shows that in 2024, the annual average daily flow was 66 MGD across all wastewater plants, a 5.4 percent increase from 2023.

In 2017, WSSC Water began to substitute MicroC-3000 for methanol at several facilities. MicroC-3000 is an entirely agriculturally derived alternative carbon source that is composed of approximately 70 percent methanol. Because it is 100 percent agriculturally derived, carbon dioxide (CO_2) emissions from the use of the product are considered biogenic in nature and therefore do not count toward the overall GHG inventory. Using MicroC-3000 in CY2024 reduced the CO_2e emissions in water resource recovery by approximately 34 percent compared to what they would have been if only methanol had been used because of increased biogenic emissions. Overall, there was an increase in process emissions largely due to the increase in methanol use across all facilities. This is likely due to both the increase in flow (and thus the increase in methanol needed for denitrification) and the Piscataway WRRF Bioenergy Project coming online in summer 2024. Anaerobic digesters at this facility contain a high ammonia waste stream that is sent back to the Piscataway WRRF's liquid treatment process, creating high aeration and methanol demand to meet nutrient limits. Startup on a sidestream Anitamox process at Piscataway took place in October 2024. This sidestream process is meant to reduce the high aeration and methanol demand as a result of anaerobic digestion. This process is still in the startup and optimization stage though and cannot be considered fully implemented in CY2024.

Refrigerant Fugitive Emissions

Table 2-5 summarizes the GHG emissions attributed to hydrofluorocarbon (HFC) refrigerant use in each CY.

Table 2-5

Refrigerant Usage and Greenhouse Gas Emissions by Calendar Year

Material Type	2005 (Baseline)	2020	2021	2022	2023	2024
Total HFC Refrigerant Use (lb)	0	99	113	67	87	274
Total Fugitive Emissions (tonnes CO_2e)	0	35.5	83.0	76.0	68.1	216

lb = pound(s)

WSSC Water is currently phasing out all use of hydrochlorofluorocarbon (HCFC) and chlorofluorocarbon (CFC) refrigerants (R-22) because of their ozone-depleting qualities. New equipment will be phased in that uses hydrofluorocarbon (HFC) and perfluorocarbon (PFC) refrigerants, which are reportable GHG emissions. This change may result in increased refrigerant-related emissions for the year or years in which new equipment is charged and set up. 2024 saw an increase in refrigerant usage of over 200 percent compared to 2023. Discussions with WSSC Water indicated that this may be due to upgraded laboratory facilities that experienced refrigeration and/or heating, ventilating, and air conditioning (HVAC) issues in CY2024. The cause of this increase in refrigerants needs to be confirmed by WSSC Water.

Indirect Emissions (Scope 2)

Scope 2 emissions, or indirect emissions, result from energy-related activities owned or controlled by another entity that are being completed on behalf of the reporting entity. For the WSSC Water inventory, only indirect emissions from purchased electricity are included. Other sources of Scope 2 emissions, such as purchased heating, cooling, or steam, do not exist at WSSC Water.

Scope 2 Emissions

A summary of annual electricity usage for all facilities within the WSSC Water operations and associated GHG emissions are provided in Table 2-6, alongside the location-based and market-based Scope 2 emissions from purchased electricity. The market-based method is used to track WSSC Water's progress toward its target and is therefore used throughout this report in the tables and associated figures.

Table 2-6

Purchased Electricity Use and Greenhouse Gas Emissions by Calendar Year

Type	2005 (Baseline)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Entity-wide Electricity Use (MWh)	205,645	221,495	225,794	223,685	218,796	208,328	218,860	213,171	214,706	210,315	210,402
Offsets (RECs, Wind) (MWh)	0	(56,816)	(56,451)	(53,831)	(220,000)	(145,000)	(48,970)	(58,812)	(46,706)	(45,860)	(46,797)
Net Total Electricity Use (MWh)	205,645	164,680	169,343	169,854	(1,204)	63,328	169,890	154,359	168,000	164,455	163,605
Total Indirect Emissions (tonnes CO_2e) Location-based	102,741	101,176	87,881	77,318	75,629	68,015	71,054	63,360	69,363	62,981	56,981
Total Indirect Emissions (tonnes CO_2e) Market-based	122,673	72,516	76,521	76,249	0	26,207	69,088	64,794	70,848	73,805	65,529

MWh = megawatt-hour(s)

In 2024, RECs, including both wind totals and purchased RECs, totaled 46,797 MWh. This renewable energy source provides a net reduction in the amount of fossil-fuel generated power used by WSSC Water operations.

Since 2005 (the baseline year), electricity use at WSSC Water has been variable, going up and down by approximately 4 percent from year-to-year. In 2024, overall electricity use at WSSC Water increased by 2.3 percent over the baseline year of 2005.

Table 2-6A illustrates the electricity use for water resource recovery and total treated flow since 2020. Piscataway saw a 31 percent decrease in electricity use in 2024.

Table 2-6A

Electricity Use at Water Resource Recovery Facilities

Location	2020	2021	2022	2023	2024
Damascus (MWh/yr)	2,515	2,316	2,186	2,169	2,274
Parkway (MWh/yr)	5,550	6,724	6,742	6,289	6,278
Piscataway (MWh/yr)	19,897	18,414	19,036	16,463	11,366
Seneca (MWh/yr)	18,621	16,506	19,154	19,132	16,454
WB[a] (MWh/yr)	20,172	22,862	27,901	28,498	27,574
Marlboro Meadows (MWh/yr)	111	138	123	135	97
Hyattstown (MWh/yr)	89	68	61	64	54
Total MWh WRRFs	66,844	66,890	75,080	72,751	64,097
Total Flow Treated (MGD)	78	70	67	62	66
kWh per MG Treated	2,357	2,384	3,068	3,194	2,670

[a] Seneca and Western Branch (WB) facilities have solar installations. The electricity use includes solar MWh generated at those facilities.
kWh = kilowatt-hour(s)
MG = million gallons
MWh/yr = megawatt-hour(s) per year

Table 2-6B presents the electricity use for drinking water treatment and total treated flow since 2018. Water Treatment Plant electricity use has been generally consistent at each facility for the past 5 years.

Table 2-6B

Electricity Use at Water Filtration Plants

Location	2020	2021	2022	2023	2024
Patuxent (MWh/yr)	9,645	9,665	10,530	9,108	9,895
Rocky Gorge (MWh/yr)	17,795	14,467	14,787	12,099	12,114
Potomac (MWh/yr)	75,968	75,305	72,158	76,761	79,064
Total MWh WFPs	103,408	99,437	97,475	97,968	101,073
Flow Treated Patuxent (MGD)	59.9	57.8	50.54	43.73	46.03
Flow Treated Potomac (MGD)	112.9	116.3	119.01	127.57	127.35
Total Flow Treated (MGD)	173	174	170	171	173
kWh per MG Treated	1,639	1,565	1,575	1,567	1,597

Table 2-6C presents the electricity use at WSSC Water facilities since 2018. Electricity use across facilities has not varied significantly over the past 5 years.

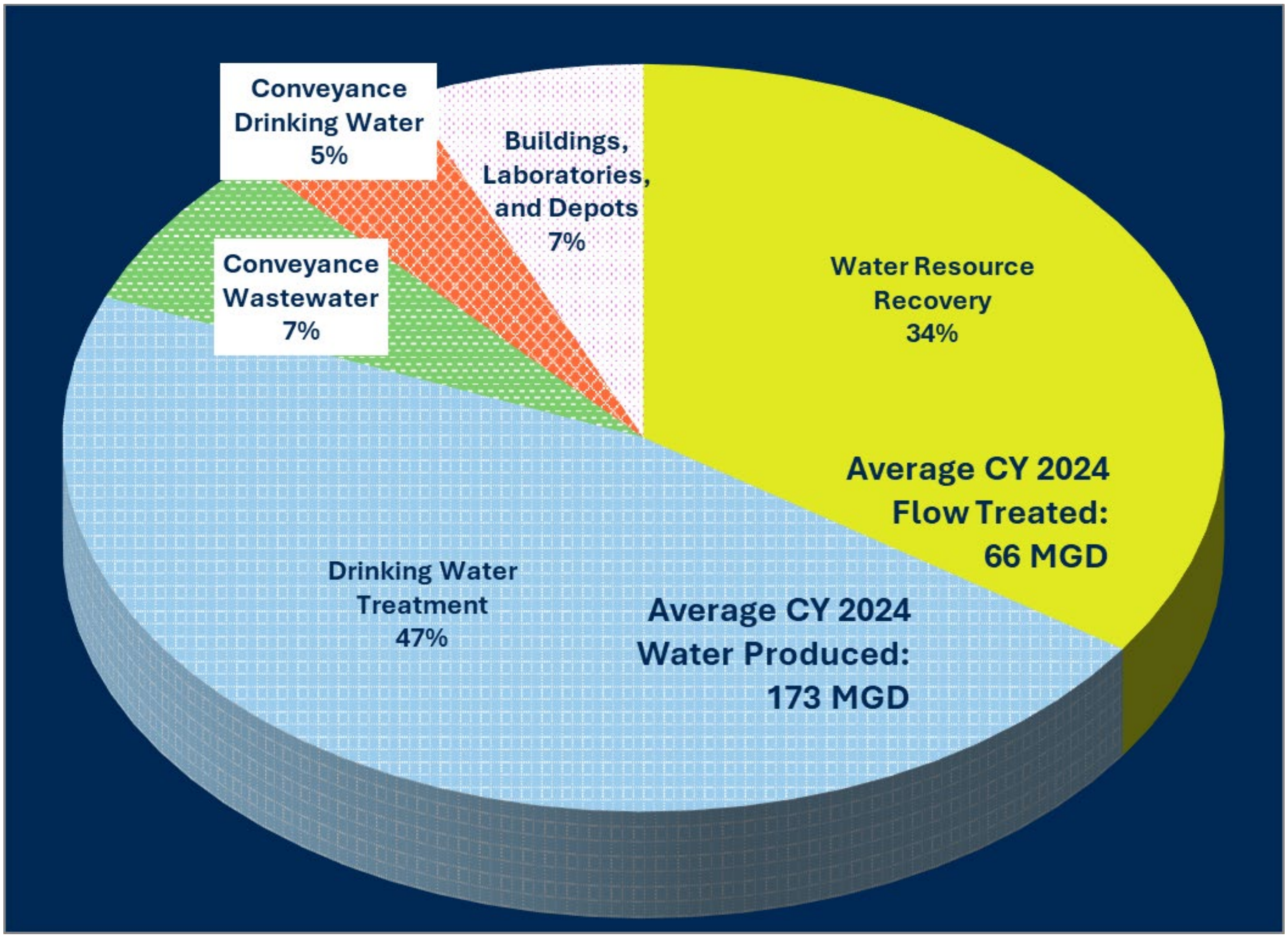
Table 2-6C

Electricity Use at Buildings, Laboratories, and Depots

Location	2020	2021	2022	2023	2024
Mission Support Center (MWh/yr)	8,987	9,617	9,892	8,928	8,432
Consolidated Lab (MWh/yr)	1,764	1,892	1,786	1,806	1,848
Anacostia Facilities Maintenance Division (MWh/yr)	817	910	1,418	799	854
Gaithersburg Depot (MWh/yr)	429	424	398	370	398
Lyttonsville Depot (MWh/yr)	599	641	610	568	574
Temple Hills Depot (MWh/yr)	943	968	872	799	725
Total MWh Buildings	13,540	14,451	14,975	13,271	12,832

