Air Quality 4

Brookhaven National Laboratory (BNL) monitors both radioactive and nonradioactive emissions at several facilities on site to ensure compliance with the requirements of the Clean Air Act (CAA). In addition, BNL conducts ambient air monitoring to verify local air quality and detect possible environmental impacts from Laboratory operations.

During 2022, BNL facilities released a total of 14,116 curies of short-lived radioactive gases. Oxygen-15 and Carbon-11 emitted from the Brookhaven Linac Isotope Producer (BLIP) constituted 99.9 percent of the site's radiological air emissions.

Because natural gas prices were comparatively lower than residual fuel oil prices throughout the year, BNL's Central Steam Facility (CSF) used natural gas to meet 91.4 percent of the heating and cooling needs of the Laboratory's major facilities in 2022. As a result, emissions of particulates, oxides of nitrogen, sulfur dioxide, and volatile organic compounds were well below the respective regulatory permit criteria pollutant limits.

The Laboratory's transition from "Limited Operations with Maximum Telework" to "Normal Operations with Telework" on March 14, 2022, contributed to increases in air travel and commuting greenhouse gas (GHG) emissions. Since 89 percent of air travel trips occurred after March 14, air travel GHG emissions rose to 1,247 metric tons (MT) of carbon dioxide equivalent (CO_2e), more than eight times the total of 150 MT CO_2e in fiscal year 2021. Meanwhile, commuting GHG emissions rose 15 percent as the average number of employees working on site increased from 1,200 to 1,500 employees after March 14.

4.1 RADIOLOGICAL EMISSIONS

Federal air quality laws and U.S. Department of Energy (DOE) regulations that govern the release of airborne radioactive material include 40 CFR 61: Subpart H, National Emission Standards for Hazardous Air Pollutants (NESHAPs) part of the Clean Air Act (CAA), and DOE Order 458.1, Chg. 4, Radiation Protection of the Public and the Environment. Under NESHAPs Subpart H, facilities that have the potential to cause an annual radiation dose greater than 0.1 millirem (mrem) microSieverts (µSv) to a member of the public must continuously monitor emissions. Facilities capable of delivering radiation doses below that limit require periodic, confirmatory sampling.

BNL has two active facilities: the Brookhaven Linac Isotope Producer (BLIP), whose emissions are continuously monitored with an in-line detection system, and the Target Processing Laboratory (TPL), which has a particulate filter sampling system to continuously collect samples for gross alpha and gross beta activity, and one inactive facility, the High Flux Beam Reactor (HFBR), where periodic emissions monitoring is conducted. Figure 4-1 provides the locations of these monitored facilities and Table 4-1 presents airborne release data from these facilities. Annual emissions from monitored facilities are discussed in the following sections of this chapter. The associated radiation dose estimates are presented in Table 8-5 in Chapter 8.

4.2 FACILITY MONITORING

Radioactive emissions are monitored at the HFBR, BLIP, and TPL. The sampling points in the exhaust stack for BLIP and the TPL exhaust duct are equipped with glass-fiber filters that capture samples of airborne particulate matter released from these facilities. The filters are collected and analyzed weekly for gross alpha and beta activity. Particulate filter analytical results for gross alpha and beta activity in 2022 are reported in Table 4-2. The average gross alpha and beta airborne activity

Figure 4-1. Air Emission Release Points Subject to Monitoring.

concentration levels for samples collected from the BLIP exhaust stack were 0.0003 and 0.0070 picocuries per cubic meter (pCi/m^3), respectively. Annual average gross alpha and beta airborne activity concentration levels for samples collected from the TPL were 0.0005 and 0.0047 pCi/m^3, respectively.

4.2.1 High Flux Beam Reactor

In 1997, a groundwater plume was traced back to a leak in the HFBR spent fuel storage pool. Consequently, the HFBR was permanently shut down in 1999. Residual tritium in water in the reactor vessel and piping systems continued to diffuse into the building's air through valve seals and other system penetrations, though emission rates were much lower than during the years of operation. In 2010, the HFBR was disconnected from the 100-meter stack, and a new HFBR exhaust system was installed in 2011. As part of the HFBR Long-Term Surveillance Program (BNL 2018), air samples are collected from outside the HFBR confinement structure using a permanently installed sample port. Samples are analyzed for tritium to evaluate facility emissions and to ensure that air quality within the building is acceptable to permit staff entry for inspections and routine maintenance. Samples are collected for three or four weeks per month using a standard desiccant sampling system for tritium analysis. Desiccant samples are analyzed by an off-site contract laboratory.

