Brookhaven National Laboratory

FY 2023
Site Sustainability Plan

managed by Brookhaven Science Associates
on behalf of the U.S. Department of Energy

U.S. DEPARTMENT OF ENERGY

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Brookhaven Science Associates (BSA) is pleased to submit this annual Site Sustainability Plan for Brookhaven National Laboratory (BNL). Effectively managing such a large, diverse portfolio of programs takes many committed individuals working towards a common goal. This document is the work of a large cross-functional team of BSA employees both within the science directorates as well as the support or operations directorates.

BNL is operated and managed for the Department of Energy Office of Science (DOE-SC) by BSA, a partnership formed by Stony Brook University (SBU) and Battelle Memorial Institute. BNL is staffed by over 2,750 research and support employees and hosts an even greater number of facility users, guest researchers, and scientists annually. The Laboratory operates from an extensive campus located in Upton, New York, on 5,320 acres with approximately 4.9 million gross square feet (GSF) of space in over 300 buildings.

BNL conceptualizes, designs, builds, and operates major scientific facilities and makes them available to university, industry, and government researchers in support of the SC mission. The sustainability vision for BNL leverages this unique combination of access to diverse research talent, stewardship for a significant national research infrastructure, and a location in the energy intensive northeastern United States.

As a result, BNL is well established as a northeastern regional resource for sustainability expertise and is effectively utilizing its physical infrastructure to demonstrate sustainability technology. This approach to development and deployment of technology, combining the unique resources of both research and operations, is the vision of the BNL Site Sustainability Plan (SSP) to help ensure a successful future for our nation.

The Laboratory's efforts in sustainability have been consistent over the last several years and they focus on four broad principles:

1. Striving to be climate neutral through reducing energy use and effective energy management;
2. Lowering the environmental impact of the campus through sustainable infrastructure;
3. Leveraging research in conjunction with our operations and in support of the northeastern region; and
4. Fostering a culture of sustainability with our employees and our community.

Throughout the COVID-19 pandemic, all facilities remained operational, and successfully supported all essential operations. We transitioned through the requirements of the DOE COVID-19 Workplace Safety Plan, planned and executed recovery operations, maintained critical infrastructure, and implemented the Resumption of Operations Plan (ROOP). However, through this process we had to address newfound staffing and resource limitations by revising plans and commitments to prioritize and maintain our mission.

Despite these challenges, the Laboratory remains strongly committed to supporting and achieving the targets in the DOE Strategic Sustainability Performance Plan (SSPP). Leadership in sustainability is demonstrated through the Laboratory's management practices, stewardship of the BNL campus, as well

as our research and education programs. The efforts in sustainability are communicated widely across the Laboratory, and the Senior Leadership team remains actively engaged.

BNL's energy management program continues to be the centerpiece of our Sustainability program. We continue to maintain solid relationships with local utility providers ensuring cost effective power rates for operating the energy intensive user facilities and general infrastructure. BNL collaborates with the local utilities to leverage purchasing power and assist in renewable energy production to jointly support the goals of BNL and the New York region. These relationships are critical as energy demand and consumption will dramatically increase in the next decade due to the Electron Ion Collider (EIC).

BNL continues to host the Long Island Solar Farm (LISF), a solar photovoltaic (PV) power plant, developed through a collaboration that included BP Solar, the Long Island Power Authority (LIPA), and DOE. The LISF, located on the BNL site, began delivering power to the LIPA grid in November 2011. The LISF is made up of 164,312 PV panels and can produce up to 32 MW of electricity.

Additionally, the Laboratory has developed the Northeast Solar Energy Research Center (NSERC) on its campus that serves as a solar energy research and test facility for the solar industry. The mission of the NSERC is to support the expansion of solar power by providing high-quality data, field-testing, analyses, and solar energy expertise to address technical, economic, environmental, and policy issues facing solar power deployment in northeastern climates. The NSERC will be a proving ground for BNL and our industrial partners to test new solar technologies, including electrical inverters, storage devices, and solar modules, which effectively adds solar energy research to the user facility portfolio of BNL.

These projects demonstrate how BNL is continuing to collaborate with many organizations both internally and externally to enhance research at the Laboratory with the sustainability goals in mind. Staff members from the BNL Environment, Biology, Nuclear Science, and Nonproliferation (EBNN) Directorate, Facilities & Operations (F&O) Directorate, Information Technology Division (ITD), and the DOE Brookhaven Site Office (BHSO) have been instrumental in preparing our research agenda and developing a plan to bring it to fruition. In addition, BSA and BHSO have started cultivating relationships with local providers on a potential Grid Facility that will bring the laboratory's sustainability efforts to the entire nation.

There are areas where we've been extremely successful, and these include metering under energy management, sustainable buildings, potable water intensity, municipal solid waste, sustainable acquisition, electronics stewardship, and electronics recycling. We continue to see reduced rates of air travel and commuting; however, these are increasing. It is expected that these areas will remain at lowered rates due to remote and telework agreements, continued collaboration via virtual meeting platforms, and enforcement of travel guidelines.

The Laboratory continues to work on creative solutions to overcome challenges. This coming year we will focus on maintaining established progress, make the most of opportunities that arise, and concentrate on making improvements where we are not on track towards meeting requirements. Activities include but are not limited to increasing bio-fuel usage, planning a Net-Zero building, soliciting bids for potential disposals at a waste-to-energy facility, replacing a centrifugal chiller with a low global warming potential (GWP) chiller, ensuring power management on new computers, leasing electric vehicles when they are made available, generating ideas for reduction of single-use Laboratory plastics, and expanding our current programs addressing workforce and community investments.

The Lab's strategy for mission readiness will provide a revitalized physical plant to improve scientific productivity, promote the attraction and retention of the scientific workforce, including the significant BNL user population, and assure the safe, reliable functioning of BNL's major scientific facilities. The resulting strategy consists of five major elements:

- Focus limited DOE investment in critical core buildings and infrastructure to enable the scientific agenda. As part of the Core Facility Revitalization (CFR) Science Laboratories Infrastructure (SLI) line-item project the newest data center was completed. While power usage effectiveness (PUE) is reduced submetering is being added to ensure targets are achieved.
- Make research safe and cost effective by downsizing the campus and demolishing old buildings. This is evidenced by BNL's consolidation planning and right-sizing of its campus footprint.
- Ensure scientific reliability through targeted investments in buildings and utility infrastructure. The Critical Utility Rehabilitation Project (CURP) commenced in FY21 and in FY22, Well House 12 reconstruction was completed and is in use. This resulted in reduced water treatment at the central plant and improvement of potable water quality. Funding has been allocated for replacement of several central chilled water facility chillers with chillers that meet the Federal Energy Management Program efficiency requirements.
- Support the growing population of scientific users through an innovative concept called "Discovery Park". Construction has started on the Science and User Center. This will allow for the demolition of inefficient facilities across the campus.
- Ensure renewed critical infrastructure and buildings are resilient against severe climate and weather. Climate resiliency is being factored into all projects.