The CO_2e output emission rates associated with electricity use have been reduced because of changes in the resource mix in the electric grid, with shifts away from high-emitting combustion resources (such as coal) lowering the emission rates. The market-based CO_2e emission rate (tonne CO_2e per MWh of electricity) for Pennsylvania-New Jersey-Maryland Interconnection has decreased by 25 percent from 1,309 lb CO_2/MWh in 2005to 881 lb CO_2/MWh in 2024. Figure 2-2 shows the relative use of electricity for water treatment, water resource recovery, conveyance (both water and wastewater), and facility operations at WSSC Water in CY2024.

Figure 2-2
Comparison of 2024 Electricity Usage by Category



Optional Indirect Emissions (Scope 3)

Scope 3 emissions, or other indirect emissions, include those generated by activities over which WSSC Water has influence and that occur within WSSC Water's operational boundaries but are not owned or controlled by WSSC Water. The major sources of Scope 3 emissions are contracted services (such as WRRF solids transport, mixed solid wastes transport, and disposal), chemical manufacture, and employee travel. Mobile source emissions are generated from equipment and vehicles operated by contracted businesses and from employee commuting and business travel in personal vehicles. Fugitive emissions from landfill disposal of solid waste and the land application of biosolids are also included as part of this scope.

Employee Commuting and Business Travel

Table 2-7 lists the total mileage used by employees to commute to work and complete business travel in personal vehicles.

Table 2-7

Employee Travel Mileage and Greenhouse Gas Emissions by Calendar Year

Information	2005 (Baseline)	2019	2020	2021	2022	2023	2024
Total Number of Employees	1,396	1,657	1,681	1,612	1,594	1,644	1,817
Employee Commuting (million miles)	14.50	22.87	14.17[b]	12.49	17.81	17.45	18.99
Employee Business Travel (million miles)	0.130	0.113	0.053	0.062	0.073	0.090	0.098
Total Travel (million miles)	14.63	22.98	14.22	12.55	17.88	17.54	19.09
Total Optional Mobile Source Emissions (tonnes CO_2e)	6,755	8,607	5,300	4,505	5,639	5,532	5,702

It was assumed in 2020 and 2021, that 50 percent of all WSSC Water employees were telecommuting 85 percent of the time (at least 4 days per week). For 2022 and beyond, it was assumed that 50 percent of all WSSC Water employees were telecommuting 40 percent of the time (2 days a week). For all years, it was assumed that employees whose zip codes are located more than 100 miles away from the Mission Support Center are telecommuting at all times. Commuting mileage increased in 2024 largely due to an increase in employees, but still remained lower than pre-pandemic (pre-2020) levels.

Contracted Services

Biosolids and Solid Waste Hauling

Mobile emissions associated with contracted services include the use of contractor-owned trucks for transporting biosolids from the WRRFs and water treatment plants to a landfill or agricultural land application area, and transporting mixed solid wastes to a landfill or material recycling facility. Table 2-8 details the total miles traveled for the transportation of solids and mixed solid wastes to their final disposal destination and the corresponding GHG emissions from 2015 to 2024.

No biosolids hauling data were provided in 2020; therefore, the data from 2019 was used. 2021 biosolids data were obtained for all WRRFs except for Western Branch, which has 2019 data. Complete biosolids data for all plants were provided in 2023 and 2024. Biosolids hauling data for 2024 consisted of monthly hauling summaries from two contractors, Nutri-Blend and Synagro.

The total miles traveled by contractors to transport biosolids generated at WSSC Water facilities increased considerably after 2011, because incinerators at the WB were removed from service in August 2012. Therefore, all solids generated at this facility were hauled to various landfills in Virginia. In addition, regulations restrict the amount of biosolids that can be land-applied in Maryland and the time of year when they may be applied. These regulations have resulted in the majority of the biosolids from WSSC Water being transported to Virginia for land application, resulting in greater travel distances.

In 2019, the solids-handling facility at the Patuxent WFP started operations, and the solids hauled were added to the inventory. The solids from Patuxent WFP used to be drained via the sewer to the Parkway WRRF, and therefore, the solids production at Parkway were reduced in 2019.

Piscataway saw an almost 50 percent decrease in hauling mileage in 2024. This is due to the Piscataway WRRF Bioenergy Project coming online in July 2024, and thus they began digesting most of their solids.

Future years will likely see a decrease in hauling as solids from other facilities are brought to Piscataway for digestion rather than hauled out of state for land application.

Table 2-8

Contractor Biosolids Transport Annual Mileage and Greenhouse Gas Emissions by Calendar Year

Originating Facility	2005 (Baseline)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Damascus (miles)	7,800	10,634	10,864	11,077	7,049	10,539	10,539	12,307	12,038	12,073	8,641
Parkway (miles)	149,656	107,441	109,433	90,231	94,814	71,160	71,160	61,347	65,431	71,237	57,676
Piscataway (miles)	180,271	413,113	317,693	320,241	294,837	562,732	562,732	245,980	192,486	183,600	96,999
Potomac (miles)	32,860	42,101	40,193	53,604	68,694	51,635	13,444	37,784	35,848	45,265	48,745
Patuxent (miles)	0	0	0	0	0	19,035	23,052	17,723	16,295	10,122	12,075
Seneca (miles)	168,873	184,512	177,405	177,695	148,918	134,236	134,236	166,723	172,296	163,485	133,380
WB (miles)	0	321,138	327,508	352,490	317,220	391,586	391,586	391,586	186,531	130,914	130,229
Mixed Solid Waste (miles)[a]	51,972	51,972	51,972	51,972	62,819	86,582	53,956	55,366	72,734	87,302	91,866
Total Transport (miles)	591,431	1,130,911	1,035,068	1,057,310	994,351	1,327,504	1,260,704	988,816	753,658	703,999	579,631
Total Optional Mobile Source Emissions (tonnes CO_2e)	1,262	2,311	2,115	2,161	2,032	2,713	2,576	2,033	1,549	1,447	1,192

[a] Based on contracted annual number of total pickups.

Solid Waste Management

WSSC Water facilities generate mixed solid wastes (including trash and recyclables), which are collected and disposed in either a landfill or incinerator, depending on the county where they are collected. Landfill disposal of mixed solid wastes results in GHG emissions because of methane (CH_4) released at the landfill. Incineration results in nitrous oxide (N_2O) emissions. For the GHG inventory, purchasing contracts were used to estimate the amount of solid waste disposed by WSSC Water across all operations. In 2012, 2013, 2014, 2015, 2016, and 2017, the same value for mixed solid waste disposed was used as in previous years. Annual data for solid waste disposal were available for all inventories from 2018 onward. This data indicated the amount of waste, cardboard, and commingled recyclables collected. The hauling distance (miles) for collection of all materials (including recyclables) was calculated for the optional mobile source emissions. Only the tons of waste (not recyclables) were used to calculate the emissions from landfill or incineration. Cardboard and recyclables were assumed to be repurposed, and those emissions were not included in the scope of this inventory.

Biosolids Management

The biosolids resulting from the water resource recovery processes are applied on agricultural lands or transported to a landfill. Land application of biosolids results in GHG emissions because of the release of N_2O into the environment. Biosolids disposal in a landfill result in CH_4 and N_2O emissions. CO_2 is also sequestered in the soil during the land application or landfill disposal of biosolids. This CO_2 is considered biogenic. Land application of biosolids for agricultural use provides an offset of CO_2 emissions that would have resulted from the use of inorganic fertilizer; however, this offset is not included in the inventory because these reductions occur outside of WSSC Water's organizational boundary.

Table 2-9 summarizes the amount of biosolids generated and the corresponding GHG emissions (that is, biogenic, nonbiogenic, and avoided) released or sequestered as a result of the disposal method (for example, landfill and land application).

Table 2-9

Wet Tons Hauled and Destination by Calendar Year

Facility	2005 (Baseline)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
WB – Land Applied	0	0	0	0	0	0	0	15,529	34,757	15,529	29,754
WB – Landfilled	28,898	29,379	29,238	28,533	30,172	32,313	33,860	19,274	0	19,274	0
Piscataway - Land Applied	36,380	33,901	33,055	36,214	47,053	44,364	32,549	31,014	28,636	31,014	21,274
Piscataway – Landfilled	0	0	0	0	0	0	5,441	0	24	0	1,850
Parkway – Land Applied	15,542	13,635	14,813	13,056	16,873	9,621	9,133	6,486	9,379	9,482	9,972
Seneca – Land Applied	20,336	21,897	21,989	22,543	22,343	22,945	22,840	24,233	24,176	24,233	24,729
Seneca – Landfilled	0	0	0	0	0	0	32	0	0	0	0
Damascus – Land Applied	1,288	1,315	1,246	1,272	1,353	1,379	1,516	1,540	1,527	1,540	1,435
Damascus – Landfilled	0	0	0	0	0	0	33	0	0	0	0
Marlboro Meadows – Land Applied	0	0	0	0	0	0	0	0	0	0	0
Total Wet Tons	69,511	100,537	101,305	98,584	105,434	110,541	110,133	102,731	100,969	98,601	89,014
Total Biosolids Emissions (tonnes CO_2e)	4,165	6,537	6,428	6,113	6,782	7,438	8,262	8,008	5,680	3,566	3,207
Biogenic CO_2 Sequestered (tonnes CO_2e)	(2,873)	(4,179)	(4,112)	(3,874)	(4,307)	(4,748)	(4,981)	(4,215)	(3,944)	(3,615)	(3,206)
Net Emissions (tonnes CO_2e)	1,292	2,357	2,316	2,239	2,475	2,690	3,281	3,795	1,736	(48)	1

Emergency landfilling occurred at Piscataway WRRF in 2024 due to the startup of the Piscataway WRRF Bioenergy Project but ultimately fewer biosolids were produced in 2024; this resulted in an overall decrease in emissions.