4.2.2 Brookhaven Linac Isotope Producer

Protons from the Linear Accelerator (LINAC) are sent via an underground beam tunnel to the BLIP, where they strike various metal targets to produce new radionuclides for medical diagnostics. The activated metal targets are transferred to the TPL in Building 801 for separation and shipment to various radiopharmaceutical research laboratories. During irradiation, the targets become hot and are cooled by a continuously recirculating water system. The cooling water also becomes activated during the process, producing secondary radionuclides. The most significant of these radionuclides are oxygen-15 (O-15, half-life: 122 seconds) and carbon-11 (C-11, half-life: 20.4 minutes). During target irradiations, both isotopes are released as gaseous, airborne emissions through the facility's 33-foot-tall stack. Emission levels of these radionuclides are dependent on the current and energy of the proton beam used to produce the radioisotopes.

In 2022, BLIP operated over a period of 37.1 weeks, during which 4,705 Ci of C-11 and 9,411 Ci of O-15 were released, totaling 14,116 Ci (see Table 4-1). In 2022, BLIP combined emissions of C-11 and O-15 were higher than 2021 levels at 11,054 Ci. The 2022 release of tritium produced from activation of target cooling water was 0.042 Ci compared to 0.026 Ci of tritium released in 2021.

4.2.3 Target Processing Laboratory

As mentioned above, in Section 4.2.1, metal targets irradiated at the BLIP are transported to the TPL in Building 801, where isotopes are chemically extracted for radiopharmaceutical production. Airborne radionuclides released during the extraction process are drawn through multistage HEPA and charcoal filters and the filtered air is then vented to the atmosphere. The types of radionuclides that are produced depend on the isotopes chemically extracted from the irradiated metal targets, which may change from year to year. Annual radionuclide quantities released from this facility are very small, typically in the microcurie (µCi) to mCi range. Historical analytical results of TPL particulate filters show gross alpha/beta levels to be minimal. As a result, there are no reported radionuclide emissions from the TPL in Table 4-1. Should future gross beta analyses of

Table 4-1. Airborne Radionuclide Releases from Monitored Facilities.

Facility	Nuclide	Half-Life	Ci Released
HFBR	Tritium	12.3 years	3.43E-01
BLIP	C-11	20.38 minutes	4.71E+03
	O-15	122 seconds	9.41E+03
	Tritium	12.3 years	4.20E-02
Total			**1.41E+04**

Notes:
1 Ci = 3.7E+10 Bq
BLIP = Brookhaven Linac Isotope Producer
HFBR = High Flux Beam Reactor (operations were terminated in November 1999)

TPL emissions show the potential for other radionuclide emissions, gamma analysis may be used to identify potentially emitted radionuclides.

4.2.4 Additional Minor Sources

Several research departments at BNL use designated fume hoods for work that involves small quantities of radioactive materials in the µCi to mCi range. The work typically involves labeling chemical compounds and transferring material between containers. Due to the use of HEPA filters and activated charcoal filters, the nature of the work conducted, and the small quantities involved, these operations have a very low potential for atmospheric releases of significant quantities of radioactive materials. Compliance with NESHAPs Subpart H is demonstrated using an inventory system that allows an upper estimate of potential releases to be calculated.

Facilities that demonstrate compliance in this way include Buildings 463, 490, 510, 555, 734, 745, 815, and 817, where research is conducted in the fields of nuclear safety, nuclear science, biology, chemistry, high energy physics, photon science, advanced technology, environmental chemistry, and synthetic biology. See Table 8-5 in Chapter 8 for the calculated dose from these facility emissions.

4.2.5 Nonpoint Radiological Emission Sources

Nonpoint radiological emissions from a variety of diffuse sources may be evaluated for compliance with NESHAPs Subpart H. Diffuse sources evaluated often include planned research, planned waste management activities, and planned decontamination and decommissioning activities. Evaluations determine whether NESHAPs permitting and continuous monitoring requirements are applicable, or periodic confirmatory sampling is needed to ensure compliance with Subpart H standards for radionuclide emissions. Chapter 8 discusses the NESHAPs evaluations of diffuse sources in 2022.

4.3 AMBIENT AIR MONITORING

As part of the Environmental Monitoring Program, air monitoring stations are in place around the perimeter of the BNL site (see Figure 4-2). There are four blockhouse stations equipped for collecting samples. At each blockhouse, vacuum pumps draw air through columns where particulate matter is captured on a glass-fiber filter. Particulate filters are collected weekly and analyzed for gross alpha and beta activity using a gas-flow proportional counter. Also, water vapor for tritium analysis is collected on silica-gel adsorbent material for processing by liquid scintillation analysis. In 2022, silica-gel samples were collected every two weeks.