Sustainability remains an important focus for BNL. BSA and BHSO work collaboratively on these efforts. We continue with our quarterly meetings to ensure that we are on track to meet the goals as well as to discuss challenges in meeting these goals. This is a marathon, not a sprint and requires a strong team effort to ensure that we continue to press forward in doing our part to protect the environment. We are on a very good path.

A copy of the Executive Summary Table is provided below, highlighting plans for anticipated performance towards DOE targets as a guide.

Prior DOE Goal	**Current Performance Status**	**Planned Actions & Contributions**	**Overall Risk of Non-Attainment**
Energy Management			
Reduce energy use intensity (Btu per gross square foot) in goal-subject buildings.	FY22 site-wide energy intensity was 11% higher than the base year of 2015. 378,940 Btu/GSF vs. 338,903 respectively.	A second UESC II (or self-funded effort) effort focusing on Building HVAC controls, temperature set-back, re-heat minimization and lighting. Increased emphasis on Temperature Set-back policy.	**High**

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
EISA Section 432 continuous (4-year cycle) energy and water evaluations.	269,325 sq. ft. were audited in FY21.	Continue audits meeting the 4-year cycle.	Low to Medium
Meter individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate.	23 new smart meters were added in FY22. 99% of electricity, 100% of natural gas, +90% of steam are metered. Most potable water is used for cooling tower make-up. Metering ≈30% of cooling tower make-up and adding meters regularly.	Continue maintaining and expanding metering installations, with an emphasis on potable water make-up for cooling towers.	Low
Water Management			
Reduce potable water use intensity (Gal per gross square foot).	BNL will continue to implement BNL's Water Management Plan and reduce water usage by implementing best-management practices.	Water meters continue to be installed on new installations such as SUSC, as well as cooling towers. This will help BNL better manager water usage. Cooling tower chemical monitoring systems will allow BNL Energy Management to track make-up water usage in many cooling towers across site Progress towards automating the Central Chilled Water Facility's water usage report has been made. The final meter has been installed and the report is in the process of being developed.	Low
Reduce non-potable freshwater consumption (Gal) for industrial, landscaping, and agricultural.	BNL's minimal formal landscaping is compatible with the local climate and rainfall. BNL does not routinely irrigate lawns and landscape.	N/A	Low
Waste Management			

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
Reduce non-hazardous solid waste sent to treatment and disposal facilities.	The MSW contract was not rebid during FY22 as expected, so BNL was unable to solicitate bids to evaluate disposal to a Waste-to-Energy facility versus disposal at a landfill. Doing so would make BNL a net-zero waste site. BNL continues its successful waste diversion program, consistently exceeding DOE's 50% landfill diversion goal. BNL will continue to pursue New-Zero concept waste practices. BNL's Pollution Prevention Opportunity Program for FY22 identified and promoted new ideas for waste reduction, recycling, and reuse. The request solicitation form was revised to favor requests that result in measurable source or waste reduction. A program for recycling wood pallets by an offsite vendor was implemented at the end of FY22.	The contract for hauling BNL's MSW will be rebid during the first quarter 2023 with requests for both disposal via landfill and disposal via waste-to-energy facilities. The contracts for management of recycled materials and C&D waste will follow during 2023 & 2024. Opportunities for further waste reduction via reuse and recycling will be incorporated into the Statement of Work for these contracts as appropriate. Other waste reduction efforts will come from source reduction efforts and will be addressed in the "Acquisitions" section. A Lab-wide team will be formed to solicit input on ideas and help drive enthusiasm around reducing the use of single-use plastic or improving BNL's plastic recycling program.	**Low**
Reduce construction and demolition materials and debris sent to treatment and disposal facilities.	Management of C&D recycle material from large demolition projects will be centralized through F&O's contracted C&D Hauler allowing for better reporting and accounting instead of handled through the construction sub-contractor.	Recyclable materials are already separated from C&D debris prior to leaving site, so further reduction options will be challenging to achieve. BNL will consider if sheet rock generated from future building demolitions can be segregated for recycling.	**Low**

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
Fleet Management			
Reduce petroleum consumption.	Providing Chargepoint station access to guests and employees.	Order more AFVs as they become available.	**Low**
Increase alternative fuel consumption.	Flex Fuel vehicles will only be assigned E-85.	Order more AFVs as they become available.	**Medium**
Acquire alternative fuel and electric vehicles.	Picking more EVs for FY23 and purchasing EV LSVs.	Order more AFVs as they become available.	**High**
Clean & Renewable Energy			
Increase consumption of clean and renewable electric energy.	Signed pending purchase of 24,000,000 kWh of REC's for FY22. NSERC Solar PV array produced 644,479 kWh.	Increase purchase RECs. Maintain and improve NSERC output. Look for additional opportunities locally and on-site.	**High**
Increase consumption of clean and renewable non-electric thermal energy.	Biofuel use in off-road utility vehicles.	Increase biofuel use, potentially in satellite hot water or steam heating systems on site.	**Low** to **Medium**
Sustainable Buildings			
All new construction and modernization projects greater than 25,000 gross square feet must apply the Guiding Principles.	Metric: Percentage of buildings that qualify as a Sustainable Federal Building: 5.9%	As BNL constructs new buildings and demolishes old non-compliant buildings, the percentages will increase.	**Medium**
All renovation projects must apply the Guiding Principles, to the greatest extent technically feasible.	Metric: Percentage of gross square footage that qualifies as a Sustainable Federal Building: 26.5%	As BNL constructs new buildings and demolishes old non-compliant buildings, the percentages will increase.	**Medium**
Acquisition & Procurement			