Chemical Use

WSSC Water's seven WRRFs and two WFPs use various chemicals in the treatment process. GHGs may be emitted during the manufacture or use of these chemicals. The emissions associated with the manufacture of methanol are included as Scope 3 emissions, while emissions resulting from use in the process are included in the Scope 1 category, direct process emissions, as previously presented. Calcium carbonate ($CaCO_3$), or lime, also releases process-related emissions of CO_2 when manufactured. These emissions are included as Scope 3 emissions within the inventory. In 2017, WSSC Water WRRFs started substituting MicroC-3000, a 100 percent agriculturally derived alternative carbon source for methanol. Table 2-10 summarizes lime, methanol, and MicroC-3000usage by plant from 2015 to 2024, and the corresponding GHG emissions.

Table 2-10 shows lime use has decreased at Piscataway significantly from 2023 to 2024; this is due to the Piscataway WRRF Bioenergy Project coming online, reducing the need for stabilizing solids with lime. Overall, lime usage across WSSC Water has remained consistent between 7,000 to 10,000 tons annually over the past 10 years.

Methanol use increased in 2024 by over 30 percent, but this did not result in an increase in emissions. This is likely due to the emissions factor for methanol decreasing because manufacturing became cleaner in 2024. Using MicroC-3000 in CY2024 reduced the CO_2 emissions because of alternative carbon use in water resource recovery by approximately 34 percent compared to what they would have been if only methanol had been used. Overall, the GHG emissions associated with manufacture of lime and methanol decreased by 4 percent under the 2005 baseline.

Table 2-10

Chemical Use and Greenhouse Gas Emissions by Calendar Year

Facility	2005 (Baseline)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
WB (Lime, tons)	0	0	0	0	0	1,506	2,200	2,746	1,516	1,288	1,116
Piscataway (Lime, tons)	2,032	3,068	2,415	2,598	3,328	5,261	3,506	2,817	1,687	1,474	777
Parkway (Lime, tons)	1,003	874	1,053	909	1,353	605	621	637	627	595	576
Seneca (Lime, tons)	1,408	809	860	1,540	1,958	806	858	923	917	718	1,227
Damascus (Lime, tons)	23	48	52	48	49	51	52	49	24	46	59
Hyattstown (Lime, tons)	0	0	0	0	0	0	0	0	0	0	0
Patuxent (Lime, tons)	543	522	527	366	543	521	516	501	472	438	419
Potomac (Lime, tons)	1,127	2,133	1,875	1,711	2,762	2,193	2,300	2,551	2,229	2,642	3,039
Total Lime Usage (tons)	6,136	7,454	6,782	7,172	9,993	10,943	10,053	10,225	7,472	7,202	7,212
WB (Methanol, gal)	404,732	504,505	642,752	412,057	275,124	166,625	420,173	528,188	357,418	277,095	368,024
Piscataway (Methanol, gal)	0	238,446	174,957	178,269	238,178	516,353	334,761	407,311	488,722	364,337	489,010
Parkway (Methanol, gal)	0	78,088	53,566	0	0	0	0	0	0	0	0
Seneca (Methanol, gal)	0	28,156	30,208	39,304	0	0	83,617	81,859	0	0	0

Total Methanol Use (gal)	404,732	821,039	901,483	634,876	513,302	682,978	838,551	1,017,358	846,140	641,432	857,034
WB (MicroC-3000, gal)	0	0	0	62,890	185,784	267,381	116,380	71,373	252,753	245,837	333,743
Parkway (MicroC-3000, gal)	0	0	0	63,643	73,447	67,474	60,719	58,483	63,975	76,961	70,005
Seneca (MicroC-3000, gal)	0	0	0	0	83,392	67,614	0	6,806	73,709	20,203	27,325
Hyattstown (MicroC-3000, gal)	0	0	0	0	0	0	0	0	0	0	1,098
Total MicroC-3000 Use (gal)	0	0	0	126,533	342,623	402,469	177,099	136,662	390,437	343,001	432,171
Total Chemical Usage Emissions (tonnes CO_2e)	5,000	6,745	6,452	6,164	8,272	9,041	8,499	8,884	7,206	5,072	4,815

Section 3

WSSC’s Projected Future Emissions

Inventory Conclusions

Overall, total gross GHG emissions (including Scope 1, Scope 2, and Scope 3 emissions before accounting for offsets from RECs or wind contracts) decreased 25 percent from the 2005 baseline. Gross emissions totaled 156,065 tonnes CO_2e in 2005, and totaled 117,475 tonnes in 2024.

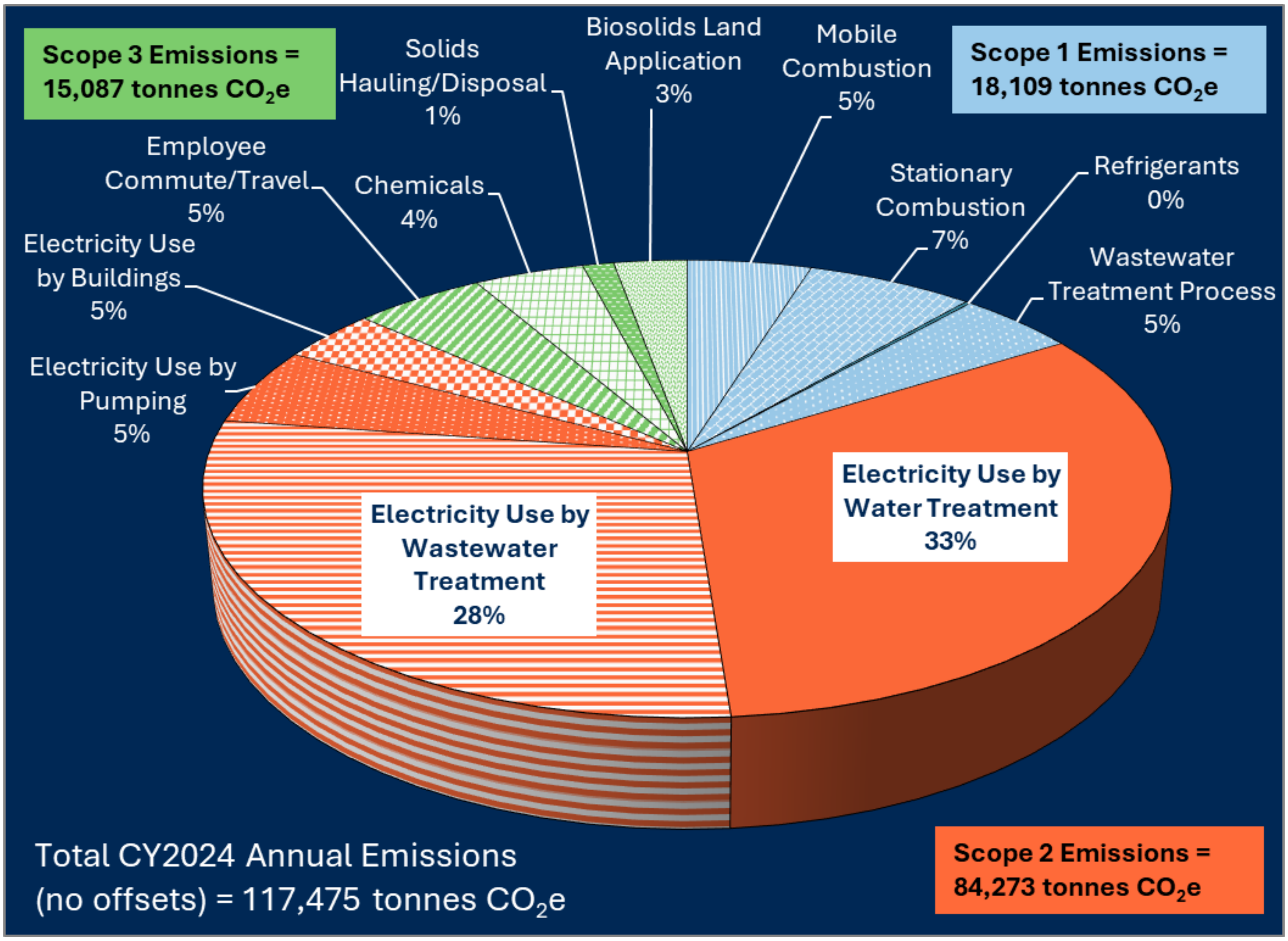
2024 is the first year since 2005 that emissions due to stationary fuel consumption have increased. Previously, stationary fuel consumption was on trend to reduce each year mainly because of an overall decrease in natural gas therms and fuel oil usage. Demand for natural gas has increased beyond 2005 levels due to the installation of the Piscataway WRRF Bioenergy facility in July of 2024 that uses natural gas-powered engines. Propane and heating oil remain on trend to decrease annually from 2005 usage levels. Diesel usage increased significantly in 2020 and has remained high, averaging 62,000 gallons annually, although usage data for 2024 was not available.

Electricity use has increased by an average of 4 percent since 2005, but this increase has been offset by an average 30 percent lower emissions rate per MWh consumed. This is because of cleaner electricity generation in the grid. While electricity demand has increased, the cleaner electricity from the grid has resulted in a net reduction in the tonnes of CO_2e emitted compared to the base year.

Emissions associated with the management of biosolids have decreased as more of the biosolids produced are land-applied instead of landfilled, and as hauling has decreased due to the implementation of the Piscataway WRRF Bioenergy Project.

Figure 3-1 illustrates the impact of the various operations conducted at WSSC Water on the average total entity wide GHG emissions in 2024. The areas shaded in blue represent Scope 1 GHG emissions. The areas shaded in orange represent Scope 2 emissions. The areas shaded in green represent Scope 3 emissions. Gross emissions are shown (with no avoided emissions) to better illustrate the contributions from the various elements to the overall total.