4.3.1 Gross Alpha and Beta Airborne Activity

Particulate filter analytical results for gross alpha and beta airborne activity are reported in Table 4-3. Ambient air samples are collected weekly from site perimeter monitoring stations P2, P4, P7, and P9. Validated samples are those not rejected due to equipment malfunction or other factors (e.g., sample air volumes were not acceptable).

In 2022, the annual average gross alpha and beta airborne activity levels for the four monitoring stations were 0.0013 and 0.0123 pCi/m^3, respectively. Annual gross beta activity trends recorded at Station P7 are plotted in Figure 4-3. The results for this location are typical for the site and show seasonal variation in activity within a range that is representative of natural background levels. The New York State Department of Health (NYSDOH) received duplicate filter samples that were collected at Station P7, using a sampler provided by NYSDOH. These samples were collected weekly and analyzed by the NYSDOH laboratory for gross beta activity. The analytical results were comparable to the Station P7 samples analyzed by General Engineering Lab,

Table 4-2. Gross Activity in Facility Air Particulate Filters.

Monitored Facility		Gross Alpha (pCi/m^3)	Gross Beta (pCi/m^3)
BLIP	N	50	50
	Max.	0.0016 ± 0.0006	0.0208 ± 0.0016
	Avg.	0.0003 ± 0.0004	0.0070 ± 0.0010
	MDL	0.0006*	0.0009*
TPL - Bldg. 801	N	51	51
	Max.	0.0018 ± 0.0007	0.0132 ± 0.0013
	Avg.	0.0005 ± 0.0004	0.0047 ± 0.0008
	MDL	0.0006*	0.0007*

Notes:
See Figure 4-1 for monitored facility locations.
All values shown with a 95% confidence interval.
BLIP = Brookhaven Linac Isotope Producer
MDL = Minimum Detection Limit
N = Number of validated samples collected
TPL = Target Processing Laboratory
*Average MDL for all validated samples taken at this location

Table 4-3. Gross Activity Detected in Ambient Air Monitoring Particulate Filters.

Sample Station		Gross Alpha (pCi/m^3)	Gross Beta (pCi/m^3)
P2	N	52	52
	Max	0.0023 ± 0.0007	0.0208 ± 0.0015
	Avg.	0.0013 ± 0.0005	0.0119 ± 0.0010
	MDL	0.0004*	0.0006*
P4	N	50	50
	Max	0.0034 ± 0.0009	0.0238 ± 0.0018
	Avg.	0.0012 ± 0.0005	0.0112 ± 0.0010
	MDL	0.0004*	0.0006*
P7	N	47	47
	Max	0.0039 ± 0.0028	0.0509 ± 0.0076
	Avg.	0.0014 ± 0.0006	0.0142± 0.0014
	MDL	0.0007*	0.0010
P9	N	50	50
	Max	0.0028 ± 0.0010	0.0355 ± 0.0058
	Avg.	0.0014 ± 0.0006	0.0119 ± 0.0011
	MDL	0.0005*	0.0008*
Grand Average		**0.0013 ± 0.0007**	**0.0123 ± 0.0058**

Notes:
See Figure 4-2 for sample station locations.
All values shown with a 95% confidence interval.
MDL = minimum detection limit
N = Number of validated samples collected
*Average MDL for all validated samples taken at this location