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring all sustainability clauses are included as appropriate.	Continued to promote, advance, and enhance BNLs E-buy system for EPP related items/purchases. Continued to support and advise requistioners/Lab users on responsibilities in this area. Current Lab programs drive a high level of conformance mostly through contractual terms and conditions. 2021 Green Buy Gold Award winner. 2021 Green Buy Superior Award winner.	Explore a new ERP/Procurement system with enhanced data/metrics capabilities. Hire a Category and Supply Chain Analyst to provide focused effort in sustainable purchasing. BNL will provide E-Buy training and support specific to EPP requirements and create better support tools to help requisitioners identify conforming products. A Laboratory team consisting of volunteers from across the Lab will be formed to generate ideas and enthusiasm for reduction of single-use laboratory plastics first by source reduction, second by recycling. Single-use plastic water bottles will be targeted. Future software upgrades will improve BNL's ability to identify conforming products in the purchasing system improving tracking and measuring progress.	**Low**
Efficiency & Conservation Measure Investments			
Implement life-cycle cost effective efficiency and conservation measures with appropriated funds and/or performance contracts.	Internally funded energy conservation and sustainability related initiatives include a continuation of best practices, with continued emphasis on temperature setback during unoccupied periods.	Re-evaluate the UESC II project and other potential initiatives using updated energy cost escalation factors. BNL will also revisit the UESC II scope to aggressively address energy and GHG savings.	Near-term-**High** Longer term-**Medium**

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
Electronic Stewardship & Data Centers			
Electronics stewardship from acquisition, operations, to end of life.	BNL's ITD offers staff a variety of computer options that have been preselected to meet EPEAT Gold criteria driving high conformance to purchasing requirements, as most employees purchase computers from preapproved stock. The average age of a BNL computer prior to disposal is approximately six years, which is 50% above the average retirement age of four years. Usable computers and peripherals are sent to an on-site warehouse where departments can go to acquire computers as needed. Last year, approximately 494 desktop computers, 262 laptops, 27 tablets, and 70 servers were reused internally by BNL personnel, as well as numerous other small electronics. BNL has a power management policy where the power savings options are automatically activated for new computers.	BNL looks forward to a modernized purchasing system that better tracks conformance, but the system is still a number of years from implementation. BNL will continue to dispose of electronic waste in an environmentally sound manner through a certified e-Steward or R2 recycler. Increases communication to staff regarding EPEAT and Energy Star requirements associated with electronics purchases.	**Low**
Increase energy and water efficiency in high-performance computing and data centers.	BNL actively monitors PUE of both on-site data centers. BNL will continue to monitor and maintain mechanical equipment to sustain the reduction from a PUE of 2.5 to 1.5.	BNL is reviewing manufacturer data for installed equipment in B725. The EM team will revise steam, chilled water, and condenser water setpoints and equipment sequences to optimize performance and	**Low**

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
		further reduce PUE. The team will be working on the ALCs system sequences to optimize the use of the free cooling heat exchanger. The team will carefully monitor the humidifying system and associated steam distribution/condensate return equipment to ensure optimal performance.	
Adaptation & Resilience			
Implement climate adaptation and resilience measures.	To increase site adaptation and resilience to address the impacts of climate change, BNL prepared a VARP in accordance with guidance provided by the DOE Sustainability Performance Division (Guidance Version 1.2, February 2022) and associated Risk Assessment Tool. A VARP planning team was created to help identify critical assets and infrastructure, identify projected climate change and extreme weather hazards and vulnerabilities, and propose and assess climate resilience solutions. BNL's OEM is also continuing to integrate climate resilience into its day-to-day risk management processes (e.g., Continuity of Operations planning, maintaining a Threat and	Execute Resilience Solution Options identified for inclusion in the DOE Sustainability Dashboard and continue to implement existing climate adaptation and resilience efforts that BNL has already put into practice to protect critical infrastructure and to reduce GHG emissions, enhance overall sustainability, and improve energy efficiency. OEM continues to attend weather briefings from the NWS with respect to severe weather.	**Low** to **Medium**

Prior DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
	Vulnerability Assessment Plan, and Site Emergency Plan in the All-Hazards Survey). OEM provides BNL leadership with timely weather-related data updates used to evaluate the Lab's posture to remain open or close the BNL site.		
Multiple Categories			
Reduce Scope 1 & 2 greenhouse gas emissions.	NSERC Solar PV array produced 644,479 kWh. BNL purchased 120,747 Mwh or 44% of its electricity from carbon free hydro.	Maintain and improve NSERC output. BNL will continue to purchase Hydro from NYPA and will investigate procuring electricity from the three offshore wind projects. One centrifugal chiller in Bldgs. 901A and two in Bldg. 600 to be replaced with low GWP chillers in 2023 and 2024-2025 respectively.	**Low** to **Medium**
Reduce Scope 3 greenhouse gas emissions.	The Laboratory continues to operate in Normal Operations with Telework. With forty percent of 2,331 eligible employees having approved telework agreements and another five percent having approved remote work agreements. Commuting GHGs should not be expected to increase with variable COVID-19 rates.	EPD to prepare a Monday Memo segment on the benefits of the Laboratory's Ride Share Program for the 2nd Quarter of FY23. Electric vehicle display and ride & drive planned during Earth Day 2023 celebration. MTA planning for new Yaphank rail station on pause.	**Low**

II. Performance Review and Plan Narrative

Energy Management

This category focuses on efforts to reduce energy intensity, non-fleet fuel use, and associated greenhouse gas (GHG) emissions. This category also discusses site metering and benchmarking efforts and the site's approach to conducting Energy Independence and Security Act (EISA) Section 432 evaluations.

Current Performance

Energy Intensity Initiatives

For FY22, BNL re-evaluated the planned second Utility Energy Service Contract (UESC) project. As discussed in the previous year's SSP, the economics were marginal at best especially given FY21 40-year low blended electric cost of $30.31/MWh. During FY23, we will continue the evaluation process, refining the scope, and utilizing the latest forward energy cost estimates which have had a 47% increase since FY21. Due to aggressive planned energy goals in New York State that include "carbon pricing" and decarbonization, there will be a significant upward pressure on energy costs and rates that may shift the pendulum towards more favorable.

Net-Zero Emissions Conversion

The path to Net-Zero emissions is greatly affected by many factors, including several beyond the site's ability to control; the most significant being weather. The site is in the Northeast and fossil fuel for heating is the most dominate energy source for buildings.

BNL's approach towards converting buildings to Net-Zero emissions is to continue investigating the cost and financial impact of investments as market factors change. Real property at BNL is heavily reliant on the high-pressure central steam plant for building heating and hot water. Electrifying the fossil fuel usage of the steam heating plant with a new source of energy could mean increasing consumption by 85,000-180,000 MWh annually. For comparison, the low-end estimate is the approximate annual output equivalent of a 10 MW power plant.