Figure 3-1
Comparison of Calendar Year 2024 Gross Greenhouse Gas Emissions by Category



Emissions Conversion Factors for Project Planning

To aid WSSC Water's future project planning, emissions conversion factors for gallons of methanol used and saved and kWhs used and saved are presented in Table 3-1. These conversion factors can be used to estimate the GHG emissions impact of a potential capital project or operational strategy and are updated annually based on the results of the inventory calculations. Methanol emissions per gallon accounts for both Scope 1 (process emissions) and Scope 3 (manufacturer emissions).

Table 3-1

Emissions Conversion Factor

Emissions Conversion Factor	Value	Unit
Methanol (Scope 1 and 3)	0.0042	Tonne CO_2e/gal
MicroC (Scope 3)	0.0010	Tonnes CO_2e/gal
Electricity (Scope 2)	0.4005	Tonnes CO_2e/MWh

Greenhouse Gas Emissions Projections (2024 to 2050)

The next step in the process of updating the GHG Action Plan was to determine how the GHG emissions would change in the future and how the projected future emissions compared to the stated GHG reduction goal of net zero by 2050. The inventory results were used as the baseline from which the future GHG emissions could be projected. Future GHG emissions at WSSC Water will be mainly affected by the following factors:

1. Population growth in the service area that will increase the demand for potable water and the resulting wastewater flows.
2. Regulatory drivers that require process upgrades to meet more advanced levels of treatment.
3. Implementation of renewable energy programs such as wind, solar, and biogas (anaerobic digestion [AD] and combined heat and power [CHP]).

Data were collected from current planning, design, and construction documents to estimate the impact of these factors on future GHG emissions, and the results are summarized in this section.

Note that the table and figure numbers in this document have been kept identical to those in Section 2 of the November 2012 GHG Action Plan for ease of reference, but they have been updated with the latest data.

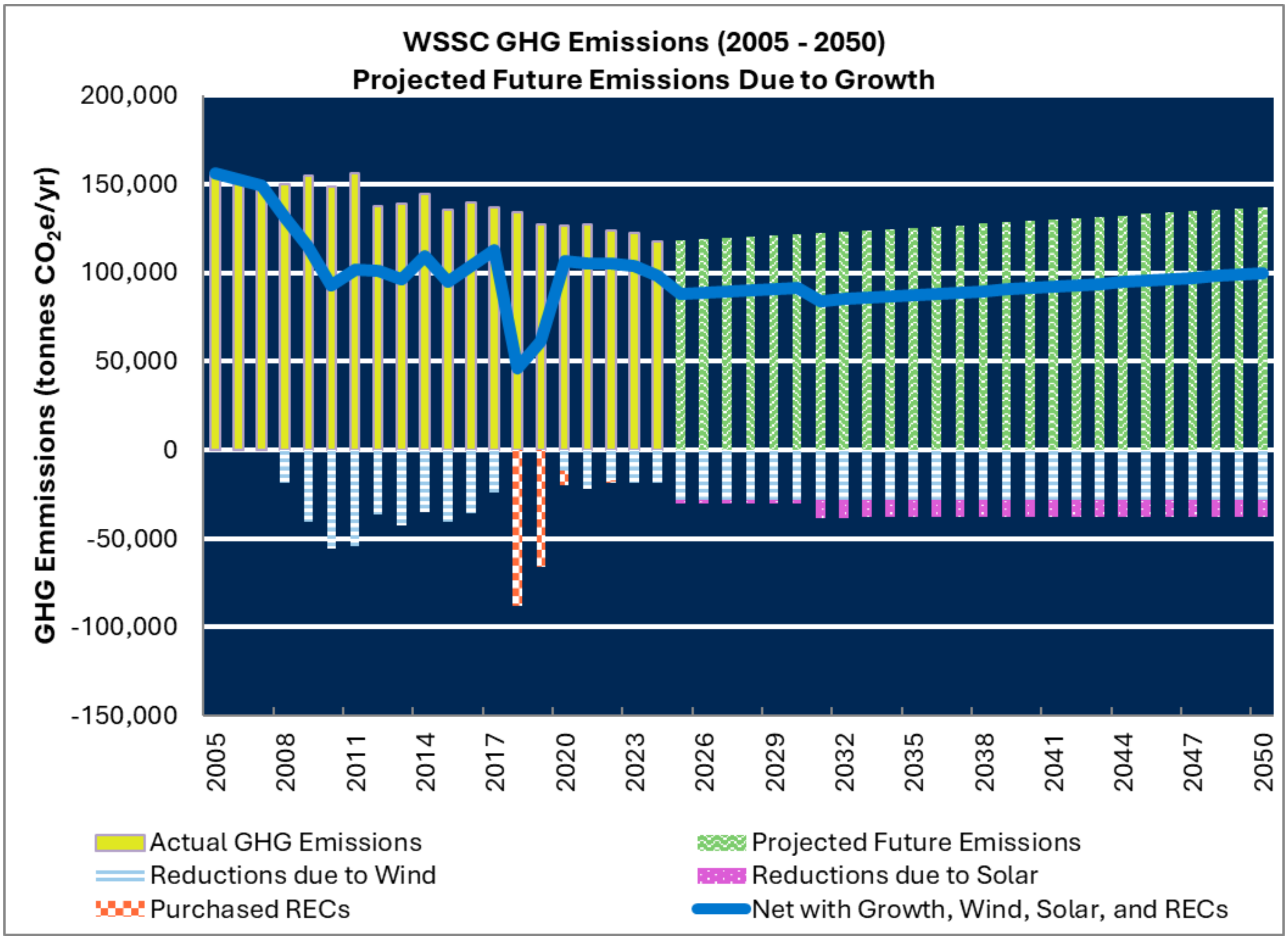
Greenhouse Gas Emissions Increase Because of Population Growth

Current planning projections at WSSC Water predict zero growth in drinking water demand through 2024. For the purposes of this update, the growth rate in water production was also assumed to be zero through 2050. The water resource recovery demand was assumed to grow at about 1 percent per year through 2050. The 1 percent per year increase was also applied to other aspects of WSSC Water operations (such as, personnel and fleet vehicles).

Figure 3-2 shows the historical GHG emissions through CY2024 and the projected future GHG emissions associated with the estimated growth in water resource recovery demand.

Figure 3-2 also shows the net GHG inventory for WSSC Water including the effect of the 10-year wind contract from 2020 to 2050, solar installations, and the purchase of RECs. Note that market-based Scope 2 methodology is being used for planning purposes.

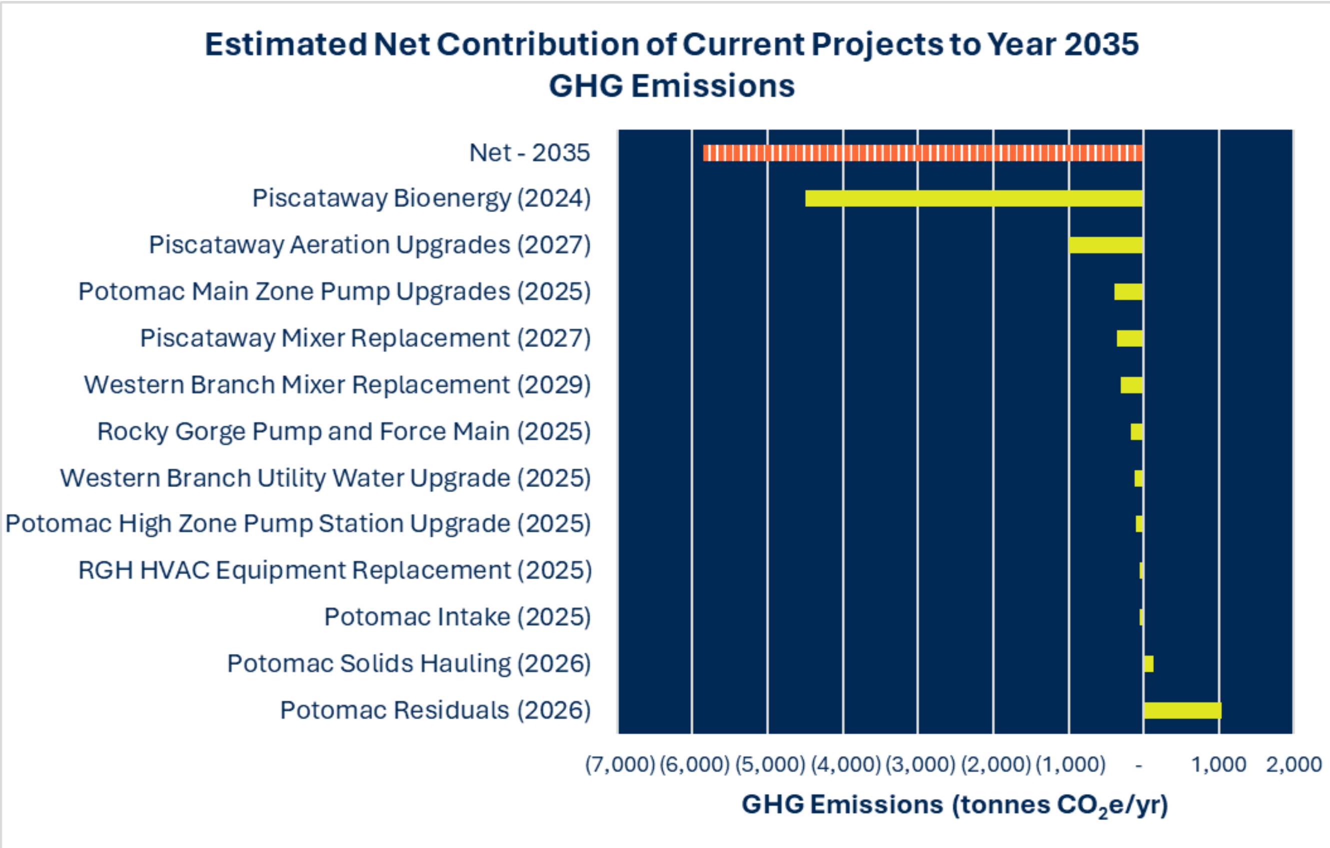
Figure 3-2
Projected Future Emissions Because of Growth



Greenhouse Gas Emissions Increase Because of Major Capital Improvement Projects

The next step in updating the projection of future GHG emissions at WSSC Water was to update the estimated impact of current major capital improvement projects on GHG emissions. WSSC Water is currently in the process of upgrading or expanding several facilities to meet future demand and treatment requirements. Specific information was collected about each major project, and future energy use was estimated. Figure 3-3 illustrates the relative contributions of the major projects currently underway to the projected 2035 annual GHG emissions. This updated figure only includes projects currently in development (planning, design, or construction phases) and indicates the year in which it is expected to be completed and operational. Strategy 2.9 (Potomac Main Zone Pump Replacement) was removed from the strategies list and added to the capital improvement projects list in 2023. The capital improvement projects account for a total reduction of 2,662 tonnes CO_2e from the 2035 annual GHG emissions.