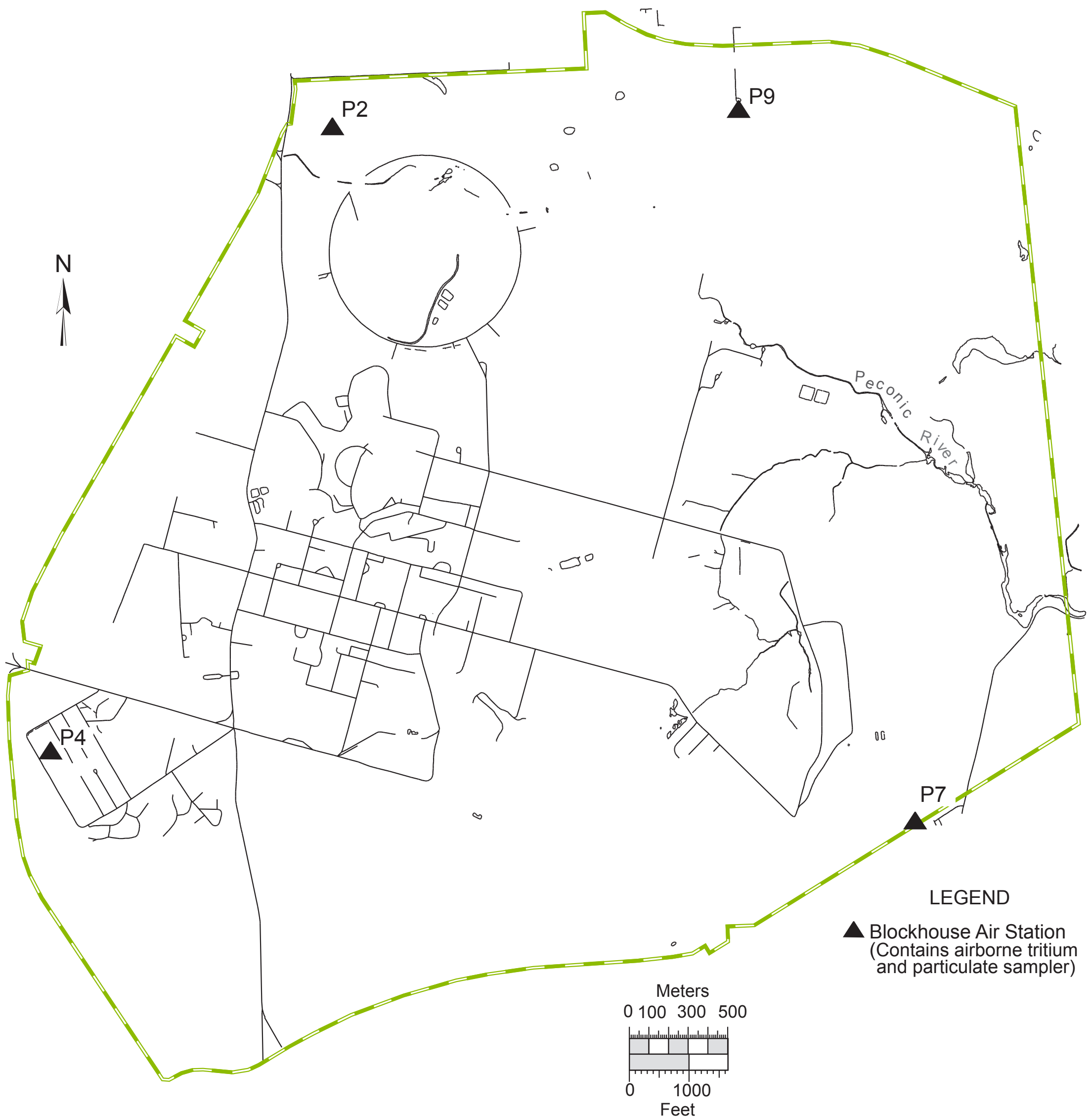


Figure 4-2. BNL On-Site Ambient Air Monitoring Stations.

an analytical laboratory contracted by BNL. New York State's analytical results for gross beta activity at the Laboratory were between 0.0019 and 0.0244 pCi/m^3, with an average concentration of 0.0152 pCi/m^3. BNL results ranged from 0.00481 to 0.0509 pCi/m^3, with an average concentration of 0.0141 pCi/m^3.

As part of a state-wide monitoring program, NYSDOH also collects air samples in Albany, New York, a control location with no potential to be influenced by radiological facility emissions. In 2022, NYSDOH reported that airborne gross beta activity at that location varied between 0.0048 and 0.0326 pCi/m^3 and had an average concentration of 0.0169 pCi/m^3. All but two of the BNL samples were less than the maximum concentration collected at the NYSDOH control location, demonstrating that on-site radiological air quality was consistent with that observed at locations in New York State not located near radiological facilities.

4.3.2 Airborne Tritium

Airborne tritium in the form of tritiated water (H_2O) is monitored throughout the BNL site. In

2022, samples were collected from Stations P2, P4, P7, and P9 to assess the potential impacts from the Laboratory's two tritium sources. Table 4-4 lists the number of validated samples collected at each location, the maximum value observed, and the annual average concentration. Validated samples are those not rejected due to equipment malfunction or other factors (e.g., a battery failure in the sampler, frozen or supersaturated silica gel, insufficient sample volumes, or the loss of sample during preparation at the contract analytical laboratory). Samples for airborne tritium were collected every two weeks from each sampling station during 2022. The average tritium concentrations at all the sampling locations were less than the typical minimum detection limits, ranging from 4.7 to 20.2 pCi/m^3.

Table 4-4. Ambient Airborne Tritium Measurements in 2022.