BNL continues to evaluate opportunities for Net-Zero buildings and completed a high-level concept for a Net-Zero short-term housing project we hope to further develop.

High-Energy Mission-Specific Facilities (HEMSFs) and High-Performance Computing (HPC)/Data Centers

BNL currently operates two data centers. B725 is the newest data center with construction completed to the 2016 Guiding Principle (GP) for data centers. The functional system is not currently meeting the PUE of 1.2-1.4 initially prescribed by the system design. BNL is investing in sub metering for data center loads to better track key performance indices and staff resources to optimize the control sequences of the system. BNL's efforts have reduced PUE from 2.5 to 1.5 based on a 2-week running average.

The EIC is schedule to be completed in the fourth quarter of FY 2032. This HEMSF will require BNL to source an addition 60 MW of power. Currently, BNL's primary source of carbon free energy (CFE) is the fully utilized 15 MW allocation of low-cost renewable hydropower; an allotment which accounts for ≈44% of the annual usage. The added usage associated with the EIC is projected to negatively impact BNL metrics sustainability as it relates to CFE, given the current availability of CFE sources.

Energy Management Strategies-ISO 50001

BNL is in the early stages of discussing pursuit of the ISO 50001 standard and potential self-certification.

Non-Fleet Vehicle and Equipment (V&E) Fuel Use

BNL continues to maximize bio-fuel use in non-fleet vehicles.

Metering and Advanced Metering

BNL continues its decades-long tradition of advanced metering efforts and is meeting the metering goals for electricity, natural gas, and chilled water. During FY22, 23 additional advanced electric meters were installed on large critical loads including the new data center. BNL is also investing resources into metering condensate return flows from facilities on the campus steam distribution network.

There are nearly 280 advanced electric meters currently installed and they capture over 99% of consumed electricity. Of the 158 buildings greater than 4,000 square feet, 153 (97%) advanced meters are installed.

Chilled water is metered at 100% with 43 advanced chilled water meters installed in 34 buildings or loads with chilled water.

All three (3) of BNL's natural gas-supplied facilities have advanced meters installed.

Due to BNL's low cost of water (less than $0.43 per 1,000 gallons), the installation of water meters is not economically justifiable. However, BNL's major facilities with cooling towers, as well as new buildings and major renovations include water metering. A substantial amount of the water used at BNL is utilized by cooling towers, most of which are currently metered. BNL plans to meter all cooling towers within the next few years. Currently approximately 25% of BNL's potable water consumption is metered at the main cooling towers and new buildings.

A comprehensive real-time and historical energy use dashboard continues to be enhanced. The dashboard includes all forms of energy use on a high-level and allows users to drill down to local building meters. Chilled water meters are calibrated annually. Electric meters require little to no maintenance. Steam usage at the building level is becoming increasing understood with the growing number of building condensate meters brought online each year.

BNL has a long history of advanced metering dating back nearly 40 years. Energy data is utilized for numerous purposes including the following:

- Verification of utility bills. There have been several occasions where utility billing errors were captured, saving hundreds of thousands of dollars in cost.

- Re-distribution of all energy costs (electric, chilled water, steam) to various users, departments, and organizations.
- Measurement and verification (M&V) for both third party and internal energy and water conservation projects including the current UESC effort.
- Participation in electric load curtailment programs that allow BNL to reward individual departments and organizations in direct relation to their contribution to the curtailment.
- Live monitoring of energy usage.
- Troubleshooting and evaluation of unusual loads and disturbances.
- Sizing of energy distribution systems.
- Energy use optimization when combined with the site-wide energy management control system.
- Detailed measurement of BNL's ≈1 MW Solar PV system.
- Assisting the BNL scientists and researchers in developing new projects and endeavors such as Connected Communities, microgrid proposals, and more.

Retro-commissioning and Continuous Commissioning

BNL is in the early stages of piloting an artificial intelligence (AI) software program that will analyze the existing Automated Logic Controls (ALC) system control points and alarms. The AI will use this information to provide early detection and prediction of issues that would prevent facility mechanical equipment from meeting the current facility and building efficiency requirements.

Cyber Security

The Energy Management team owns the campus's building automation equipment and works closely with BNL's Cyber Security group to establish secure communication conduits. The team regularly backs-up and updates the building automation software to maintain the most up-to-date service patches. In addition, the automation controls are on or being migrated to isolated local area networks with multi-factor authentication to access, virtually eliminating the risk of an external cyber security breach.

Plans and Projected Performance

Energy Intensity

Continued reductions in Energy Intensity have been and will continue to be one of the biggest energy related challenges for BNL. BNL will continue to work to develop financeable energy projects that can be funded via third party (such as a UESC, internally funded, or a combination of funding). The biggest obstacles are BNL's low energy rates and high construction costs. As discussed earlier, we anticipate a sharp increase in energy prices in the future as the cost of carbon emissions gets factored into pricing. Higher energy rates will allow more projects to be economically justified.

BNL's electric demand is expected to increase dramatically over the next decade, increasing from a current peak of ≈52 MW to ≈125 MW. This increase will predominately be due to the EIC but other loads, such as the new data center and those at the National Synchrotron Light Source-II (NSLS-II), will contribute. The increase in demand and consumption will also result in a large increase in both electricity costs and rates. A high-level graph of the expected electricity demand increase is provided in Figure 1.