Figure 3-3
Estimated Net Contribution of Current Water and Wastewater Capital Improvement Projects to 2035 Annual Greenhouse Gas Emissions



RGH = Richard G. Hocevar Building

As Figure 3-3 illustrates, the main sources of estimated **increases** to the GHG emissions are as follows:

1. Solids Treatment at Potomac WFP: The Potomac WFP is currently planning for improvements to the existing facility to increase the number of solids treated and reduce/eliminate discharges to the Potomac River. The project is being implemented in two phases: Phase 1, an increase in solids capture of 25 percent over current levels (completed in 2021), and Phase 2, an increase in solids capture of 250 percent over current levels (by 2026).

The main sources of estimated GHG emission **reductions** are:

1. Implementation of a Piscataway WRRF Bioenergy System: The system consists of thermal hydrolysis followed by anaerobic digestion to treat sludge from all WSSC Water WRRFs. The biogas produced is cleaned and reintroduced to the natural gas pipeline, and WSSC Water sells the gas as a renewable resource. WSSC Water then purchases natural gas and uses it in CHP units to generate electricity at the plant. The Piscataway WRRF Bioenergy Project also reduce s GHGs caused by biosolids hauling and lime use (Scope 3). Construction of this completed in July 2024 and the Bioenergy operations are stabilizing; all processes are in place and running, but operational issues are still being addressed. Not all solids from all facilities were sent to Piscataway WRRF for digestion. Emergency landfilling also had to be done for solids at Piscataway during startup of the system in 2024. Emissions projections for

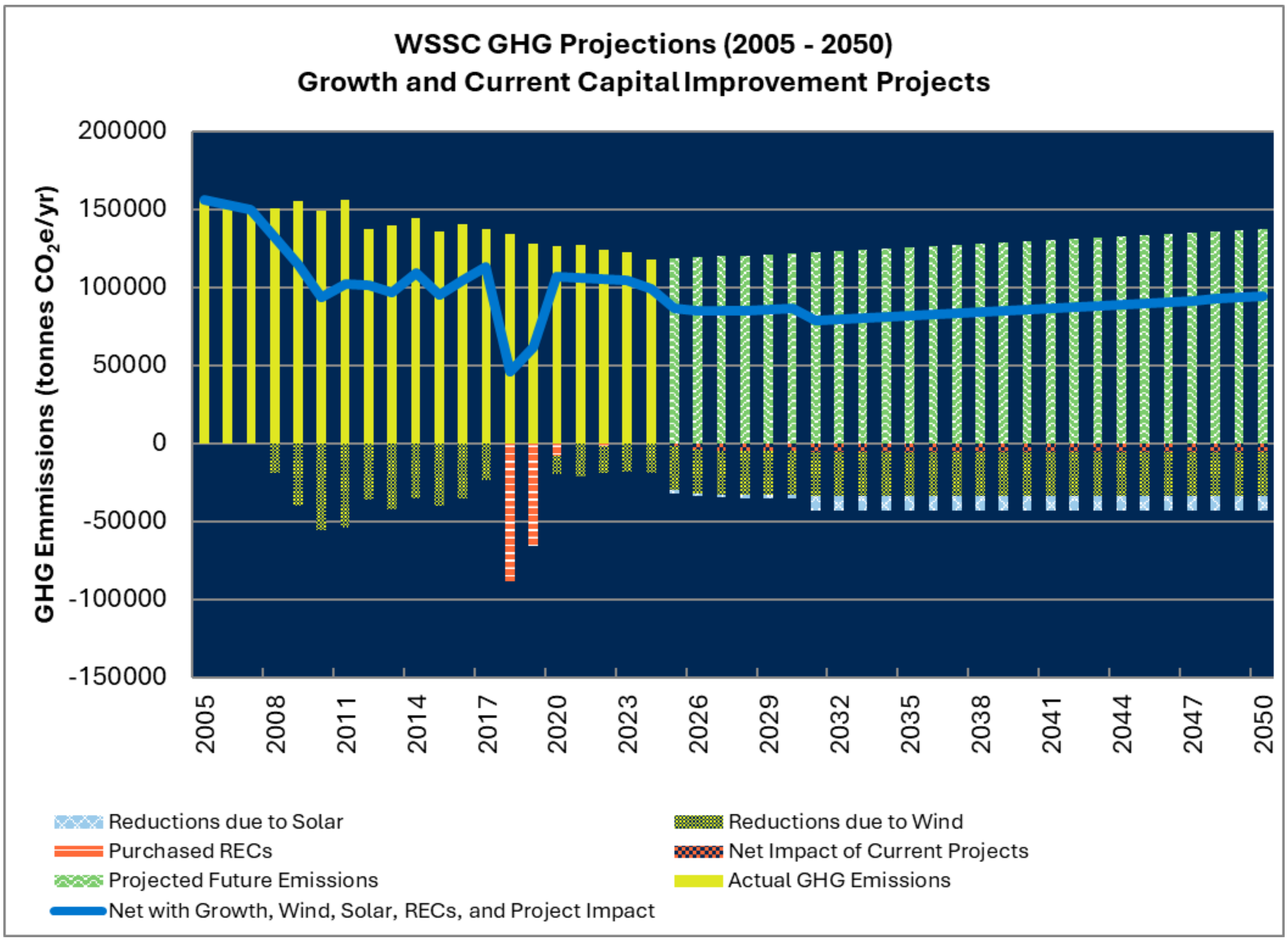
2025 assumed that half of all solids across WSSC Water will be digested at Piscataway, while the rest will be land applied. It was assumed that by 2026 and beyond, all biosolids across WSSC Water will be hauled to Piscataway WRRF for digestion.

2. Piscataway Aeration Upgrades: This project consists of blower replacements at Piscataway that will result in a decrease in required energy usage. This project is expected to be completed in 2027.

Figure 3-4 shows the cumulative effect of growth and the projects currently underway. This figure indicates that by 2050, the projected GHG emissions (dark purple) will be about 12 percent lower than 2005 levels if no additional measures are taken to reduce GHG emissions. The net GHG emissions (yellow line) includes the effect of the 10-year, wind-generated electricity contract from 2020 to 2030, an assumed renewal of that contract in 2030 through 2050, the 11.8-megawatt (MW) solar project beginning in 2026, and historical purchases of RECs. No RECs were purchased in 2024.

Figure 3-4

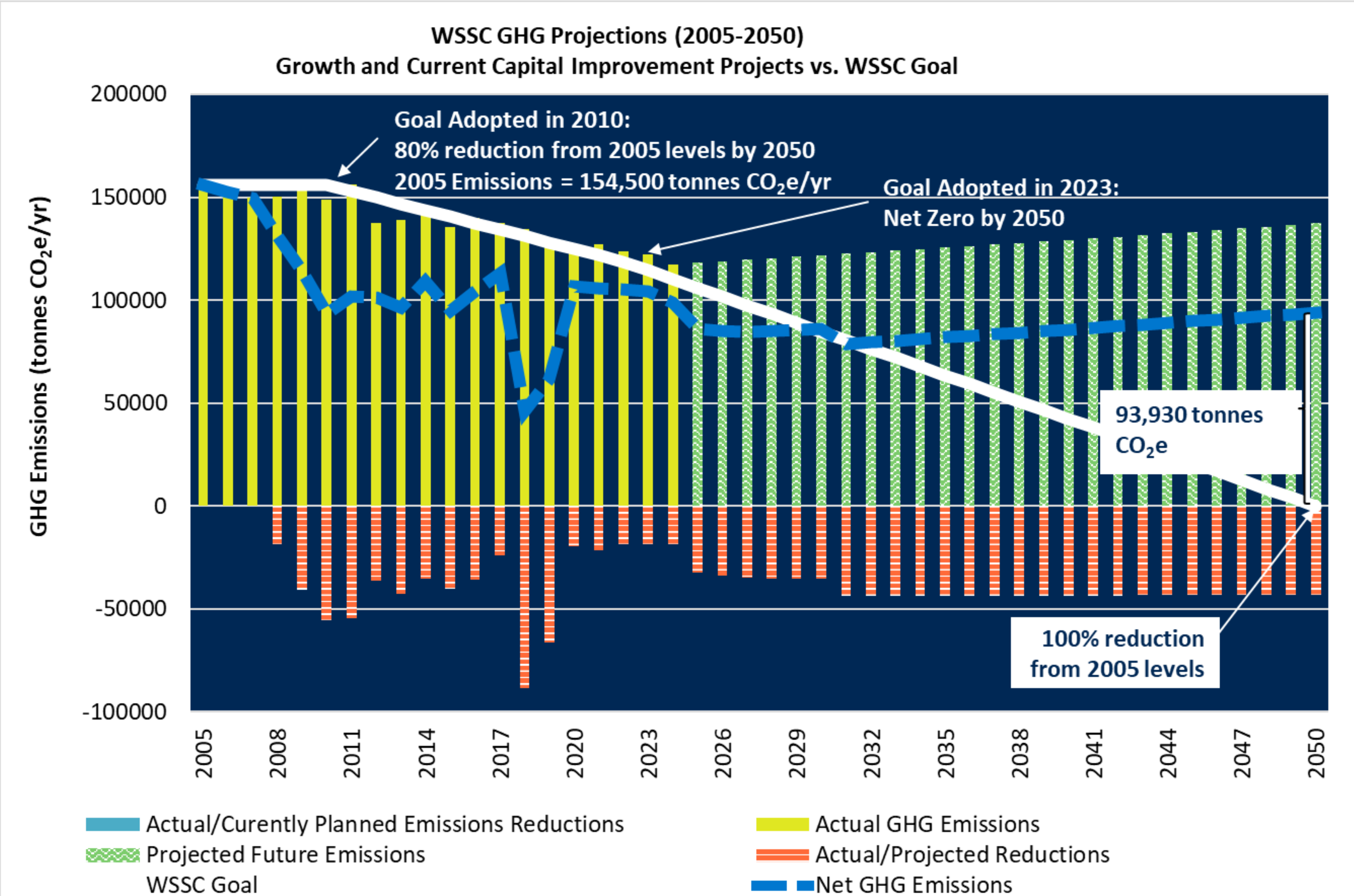
Projected Future Emissions Because of Growth and Current Capital Improvement Projects



WSSC Water's goal is to have net zero GHG emissions by 2050. This can be achieved by a 3.5 percent reduction in GHG emissions annually from 2024 to 2050. Figure 3-5 illustrates how the projected growth of GHG emissions compares to the goal. The projection indicates that WSSC Water would need to reduce annual emissions 93,930 tonnes CO_2e to reach net zero by 2050.