Sample Station	Wind Sector	Validated Samples	Maximum (pCi/m^3)	Average (pCi/m^3)
P2	NNW	24	36.3 ± 6.2	2.8 ± 7.4
P4	WSW	24	16.5 ± 13.3	2.2 ± 8.1
P7	ESE	23	9.5 ± 13	0.4 ± 6.6
P9	NE	25	24.2 ± 7.6	0.8 ± 7.3
Grand Average				**1.6 ± 7.3**

Notes:
See Figure 4-2 for station locations.
Wind sector is the downwind direction of the sample station from the High Flux Beam Reactor (HFBR) stack.
All values reported with a 95% confidence interval.
Typical minimum detection limit for tritium is between 4.7 to 20.2 pCi/m^3.

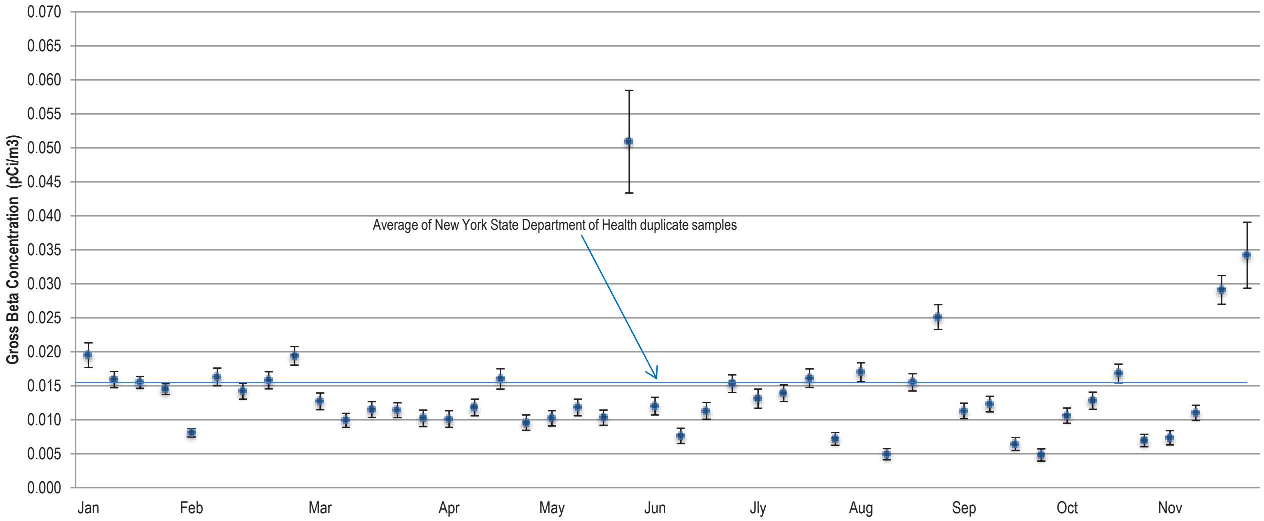
4.4 NONRADIOLOGICAL AIRBORNE EMISSIONS

Various state and federal regulations governing non-radiological releases require facilities to conduct periodic or continuous emission monitoring to demonstrate compliance with emission limits. The Central Steam Facility (CSF) is the only BNL facility that requires monitoring for non-radiological emissions. The Laboratory has several other emission sources subject to state and federal regulatory requirements that do not require emission monitoring (see Chapter 3 for details).

The CSF supplies steam for heating and cooling to major BNL facilities through an underground steam distribution and condensate grid. The location of the CSF is shown in Figure 4-1. The combustion units at the CSF are designated as Boilers 1A, 5, 6, and 7. Boiler 1A, which was installed in 1962, has a heat input capacity of 16.4 MW (56.7 million British thermal units per hour [MMBtu/per hour]). Boiler 5, installed in 1965, has a heat input of 65.3 MW (225 MMBtu/hr). The newest units, Boilers 6 and 7, were installed in 1984 and 1996, and each has a heat input capacity of 42.6 MW (147 MMBtu/hr). For perspective, National Grid's Northport, New York, power station has four utility-sized turbine/generator boilers, each with a maximum-rated heat input of 385 MW (1,315 MMBtu/hr).

Because the CSF boilers have the potential to emit more than 100 tons per year of oxides of nitrogen (NOx), the CSF is considered a major facility, and all four of its boilers are subject to the Reasonably Available Control Technology (RACT) requirements of Title 6 of the New York Code, Rules, and Regulations (NYCRR) Subpart 227-2. Because of their design, heat inputs, and dates of installation, Boilers 6 and 7 are also subject to the Federal New Source Performance Standard (40 CFR 60, Subpart Db: Standards of Performance for Industrial-Commercial-Institutional Steam Boilers). Both boilers are equipped with continuous emission monitoring systems (CEMS) to show compliance with NOx standards of Subpart 227-2 and Subpart Db, and with continuous opacity monitors to demonstrate compliance with Subpart Db opacity monitoring requirements. To measure combustion efficiency, the boilers are also monitored for carbon monoxide (CO). Continuous emission monitoring results from the two boilers are reported quarterly to EPA and the New York State Department of Environmental Conservation (NYSDEC).