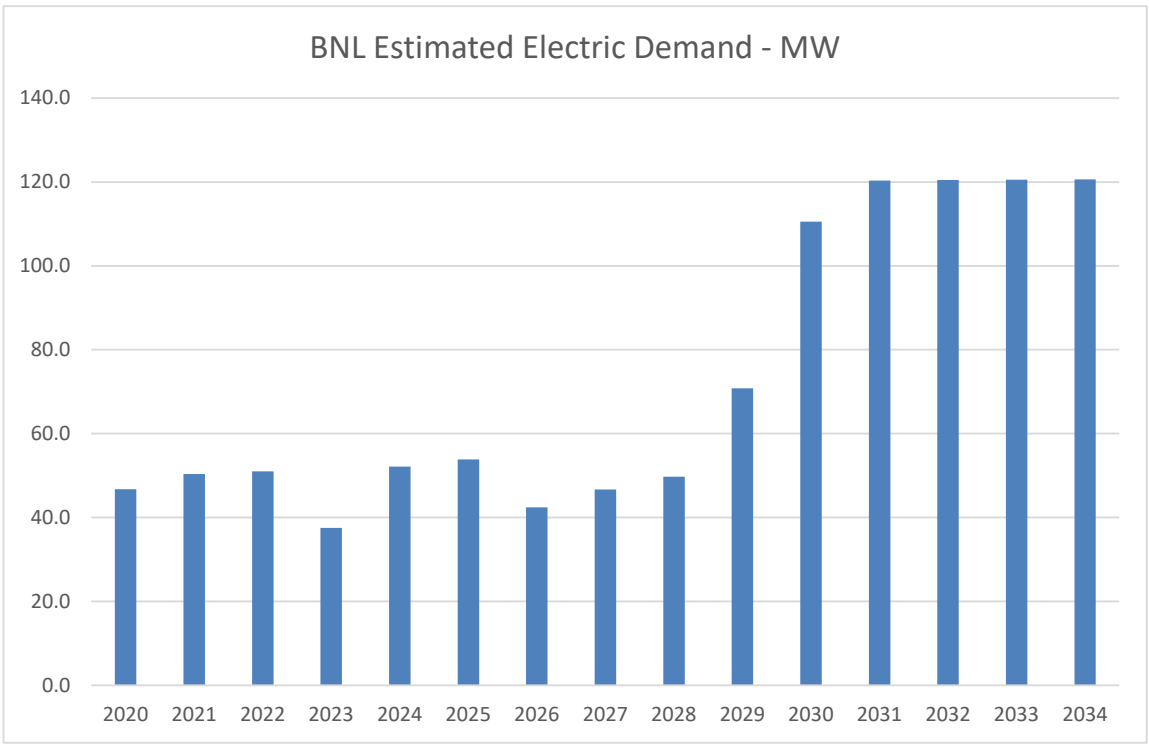
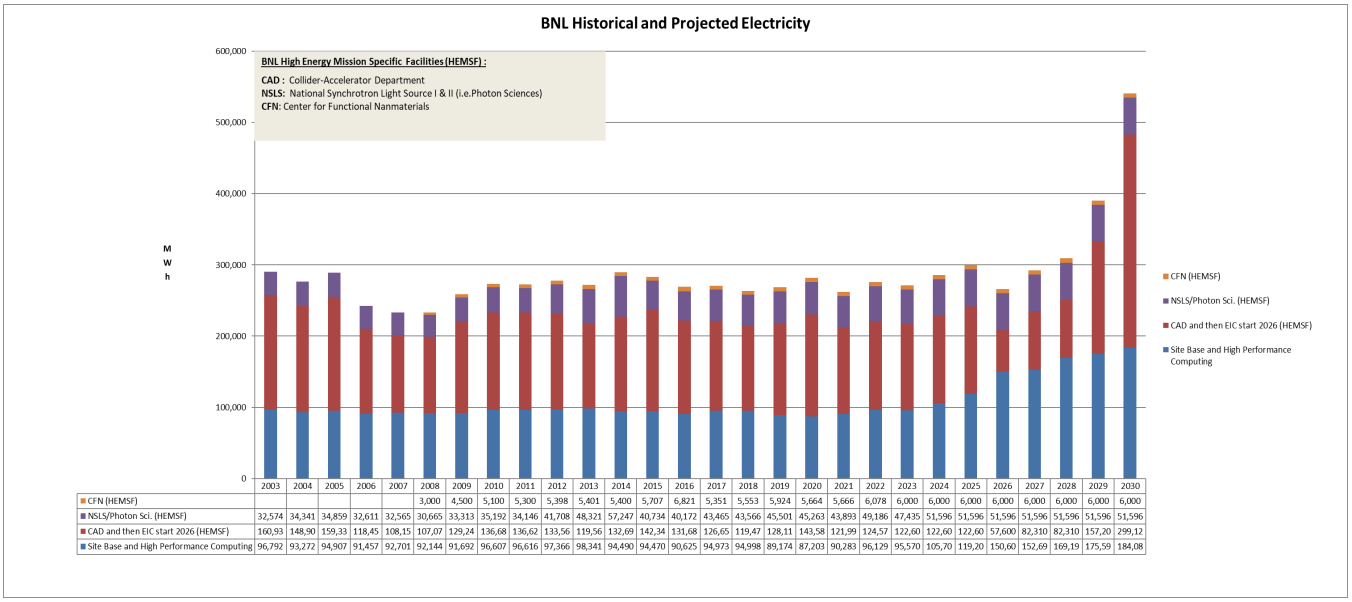


Figure 1: Estimated Electricity Demand

Electric Usage Projections



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CFN (HEMSF)						3,000	4,500	5,100	5,300	5,398	5,401	5,400	5,707	6,821	5,351	5,553	5,924	5,664	5,666	6,078	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
NSLS/Photon Sci. (HEMSF)	32,574	34,341	34,859	32,611	32,565	30,665	33,313	35,192	34,146	41,708	48,321	57,247	40,734	40,172	43,465	43,566	45,501	45,263	43,893	49,186	47,435	51,596	51,596	51,596	51,596	51,596	51,596	51,596
CAD and then EIC start 2026 (HEMSF)	160,93	148,90	159,33	118,45	108,15	107,07	129,24	136,68	136,62	133,56	119,56	132,69	142,34	131,68	126,65	119,47	128,11	143,58	121,99	124,57	122,60	122,60	122,60	57,600	82,310	82,310	157,20	299,12
Site Base and High Performance Computing	96,792	93,272	94,907	91,457	92,701	92,144	91,692	96,607	96,616	97,366	98,341	94,490	94,470	90,625	94,973	94,998	89,174	87,203	90,283	96,129	95,570	105,70	119,20	150,60	152,69	169,19	175,59	184,08