Figure 3-5

Projected Future Emissions Because of Growth and Current Projects Compared Against Washington Suburban Sanitary Commission Greenhouse Gas Reduction Goal



Section 4

Emission Reduction Strategies

Greenhouse Gas Emissions Reduction Strategies

Table 4-1 summarizes the strategies developed; the projected GHG emissions reduction impact; and the estimated capital, annual, and life cycle costs.

The following are the main focus areas of the GHG reduction strategies:

- Optimizing the efficiency of the water distribution system.
- Improving equipment efficiency for water and wastewater.
- Reducing residuals and optimizing processes.
- Reducing GHGs associated with vehicles and transportation.
- Optimizing building services (lighting and HVAC).
- Implementing renewable energy.

In 2024, the impact of the strategies was reevaluated based on the latest emissions factors and updated information about each project. The changes are noted in the description of the strategies in Table 4-1. Strategies removed from consideration or moved into implementation phase (actual projects) were removed from this table. New strategies were added because of a recent energy audit conducted at some of the WRRFs that resulted in proposed energy-reduction projects.

The annual cost and life cycle cost for the strategies were updated to reflect the new implementation year and extended out to 2050. Life cycle cost was calculated based on the capital cost, the annual operations and maintenance (O&M) cost, and the number of years between the proposed strategy's implementation year and 2050. O&M costs for electricity-related strategies were calculated based on the number of kWhs saved annually by the strategy and the cost of electricity (assumed $0.10 per kWh). Annual O&M for other projects, such as using green carbon sources for denitrification, are based on annual chemical costs.

Previous inventories assumed that MicroC-3000 cost less than methanol. While this may have been true in previous inventory years, this was updated for 2024 and now Table 4-1 shows that Strategy 3.4 will cost WSSC Water around $348,000 annually to replace methanol with MicroC-3000.

Note that the table and figure numbers in this document have been kept identical to those in Section 3 of the November 2012 GHG Action Plan for ease of reference, but they have been updated with new data collected in this GHG Action Plan update. They have also been updated to reflect the new GHG reduction goal of net zero by 2050.

Table 4-2

Proposed Greenhouse Gas Reduction Strategies

No. (Group)	Strategy Name	Description	2050 GHG Reduction (tonnes CO_2e/yr)	Year Implemented	Capital Cost (2025 $)	Annual Cost (+) or Savings (-)	Life Cycle Cost(through 2050)
1.6 (System Efficiency)	Optimize water distribution system pumping efficiency	Smart metering on pumps over 500 hp	-1,400	2026	$534,000	-$322,000	-$4,921,000
2.13 (Equipment Efficiency)	Aeration Efficiency at Parkway WRRF	Replace the existing process aeration blowers with more efficient units and implement electrical upgrades.	-300	2029	$1,530,000	-$60,000	$605,000
3.3 (Residuals/ Process)	Phosphorus Recovery at the Bioenergy Plant	Implement phosphorus recovery from the digested sludge flow stream. The process converts the phosphate to a commercial-grade fertilizer which then reduces WSSC Water's GHG footprint because it offsets GHGs produced in industrial fertilizer manufacture.	-1,500	2028	$10,199,000	-$14,000	$9,976,000

3.4 (Residuals/ Process)	Green Carbon Sources for Denitrification	Replace methanol at WB and Piscataway with “green” sources of carbon such as MicroC-3000 for the denitrification process. Reduce GHGs in the production of methanol (Scope 3) and the consumption of methanol in the process (Scope 1).	-4,800	Ongoing	$0	$348,000	$6,217,000
3.5 (Residuals/ Process)	Recycling	Uniform recycling strategy (paper, cans, bottles, light bulbs). Assume a 10 percent reduction in GHGs associated with garbage landfilling and incineration.	-14	Ongoing	$0	$0	$0
3.6A (Residuals/ Process)	Increased Nutrient Removal Process Efficiency	Implement innovative ammonia-based aeration control to promote innovative nutrient removal processes (Nite/Denite) at Seneca and WB that can potentially reduce aeration by 20 percent.	-1,800	2027	$6,200,000	-$362,000	$255,000
3.6B (Residuals/ Process)	Mainstream Anammox at Piscataway	Implement innovative biological nutrient removal process (mainstream Anammox or Nite/Denite) at Piscataway that can potentially reduce aeration by 20 percent and methanol by 50 percent.	-700	2029	$6,768,000	-$187,000	$3,878,000

4.1 (Transportation)	Electric Vehicles and Biodiesel	Reductions in fuel use due to replacing five SUVs annually with electric vehicles and replacing diesel with biodiesel	-60	Ongoing	$2,057,000	-$4,000	$1,981,000
5.7 (Lighting/ HVAC)	Anacostia Depot Sewer Thermal	Implement sewer thermal technology to replace natural gas use for heating and electricity use for cooling at three buildings at Anacostia Depot: the Admin Building, Heavy Equipment Shop, and Warehouse.	-63	2027	$4,170,000	-$15,900	$3,909,000
6.2 (Renewable Resources)	Additional Solar Installation (11.8 MW)	Install additional solar panels. This PPA is assumed to extend through 2050.	-9,400	2026	$0	$1,854,000	$31,403,000
6.3 (Renewable Resources)	Wind Energy	Current wind contract ends June 1, 2030. Assumed contract is extended through 2050 at 70,000 MWh/yr.	-28,000	2030	$0	TBD	TBD
6.4 (Renewable Resources)	Renewable Energy Purchase	Purchase renewable energy to achieve WSSC Water reduction goal of 93,930 tonnes in 2050. WSSC Water will have to begin purchasing additional renewable energy (likely through RECs) in 2041, to start meeting its reduction goals. WSSC Water will also have to purchase carbon credits in 2050.	-44,000	2042	$0	$870,000	$8,680,000

6.5 (Renewable Resources)	Potomac Carbon Recovery	Onsite carbon capture at Potomac WFP for future Microgrid system with offsite sequestration.	-22,000	2028	$26,000,000	$6,000,000	$121,621,000
6.6 (Renewable Resources)	Piscataway Bioenergy Carbon Recovery	Convert CO_2 to methanol using electro catalytic process.	-12,000	2033	$3,000,000	To be determined following planned pilot study.	To be determined following planned pilot study.
6.7 (Renewable Resources)	Anacostia Depot Solar (0.13 MW)	Install solar panels on roof of admin building and parking lot canopy.	-470	2027	$1,497,000	-$175,000	-$1,381,000
6.8 (Renewable Resources)	Hydro Block	10-year contract for hydro power will reduce electricity demand annually by 13,000 MWh. Contract is assumed to extend through 2050.	-5,000	2025	To be determined	-$1,300,000	To be determined

hp = horsepower
PPA = Power Purchase Agreement
SUV = sports utility vehicle

Selected Emissions Reduction Strategies

The evaluation conducted in the November 2012 GHG Action Plan resulted in 20 selected strategies that would be needed, in addition to the implementation of a new wind energy contract, to meet the 2030 GHG reduction goal. Note that this goal has since been updated to center around a 2050 net zero goal.

In the subsequent GHG Action Plan updates, these strategies were reviewed and revised, as needed, to reflect the current projects underway at WSSC Water, and some strategies that have already been implemented. As a result of these investigations, the list was narrowed down as follows:

1. ~~Office Equipment –~~ This strategy is being implemented.
2. ~~Reduce Water Pressure –~~ Removed from consideration in 2016 GHG Action Plan update.
3. ~~Patuxent Reclaim Pumps –~~ Removed from consideration in 2014 GHG Action Plan update.
4. ~~Optimize Water Pumping Efficiency –~~ Removed from consideration in 2016 GHG Action Plan update.
5. ~~Solar Water Heating at RGH –~~ Removed from consideration in 2014 GHG Action Plan update.
6. ~~Track Water Distribution System Valves –~~ Removed from consideration in 2022 GHG Action Plan update.
7. ~~Rentricity[SM] Flow-to-Wire –~~ Removed from consideration in 2016 GHG Action Plan update.
8. ~~Replace Mixers at Piscataway –~~Moved to Actual Projects in 2019 GHG Action Plan update.
9. ~~Business Trip Reductions –~~ Removed from consideration in 2013 GHG Action Plan update.
10. ~~Anacostia Wastewater Pumps –~~ Removed from consideration in 2015 GHG Action Plan update.
11. Aeration Efficiency at Parkway ~~and Piscataway WRRFs –~~ Piscataway moved to Actual Projects in 2019 GHG Action Plan update.
12. Solar PV at Seneca and Western Branch (4 MW) – This project was completed in 2012.
13. Additional Solar Installation (11.8 MW) – Updated from 6 MW installation to 11.8 MW installation for 2022 GHG Action Plan update. Construction on this facility is expected to begin 2025.
14. ~~Potomac High Zone Pumps –~~ Moved to Actual Projects in 2019 GHG Action Plan update.
15. Recycling.
16. ~~Telecommuting –~~WSSC Water has instituted a telecommuting policy, and therefore, this strategy has been implemented.
17. ~~HVAC/Lighting Upgrades –~~This project is under implementation and no longer a future strategy.
18. Ostara Pearl Process – WSSC Water is evaluating phosphorus recovery benefits and options after the Bioenergy facility reached steady-state operations.
19. ~~Optimize Wastewater Pumping Efficiency –~~ Removed from consideration in 2016 GHG Action Plan update.
20. ~~Digestion/CHP –~~ This project (Piscataway WRRF Bioenergy Project) is under implementation.
21. Green carbon sources for denitrification.
22. Use of hybrid/alternative fuel vehicles in WSSC Water's fleet.
23. Mainstream Anammox at Piscataway.
24. ~~Replace Potomac Main Zone Pump #1 –~~ Moved to Actual Projects in 2023 GHG Action Plan update.
25. Replace Aeration Blowers at Parkway.
26. Aeration Improvements at Seneca and WB.
27. Carbon Recovery at Potomac.
28. Carbon Recovery at Piscataway.
29. Sewer Thermal at Anacostia Depot.
30. Solar installations at Anacostia Depot.
31. Smart metering on pumps larger than 500 hp.