The Subpart 227-2 NOx RACT emission limit for the combustion of natural gas and the combustion of No. 6 oil burned in the CSF three large boilers is 0.15 lbs/MMBtu. The NOx RACT emission limit for the CSF's one mid-size boiler (Boiler 1A) is 0.20 lbs/MMBtu. From May 1 to September 30 of each year, the peak ozone period, owners and operators of boilers equipped with CEMS must demonstrate compliance with Subpart 227-2 Nox RACT limits by calculating the 24-hour average emission rate from CEMS readings and comparing the value to the emission limit. During the remainder of the year, the calculated 30-day



Note: All values are presented with a 95 percent confidence interval.

Figure 4-3. Airborne Gross Beta Concentration Trend Recorded at Station P7.

rolling average emission rate is used to establish compliance. Owners and operators of boilers not equipped with CEMS must demonstrate compliance with NOx RACT limits via periodic emissions testing. Following the end of each calendar quarter, facilities with boilers equipped with CEMS must tabulate and summarize emissions, monitoring, and operating parameter measurements recorded during the preceding three months.

Since past emissions testing and CEMS results for No. 6 oil burned have shown that CSF boilers 5, 6, and 7 cannot meet the new lower NOx RACT standards, BNL uses an approved system averaging plan to demonstrate compliance in quarterly reports submitted to NYSDEC. This plan utilizes a NOx ledger, where NOx rate credits accumulated during quarterly periods when natural gas is burned at levels below the NOx RACT limits offset ledger debits that occur when Boilers 5, 6, and 7 burn oil. The ledger must show that the actual NOx weighted average emission rate of operating boilers is less than the Subpart 227-2 permissible NOx weighted average rate for the quarter.

The actual NOx weighted average emission rates for operating boilers in the first, second, third, and fourth quarters, respectively, were 0.117, 0.105, 0.098, and 0.111 lbs/MMBtu, while the corresponding permissible weighted average emissions rate was 0.149 lbs/MMBtu for the first quarter, 0.150 lbs/MMBtu for the second and third quarters, and 0.152 lbs/MMBtu for the fourth quarter.

In preparation for required ten-year integrity inspections of the Laboratory's two 286,000 gallon No. 2 oil above-ground storage tanks, plans were made to burn 75,000 gallons of No. 2 oil in Tank 6 in advance of its required inspection due by October 8, 2023. From October and December, 35,818 gallons of No.2 oil were drawn from the tank and used in CSF Boilers 6 and 7 to produce steam. An oil sample collected from Tank 6 that was analyzed to determine its sulfur and nitrogen contents revealed it had a sulfur content of 0.173 percent wt., which was well under the current fuel sulfur content limit of 0.5 percent wt. but well above the 0.0015 percent wt. fuel sulfur content limit applicable to No. 2 oil burned in the CSF boilers after July 1, 2023. Since the No. 2 oil in Tank 5 was purchased at the same time as oil in Tank 6, it was presumed to have a similar sulfur content. Based on these findings, plans were put in place to burn down the remaining supplies of No. 2 oil in Tanks 5 and 6 before July 1, 2023.

In 2022, there were nine recorded excess opacity measurements. One recorded reading for Boiler 6 on February 6 was due to a load shift and eight Boiler 6 excess opacity readings on May 16 were artificially induced during the opacity calibration test. While there are no regulatory requirements to continuously monitor opacity for Boilers 1A and 5, surveillance monitoring of visible stack emissions is a condition of BNL's Title V operating permit. Daily observations of stack gases recorded by CSF personnel throughout the year showed no visible emissions on days when the boilers were operated.

To satisfy quality assurance requirements for the continuous emissions monitoring system of the Laboratory's Title V operating permit, a relative accuracy test audit (RATA) of the Boilers 6 and 7 continuous emissions monitoring systems for NOx and CO_2 was conducted in December 2022. The results of the RATA demonstrated that the Boiler 6 and 7 NOx and CO_2 continuous emissions monitoring systems met RATA acceptance criteria, which are defined in 40 CFR 60, Appendix B, Specifications 2 and 3.