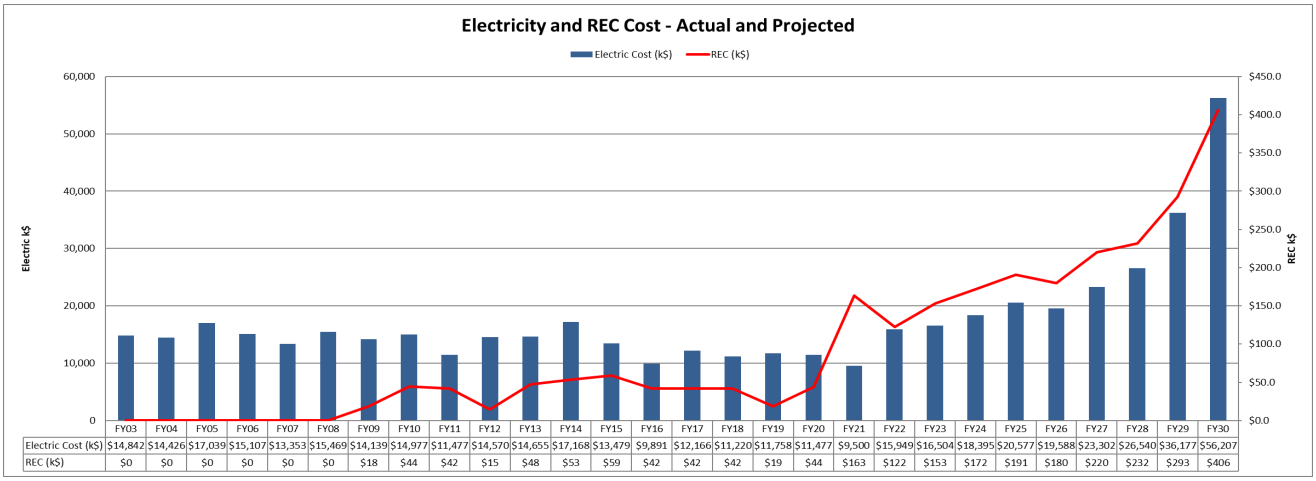
Figure 2: Electric Usage Projections

Electricity and Renewable Energy Credit (REC) Cost Projections

The chart below shows electricity and REC cost history and projections. BNL's REC purchases were once relatively inexpensive, under $1/MWh. However, in FY22 the rate was $5.10/MWh. Given the increasing renewable and clean energy requirements from New York State's new Climate Leadership and Community

Protection Act (CLCPA), BNL anticipates substantial increases in REC and energy pricing as the years progress. The CLCPA requires 100% of all electricity generation to be renewable by 2040.

The table assumes that rates will increase to ≈$10/MWh by 2030. These assumptions are based on discussions with a few REC providers as well as anticipation of the impact of the CLCPA. They will be updated in future SSPs.

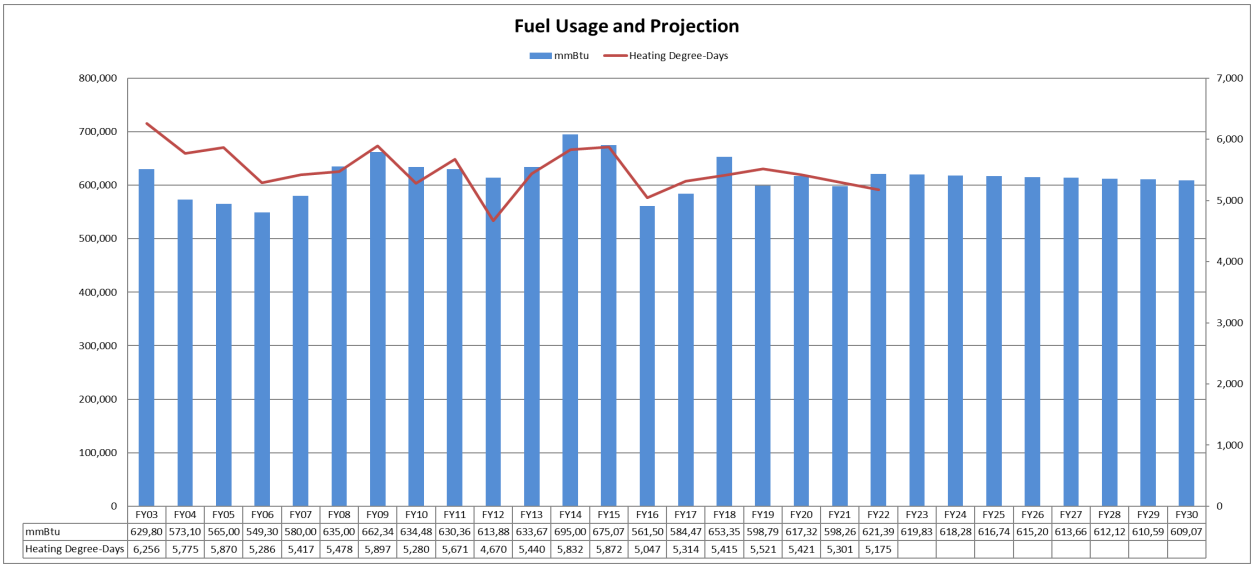


	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
Electric Cost (k$)	$14,842	$14,426	$17,039	$15,107	$13,353	$15,469	$14,139	$14,977	$11,477	$14,570	$14,655	$17,168	$13,479	$9,891	$12,166	$11,220	$11,758	$11,477	$9,500	$15,949	$16,504	$18,395	$20,577	$19,588	$23,302	$26,540	$36,177	$56,207
REC (k$)	$0	$0	$0	$0	$0	$0	$18	$44	$42	$15	$48	$53	$59	$42	$42	$42	$19	$44	$163	$122	$153	$172	$191	$180	$220	$232	$293	$406

Figure 3: Electricity and REC Cost – Actual and Projected

Fuel

Over 95% of the fuel use at BNL is for the Central Steam Facility. Estimated fuel use going forward is estimated to slightly decline by ≈0.5%/year, mainly due to continued efficiency improvement projects and a reduction of older underutilized facilities. As previously discussed, BNL is concerned about our ability to meet the continued energy intensity reduction requirements.



	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
mmBtu	629,80	573,10	565,00	549,30	580,00	635,00	662,34	634,48	630,36	613,88	633,67	695,00	675,07	561,50	584,47	653,35	598,79	617,32	598,26	621,39	619,83	618,28	616,74	615,20	613,66	612,12	610,59	609,07
Heating Degree-Days	6,256	5,775	5,870	5,286	5,417	5,478	5,897	5,280	5,671	4,670	5,440	5,832	5,872	5,047	5,314	5,415	5,521	5,421	5,301	5,175								

Figure 4: Fuel Usage and Projection

Carbon Free Energy Subsection

Approximately ≈44% of BNL's electricity comes from clean hydropower. We also purchase RECs equal to ≈8% of the total electricity use and generated ≈644,000 kWh of clean electricity from the on-site solar PV system. Further, New York State's aggressive clean energy goals include the requirement for 100% CFE by 2040.