In the 2013 GHG Action Plan update, the impact of the strategies was reevaluated based on the latest emissions factors and updated information about each project as summarized in Table 3-1. The cumulative reduction of the remaining selected strategies by 2035 was not enough to meet the 2035 reduction goal. For this reason, two of the strategies that had previously not been selected were added back into consideration: (1) using hybrid/alternative fuel vehicles in WSSC Water's fleet, and (2) using green carbon sources for denitrification. In addition, a new strategy was developed: increasing the efficiency of the nutrient removal process at Piscataway, Seneca, and WB WRRFs.

The 2014 GHG Action Plan update includes two additional energy-saving strategies identified by the Phase F EPC contract: (1) replacing the existing biological process reactor mixers at Parkway WRRF, and (2) replacing the Potomac WFP Main Zone Pump #1.

The 2015 GHG Action Plan update reflects the decision by WSSC Water to allow the solar developer to retain the RECs for any additional solar photovoltaic installations on WSSC Water facilities. These projects, therefore, will not impact WSSC Water's GHG inventory.

The 2016 GHG Action Plan update removed several strategies to reduce energy use in the drinking water distribution system and the wastewater pumping stations because these strategies have not been feasible to implement as originally envisioned. In the future, as improved pumping and control technologies come on the market, WSSC Water should continue to investigate, evaluate, and potentially pilot new monitoring and control systems that can lower electricity use for pumping and reduce nonrevenue water.

The 2017 GHG Action Plan update obtained new data on the potential to recover phosphorus from the digested sludge at Piscataway as part of implementation of the Piscataway WRRF Bioenergy Project. WSSC Water is considering implementing the AirPrex technology instead of Ostara. AirPrex results in reduced struvite production compared to Ostara.

The 2018 GHG Action Plan update removed some strategies that have been or are being implemented, such as replacing the mixers at Parkway WRRF, implementation of the telecommuting policy, and upgrades to the office equipment. Four new equipment efficiency strategies were added because of the energy audit conducted at several WRRFs.

The 2019 GHG Action Plan update removed some equipment efficiency strategies being implemented. The update also added a future 6-MW solar installation. The RECs will go to the solar developer, but WSSC Water may buy them back if an economic analysis deems it feasible.

The 2020 GHG Action Plan update revised the fleet replacement strategy to account for the use of electric vehicles instead of hybrids as the fleet is replaced in future years.

The 2021 GHG Action Plan update removed tracking water distribution valves from the strategy list.

This 2022 GHG Action Plan update incorporates updated calculations into Strategy 3.6A – Increased Nutrient Removal Process Efficiency. The updated calculations now include aeration savings if the blowers at Seneca are replaced. The 2022 GHG Action Plan update also added three new strategies: 5.7 (Sewer Thermal at Anacostia Depot), 6.5 (Potomac Microgrid and Carbon Recovery), and 6.6 (Piscataway Carbon Recovery).

The 2023 GHG Action Plan update incorporated updated calculations for all strategies and incorporated two new strategies: 1.6 (Optimize water distribution system pumping efficiency) and 6.7 (Anacostia Depot Solar).

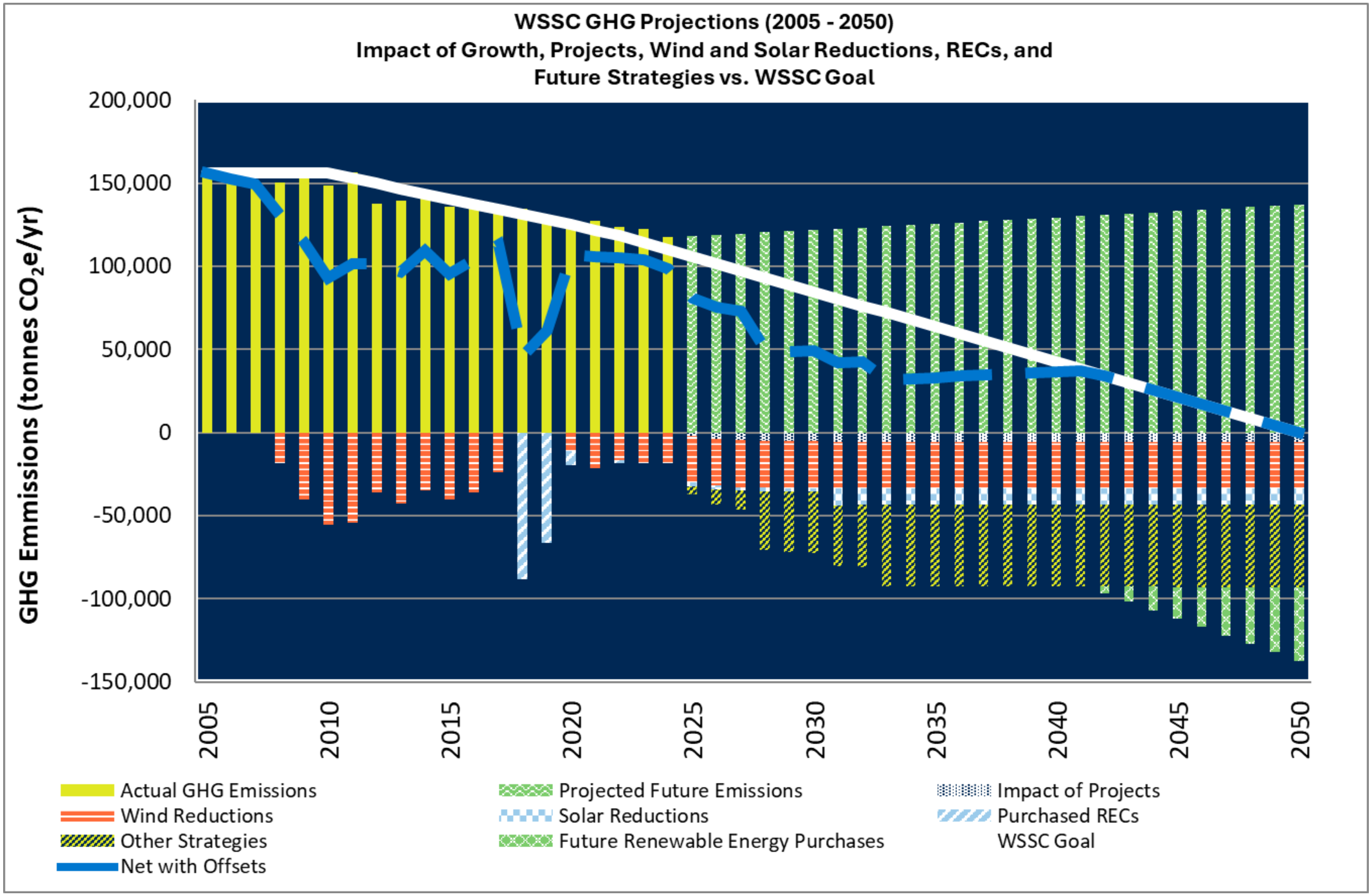
The 2024 GHG Action Plan Update revised assumptions for Strategy 4.1 due to poor market availability of American-made electric compact sedans. Calculations were revised based on the assumption that five SUVs in the fleet would be replaced with electric vehicles annually. More information is needed on the status of ammonium based aeration control (ABAC) at Seneca in order to further refine the estimated cost and GHG impact for Strategy 3.6A; there is a possibility that this impact is overestimated due to ABAC being part of the current calculation.

Impact of Selected Strategies

The strategies selected, in conjunction with renewed wind contract for roughly one-third of WSSC Water's electricity consumption, will result in a reduction of 87,000 tonnes of CO_2e in annual GHG emissions by the year 2035. Only a reduction of 63,600 tonnes CO_{2e} is required to meet WSSC Water's goals in 2035. Thus, WSSC Water will be exceeding their reduction goals until 2040. In 2040, WSSC Water will have to purchase RECs to meet their emissions goals. 2049 and 2050 both require carbon credit purchases because the required offsets would be greater than Scope 2 emissions, which are offset by RECs. Figure 4-1 shows the GHG projections with the proposed strategy reductions. Figure 4-1 identifies, in various categories, the impact of the renewed wind contract and the REC purchases (Strategies 6.3 and 6.4 listed in Table 4-1). All the other strategies combined are shown under the "Other Selected Strategies" category.

Figure 4-1

Projected Future Greenhouse Gas Emissions and Impact of Selected Strategies on WSSC Water Goal Attainment



Section 5

Future Considerations

This section summarizes and updates factors identified during the November 2012 GHG Action Plan that will affect the energy use in the service district beyond the next 20 years, as well as other opportunities WSSC Water should continue to monitor, assess, and pursue, if warranted, to achieve the emissions reduction goal.

Future Treatment Requirements

Water Resource Recovery

The primary areas of future regulations for water resource recovery include the following:

1. Reductions in the Nutrient Discharge Limits: Nitrogen and phosphorus effluent concentrations as low as 1 mg/L TN and 0.1 mg/L total phosphorus could be envisioned. Meeting these levels of treatment would require additional treatment processes such as carbon adsorption (to reduce total Kjeldahl nitrogen) and additional flocculation and filtration (to meet very low total phosphorus limits). Although these processes themselves are not overly energy-intensive, they could considerably increase the energy requirement in the facility if additional pumping of the entire plant flow is needed to meet the hydraulic requirements of the new processes.
2. Microconstituents (polychlorinated biphenyls [PCBs], per- and polyfluoroalkyl substances [PFAS], personal-care products, pharmaceuticals): Removal of some of these microconstituents could require energy-intensive processes such as reverse osmosis (RO), which could increase the energy use per MG treated by about 1,500 kWh, or about a 51 percent increase from WSSC Water’s current average use of 2,953 kWh per MG.
3. Limits on land application of biosolids: Recent changes in biosolids management as outlined by the Maryland Department of Agriculture have restricted land application practices in Maryland. Beginning in mid-2016, 6-month bans on land applications have been enforced. In addition, the Virginia Legislature is considering regulations like those implemented in Maryland. The majority of the biosolids generated in WSSC Water facilities are currently land-applied in Virginia. Because of the new regulations, management practices will force entities to manage their residuals onsite or transport stabilized biosolids greater distances to other states, which will increase trucking emissions. Emerging contaminants of concern, such as PFAS, could also result in restrictions or bans on land application. At WSSC Water, the planned Piscataway WRRF Bioenergy Project will reduce the overall volume of biosolids to be managed offsite, which will help alleviate the impact of these new restrictions.