In 2022, residual fuel prices exceeded those of natural gas for most of the year. As a result, natural gas was used to supply 91.4 percent of the heating and cooling needs of BNL's major facilities. By comparison, in 2016, residual fuel satisfied 21 percent of the major facility heating and cooling needs. Consequently, 2022 emissions of particulates and sulfur dioxide (SO_2) were 0.9, and 10.7 tons less than the respective totals for 2016, when No. 6 oil was used to supply a much higher percent of site heating and cooling needs. Table 4-5 shows fuel use and emissions since 2013.

4.5 GREENHOUSE GAS EMISSIONS

Since the implementation guidance for Executive Order (EO) 13834, Efficient Federal Operations, that was released in April 2019 did not require agencies to amend GHG reduction targets, the Laboratory has continued to strive to achieve the numerical targets set forth in EO 13693.

One of the overarching goals of EO 13693 was for federal agencies to establish agency-wide GHG reduction targets for their combined Scope 1 and 2 GHG emissions and for their Scope 3 GHG emissions (see Appendix A for definitions). DOE set the following GHG emission reduction goals for fiscal year (FY) 2025: Reduce Scope 1 and 2 GHG emissions by 50 percent relative to its FY 2008 baseline and reduce Scope 3 GHG emissions by 25 percent relative to its FY 2008 baseline. BNL includes these same goals in its annual Site Sustainability Plan (SSP), which it submits to DOE in December of each year (BNL 2022). BNL's SSP identifies several actions that have or will be taken to help the Laboratory

Table 4-5. Central Steam Facility Fuel Use and Emissions (2013–2022).

Annual Fuel Use and Fuel Heating Values							Emissions			
Year	No. 6 Oil (10^3 gals)	Heating Value (MMBtu)	No. 2 Oil (10^3 gals)	Heating Value (MMBtu)	Natural Gas (10^6 ft^3)	Heating Value (MMBtu)	TSP (tons)	NO_x (tons)	SO_2 (tons)	VOCs (tons)
2013	117.21	17,590	0	0	631.95	649,645	2.9	30.7	2.9	1.8
2014	34.03	5,107	0	0	673.80	690,584	2.6	30.9	1.0	1.9
2015	9.66	1,449	0	0	619.98	638,209	2.4	30.3	0.4	1.7
2016	804.38	120,712	0	0	441.98	453,348	3.7	33.6	19.0	1.7
2017	65.07	9,765	0	0	564.96	579,559	2.3	28.2	1.7	1.6
2018	36.04	5,409	0.04	6	642.33	662,242	2.5	31.5	1.0	1.8
2019	15.56	2,335	0.13	17.94	588.49	649,343	2.3	28.5	0.5	1.6
2020	44.20	6,455	0	0	553.70	610,905	2.2	28.9	1.2	1.5
2021	46.24	6,713	0	0	583.99	603,606	1.9	19.5	1.2	1.3
2022	342.45	49,522	40.43	5,560	567.51	587,343	2.8	36.1	8.3	1.8
Permit Limit (in tons)							**113.3**	**159.0**	**445.0**	**39.7**

Notes:
NO_x = Oxides of Nitrogen
SO_2 = Sulfur Dioxide
TSP = Total Suspended Particulates
VOCs = Volatile Organic Compounds

progress towards meeting the Scope 1 and 2 GHG emissions reduction goal.

In March 2011, BNL began receiving 15 megawatts per hour of hydropower from the New York Power Authority. In 2022, BNL consumed 120,747 megawatts of hydropower, providing a net GHG reduction of 66,420 MT CO_2e. In 2016, BNL completed an expansion of the Northeast Solar Energy Research Center (NSERC). The NSERC is a solar photovoltaic facility that now has a total peak capacity of 907 kW. In 2022, it provided 644,479 kWh and offset 355 MT CO_2e. Combined hydropower from the New York Power Authority and NSERC power offset 66,775 MT CO_2e. DOE awarded BNL's first Utility Energy Service Contract (UESC) in October 2013. This project provided for the implementation of energy savings measures to reduce Scope 1 and 2 GHG levels by approximately 7,000 MT CO_2e.