Currently, additional CFE procurement options from utility suppliers are limited but will increase over the next five years. Off-Shore wind turbine farms are planned off the shores of New York and New Jersey. These wind farms are in development as part of various New York State Energy Research and Development Authority (NYSERDA) projects, including Beacon Wind (1,230 MW), Empire Wind 1 (816 MW), Empire Wind 2 (1,260 MW), Sunrise Wind (924 MW), and LIPA's South Fork Offshore Wind Project (130 MW). The wind farms are expected to be constructed and gradually added to the grid starting in 2023 and continuing through 2028. BNL will investigate developing power purchase agreements with these carbon-free projects.

The Lab currently benefits from a conventional hydro procurement agreement that includes a 15 MW allocation of low-cost renewable hydropower. The 15MW allocation accounted for 44% of the total electrical energy consumption. As noted in the previous Energy Management subsection, the forecasted increase energy consumption anticipated for the EIC must be addressed in future procurement contracts or it may have a substantial negative impact on CFE targets.

Based on current HEMSF operational schedules, BNL anticipates reaching a new New York Independent System Operator (NYISO) peak usage in the summer of FY23, as a result it will not be possible to enroll in demand response programs. BNL will work with operators to anticipate the NYISO peak period and shift the chilled water load via the chilled water storage tank to limit the resulting NYISO peak charges that will eventually be dispersed to the entire community.

Water Management

This category focuses on initiatives to reduce potable and non-potable water consumption, comply with stormwater management requirements, and improve water efficiency. In addition, the category summarizes any obstacles related to the implementation of conservation strategies or the collection of water consumption data.

Current Performance

BNL obtains its potable, process cooling, and fire protection water from Long Island's underground aquifer. BNL runs its own NYS-regulated "community water system" which consists of five water wells, a Water Treatment (Iron Removal/Filter) Plant, two elevated water storage tanks with a capacity of 1.3 million gallons, and an underground distribution system with about 45 miles of piping, valves, and hydrants.

BNL has a long history of reducing water consumption – even though water on Long Island is plentiful and inexpensive. BNL has conducted an effective water-reduction and conservation program for more than 20 years, illustrated in Figure 5 by the trend in annual potable (includes process) water usage.

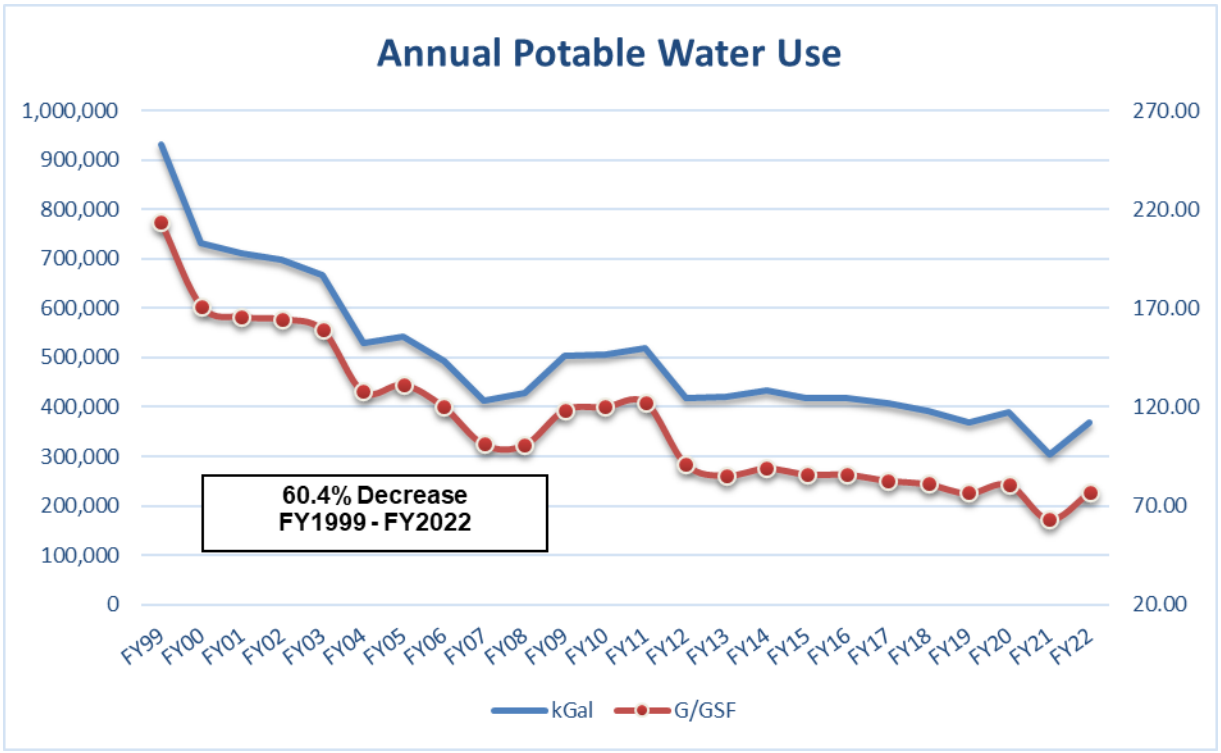


Figure 5: Annual Potable Water Use (1999-2023)

Potable-water usage fell from 931 million gallons/year in FY99 (average of 2.55 million gallons per day) to about 369 million gallons/year in FY22, a reduction of 60.4%. When normalized by site growth (building area in gross square feet), BNL's annual water use intensity has decreased from 101 gallons/GSF to 76.7

gallons/GSF, a 24.1% water usage reduction since base-year 2007. The table below illustrates the change in site gross square footage.

Table 1: Annual Change Gal/GSF Water Use (FY99-FY22)

FY	kGal	GSF	G/GSF
FY99	931,452	4,363,224	213.48
FY00	732,408	4,281,455	171.07
FY01	710,583	4,286,993	165.75
FY02	698,340	4,241,450	164.65
FY03	666,916	4,191,562	159.11
FY04	530,414	4,148,593	127.85
FY05	542,568	4,128,355	131.42
FY06	493,641	4,105,635	120.23
FY07	412,935	4,081,900	101.16
FY08	427,400	4,237,100	100.87
FY09	504,500	4,252,200	118.64
FY10	505,075	4,203,457	120.16
FY11	520,308	4,249,150	122.45
FY12	418,153	4,586,455	91.17
FY13	419,372	4,906,797	85.47
FY14	433,718	4,865,753	89.14
FY15	416,904	4,843,649	86.07
FY16	417,364	4,854,679	85.97
FY17	406,876	4,905,386	82.94
FY18	393,096	4,845,380	81.13
FY19	368,520	4,815,914	76.52
FY20	389,437	4,812,662	80.92
FY21	304,042	4,807,484	63.24
FY22	368,800	4,805,758	76.74

Water usage increased significantly from FY21 to FY22 but is more in line with previous years. BNL has not had time to fully analyze the data but believes the change may be related to operational variance ultimately stemming from COVID.