Water Treatment

In 2015, the U.S. Environmental Protection Agency (EPA) began its mandatory 6-year review of the National Primary Drinking Water Regulation (NPDWRs) as part of the Safe Drinking Water Act. In that effort, the EPA assessed all existing NPDWRs and evaluated the Contaminated Candidate List to determine which contaminants of major or immediate concern should be added to the regulations. The results of the 6-year review were released in April 2024, and included limits for five PFAS compounds: perfluorooctanoic acid (PFOA), perfluorooctanesulfonic sulfonate (PFOS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) (known as GenX Chemicals). EPA also set a hazard index level for two or more of four PFAS as a mixture: PFNA, PFHxS, HFPO-DA, and perfluorobutane sulfonate (PFBS).

WSSC Water Water's comprehensive test results for these compounds indicate that the water quality produced at the Patuxent and Potomac WFPs complies with the final rule. However, additional water treatment may be necessary to maintain an adequate margin of safety due to river water quality fluctuations.

Contaminants that could lead to further regulations in future regulatory cycles include the following:

1. Chemical contaminants such as estrogen-based hormones from pharmaceutical manufacturing, PFAS, insecticides, and fungicides used in agricultural applications and manufacturing contaminants such as perchlorates.
2. Microbiological contaminants such as cryptosporidium, which can cause gastrointestinal and respiratory illnesses.
3. Disinfection by-products such as trihalomethanes, bromates, chlorites, and haloacetic acids.
4. PCBs that are found in landfill runoff, chemical leaching, and waste chemical discharges.
5. Algal toxins produced in algal blooms that develop when nutrients flow into waterways via agricultural runoff. These toxins can threaten humans, as is the case with microcystin, which is linked to potentially serious health effects.

Most of these contaminants will require additional treatment for removal. To meet advanced treatment goals, emerging or new technologies would need to be applied that require higher consumption of energy or additional chemicals and consumables. Technologies such as ozone, ultraviolet (UV) disinfection, RO and nanofiltration, granular activated carbon systems, and Mixed Ion Exchange could increase electricity usage at the WFPs by 20 percent or more. Additional chemicals, such as hydrogen peroxide and chlorine dioxide to achieve advanced oxidation or ion exchange media for removal additional disinfection by-product precursor compounds, would also increase the GHG footprint of operating these advanced systems.

Future Technological Developments

Future technological developments that may help reduce the GHG emissions at WSSC Water include the following:

- More efficient aeration systems, including high-efficiency blowers and high-efficiency diffusers (flat panel-type). WSSC Water is currently moving forward with projects to enhance the efficiency of the aeration blowers at the major WRRFs.
- Advances in biological water resource recovery, such as the deammonification process. This process reduces the aeration and supplemental carbon requirements per pound of nitrogen removed compared to the conventional nitrification-denitrification system currently used. The process also significantly reduces the amount of waste sludge produced. The deammonification process is currently being implemented in several WRRFs in the U.S. to treat side streams such as digested sludge centrate. Hampton Roads Sanitation District and Fairfax County are currently in the process of

implementing this technology in the mainstream. The sidestream process is part of the Piscataway WRRF Bioenergy Project.

- Advances in lamp and ballast technology to reduce energy use in UV disinfection systems. These include using light-emitting diodes to emit the UV light. The technology continues to evolve, but there are no commercial large-scale applications to date.
- Microbial fuel cells, which convert chemical energy to electrical energy by the catalytic reaction of microorganisms, could be used to generate electricity directly from the wastewater. This technology continues to evolve but is not ready for full-scale implementation.
- Installation of microturbines at pressure reducing valves (PRVs) may produce some electricity for use in distribution system facilities. This technology is typically installed in high-head PRVs. However, based on discussion with WSSC Water, it is not anticipated this strategy would produce a significant amount of energy savings simply because of network PRVs being for relatively low reductions in pressure.
- Improved control technologies, neural network systems, and smart models could revolutionize how complex systems such as water distribution networks are controlled in the future. In 10 years, it is expected that new technologies will emerge that will enable systems to be optimized for energy efficiency and water quality. In addition, these advanced control systems can also be deployed at WRRFs and WFPs to optimize the facilities' operations for energy efficiency.
- Expanding implementation of micro-grids or energy storage systems that would allow WSSC Water to use and develop local renewable power more efficiently.

Reduction in Volume of Water and Wastewater Treated

To reduce the emissions associated with water treatment and pumping, WSSC Water could develop strategies to effectively reduce the volume of water treated at the WFPs and WRRFs. These strategies include the following:

- Reduction in non-revenue water: WSSC Water estimated in 2015, that approximately 17 to 18 percent of the water produced in the WFPs is "lost" in the system. This percentage represents inefficiency in the system and is caused mainly by ruptures in water mains, which WSSC Water is working to address. As the existing water mains are replaced and better monitoring takes place, non-revenue water will be reduced. Water loss reduction is an area where there are many current technological developments, considering many utilities around the world are grappling with water supply and energy-shortage problems. These technologies include development of district metering areas, where water delivery in sections of the service area is measured and compared to water delivered to the customer. A system the size of WSSC Water's should have a few hundred district metering areas that could be used to identify and repair leaks and other sources of non-revenue water. New improvements in customer-level metering would also provide more-accurate and real-time data to help identify anomalies that may indicate a water leak. Also, new "software as service" products are currently coming on the market, such as a new service offered by TaKaDu to use existing system data and scan it for deviations from patterns that indicate leaks, faulty meters, or other sources of water loss.
- Reduction in infiltration and inflow (I&I): The rapid increase in wastewater flows at the WSSC Water WRRFs can be largely attributed to I&I. WSSC Water is continuing to invest in wastewater collection infrastructure to reduce I&I. Green infrastructure is also currently being encouraged and championed

in Montgomery and Prince George's counties to keep stormwater out of the wastewater collection system.

- Water conservation: New technological advances in appliances such as washing machines, dishwashers, toilets, fixtures, and faucets continue to reduce the water used per person. In addition, WSSC Water could introduce water conservation incentives and education to its customers, including funding to upgrade old appliances and fixtures. Finally, if energy costs increase dramatically in the future, WSSC Water will have to increase water and sewer rates, which will encourage reduction in water use.
- Water reuse: Reuse of treated WRRF effluent for non-potable uses (such as irrigation or cooling) continues to be a concept that is becoming more widespread in the industry as more utilities search for ways to reduce treatment costs and increase the water supply sources. In the case of WSSC Water, reuse of WRRF effluent is an attractive strategy because it reduces the volume of water and therefore the nutrient load released to the Chesapeake Bay. For example, the Cox Creek Water Reclamation Facility effluent is used for cooling at the Brandon Shores Plant in Anne Arundel County. As the population grows and the health of the Bay continues to be a concern in the region, reuse measures are likely to gain public and regulatory acceptance. Opportunities for reuse need to be identified but could include water for irrigation of golf courses or other large landscaping users, cooling water for power plants or other industrial uses, and "purple pipe" applications such as toilet flushing in new commercial developments where a dual distribution system is installed.

Future Changes in Emissions Protocols

In 2021, both the GHG Protocol and The Climate Registry released updates to relevant protocols to align with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and Global Protocol for Community Scale GHG Inventories from GHG Protocol (2021) protocols. These updates include new guidance and standards for how GHG emissions resulting from water resource recovery processes, part of WSSC Water's Scope 1 emissions, are quantified and reported. WSSC Water considered incorporating the updated protocol concerning CH_4 and N_2O emissions. However, the decision has been made to use the previous protocol for estimating these emissions until WSSC Water is able to perform direct measurements of their process emissions at their facilities. Direct measurement is the best way to truly quantify the emissions being produced and assess and measure the effectiveness of mitigation strategies. The technology for measuring process emissions is rapidly evolving, with several pilot studies being conducted. WSSC Water is closely monitoring these pilots and planning on implementing emissions monitoring technology once it has been proven and demonstrated.

Methane emissions from wastewater collection systems have historically not been included in GHG emissions inventories despite the growing evidence this infrastructure can be a potentially significant source of such emissions. A key challenge of including sewer methane in GHG inventories is the lack of an accepted protocol to estimate these emissions and the extent and widespread nature of sewer networks to embark on a monitoring campaign. A preliminary estimation of GHG emissions from WSSC Water's collection system, CH_4 specifically, was developed using a published methodology [1] that relies on the physical characteristics of the assets in such system. The methodology used in these estimates was empirically generated based on a limited pool of data. For this reason, the uncertainty regarding how the

[1] Willis, J., B. Brower, C. Peot, S. Murthy, P. Regmi, W. Graf, K. Sharma, and Z. Yuan. 2018. *New GHG Methodology to Estimate/Quantify Sewer Methane*. WEF 2018 Odors and Air Quality. Portland, Oregon. March 28.

specific site conditions where the data were gathered may impact the resulting equations used for this estimate.

Preliminary estimates of collection system emission (Table 5-1) using the proposed methodology and available data are between 14,600 to 34,700 tonnes CO_2e, which is approximately 14 to 34 percent of the CY2022 inventory (101,100 tonnes CO_2e). There are 13,200 to 32,00 tonnes (13 to 32 percent) of emissions from the gravity network. There are 1,400 to 2,700 tonnes (1 to 3 percent) of emissions from the pressure network and force mains. Preliminary estimates are based purely on pipe size; once average flow information and wastewater temperature become available, this estimate can be further refined using the same methodology.

Table 5-1

Collection System Greenhouse Gases

Pipe Type	Estimated Tonnes GHGs	Percentage of Total GHGs
Force Main	1,400 to 2,700	1 to 3
Gravity Main	13,200 to 32,000	13 to 32

Increasing the accuracy of these estimates would require a deeper analysis of the collection system characteristics (for example, hydraulic behavior, ventilation regime, and wastewater quality). As with any other protocol for estimating GHG emissions, direct measurement by monitoring actual sewer methane levels at strategic locations could also increase the understanding of the extent of these emissions within the context of the overall WSSC Water GHG inventory.

WSSC WATER
DELIVERING THE ESSENTIAL