The UESC project was completed in May 2015 and included the following energy conservation measures:

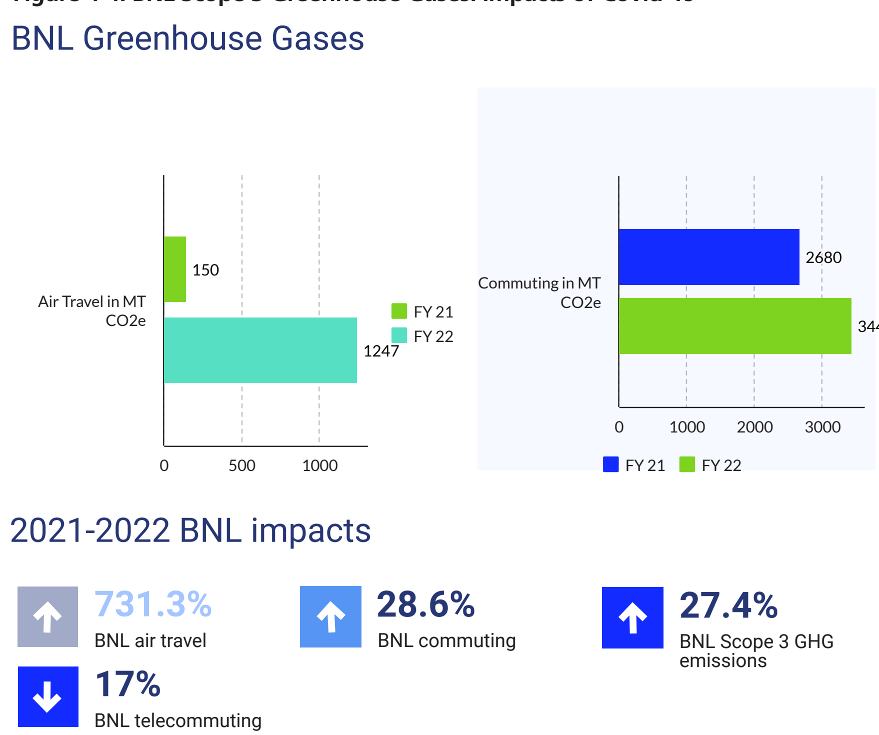
- Installation of a 1,250-ton high-efficiency chiller to increase the efficiency of supplied chilled water.
- Upgraded lighting systems in 18 buildings; and
- Enhanced building control upgrades and additions to provide for heating, ventilation, and air conditioning temperature setbacks in nine buildings.

The UESC project has been a success, with annual energy savings within three percent of the original estimates for each of the seven years since completion. In FY 2018, an investment grade audit (IGA) was initiated for a potential Phase II UESC project. In 2019, the IGA was completed and the process to issue a contract was begun. Planned energy savings projects under consideration include additional lighting and building control upgrades, free cooling, and some HVAC improvements for the Chemistry Building. Due to unattractive economics, BNL has made the decision not to move forward with UESC II.

In FY23, BNL received further guidance on federal sustainability goals. Key targets include 100 percent carbon-free electricity by 2030 and a net-zero campus by 2045. As a result of these new targets, BNL is refocusing its sustainability efforts on developing renewable energy on site and beginning to assess the feasibility of decarbonizing the CSF. BNL has and will continue to apply for funding to support this agenda through the Federal Energy Management Program and other available grant resources. BNL is also investigating ways to fund these goals through funding opportunities made available through the New York State Climate Leadership and Community Protection Act.

To meet the 2025 Scope 3 GHG emissions reduction goal, Scope 3 emissions must be lowered by 5,034 MT CO_2e from the FY 2008 baseline of 20,136 MT CO_2e. Overall, Scope 3 GHG emissions in 2022 increased by 2,801 MT CO_2e, up 27.4 percent from FY 2021, and 35 percent less than the FY 2008 baseline value. The increase from FY 2021 is mostly due to a 1,097 MT CO_2e

Figure 4-4. BNL Scope 3 Greenhouse Gases: Impacts of Covid-19



increase in GHG emissions from business air travel, and a 767 MT CO_2e increase in commuting GHG emissions.

The COVID-19 pandemic had significant impacts on Laboratory air travel and commuting GHG emissions, as noted in Figure 4-4. Since the Laboratory followed its limited operations plan consistent with New York State and DOE guidelines throughout the year, air travel trips were restricted to those that were mission critical and 67 percent of employees telecommuted. As a result of recent news that the Federal government is beginning to push for employees to come back to work, there is reason to forecast an uptick in emissions in FY 2024.

4.5.1 Hydrofluorocarbons

To prepare for anticipated decreases in the availability of certain hydrofluorocarbons (HFCs) as EPA implements the HFC phasedown requirements of the American Innovation and Manufacturing Act, the Laboratory examined its operations and activities that use HFCs. Refrigerants in existing air conditioning and refrigeration equipment account for 84 percent of the 19,430 pounds of HFCs in use. Based on a review of leaks associated with Laboratory HFC refrigeration and air conditioning equipment over the last five years, current supplies of HFC-134A, HFC-407C, HFC-410A, and R-500 (i.e., a blend of R-12 and HFC-152a) are sufficient to meet anticipated future needs for system leaks.

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