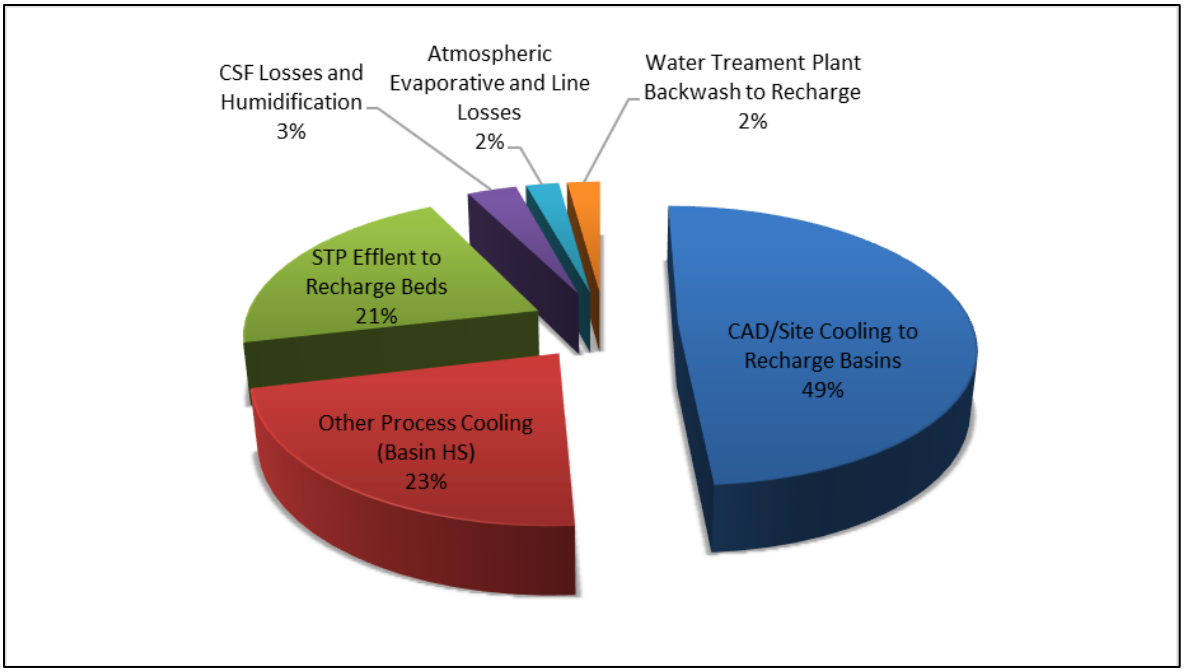


Figure 6: 2022 Potable Water Utilization

Beginning October 2014 BNL implemented groundwater recharge of treated wastewater at its Sewage Treatment Plant. Currently, about 85% of water used at BNL is recharged (recycled) to groundwater via groundwater recharge basins. The water recharged is near potable water quality.

We estimate that over two-thirds of BNL's water production is attributable to High Energy Missions Specific Facilities.

Scope 1 Emissions

Based on monthly effluent monitoring data from FY21 where total nitrogen concentrations ranged from 1.8 – 7.2 mg/l, calculated N_2O emissions reported for the year were 0.0012 metric tons (i.e., 0.47 mTCO2e). BNL expects the N_2O emissions for FY22 slightly higher at 0.0015 metric tons (i.e., 0.61 mTCO2e), because the number of residents in BNL housing units onsite was higher in FY22. Nonetheless, since the Wastewater Treatment Plant (WWTP) greenhouse gas emissions are so low, there are no economically viable approaches to lower Scope 1 wastewater management GHGs.

Plans and Projected Performance

Water Management Plan

BNL's Water Management Plan describes how BNL designs and operates the Laboratory's buildings and facilities to be sustainable and water efficient. It outlines our efforts to continue to reduce water usage by implementing best-management practices. The Executive Order 13834 goals require that BNL reduce potable water intensity (Gal per gross square foot) by 20% relative to FY07 by FY15 and 0.6% year after year thereafter.

Presently, we are implementing best-management practices (BMPs) as detailed in Section 2.2 of our Water Management Plan. Implementing water conservation is a significant economic challenge. Water is plentiful and inexpensive at BNL. The variable cost of producing water currently is estimated at about $0.45 per thousand gallons. Most water conservation measures are capital- and labor-intensive. We are always evaluating the return on investment of implementing additional BMPs. These BMPs have the potential to lower water consumption by more than 40 million gal/yr. Our ability to implement these capital-intensive measures will depend upon obtaining additional benefits (i.e.. such as: replacing obsolete equipment, extending equipment's useful life, reduced maintenance costs, reducing wastewater discharges to the sewage treatment plant, and increasing energy savings,) and obtaining the capital funding for construction costs.

Finally, we emphasize that over 80% of BNL's water consumption is returned and recharged to groundwater at potable water quality. We believe that BNL's groundwater recharge fully meets the DOE's water management "recycling" or "non-consumptive" criteria (except for insignificant temperature changes). To increase the rate of on-site recharge, BNL completed a project in 2014 to re-route the treated effluent from the sewage treatment plant from a surface water discharge to a groundwater recharge system. This project eliminated a potential source of trace metals contamination to the Peconic River and continues to improve the quality of the river down-stream of BNL. Review of analytical data for the Sewage Treatment Plant effluent shows that the water quality meets all Federal and state groundwater quality standards. This change resulted in an increase of over 100 million gallons per year recharged locally versus off-site flow via the Peconic River.

The following bullets summarize BNL's past and present (ongoing) efforts in water conservation (best management practices); more details are available in BNL's Water Management Plan.

- Public Information and Education Programs: BNL's water-related public information and education programs emphasize the excellent quality of BNL's potable water supply and seek to minimize employee's use of expensive, environmentally unfriendly bottled water.
- Distribution System Audits/Metering: BNL periodically audits its water distribution system as part of infrastructure planning and utility reviews (e.g., 10-year Master Plans). BNL's utility engineers understand BNL's water system to be "tight" and relatively leak-free. Because of the plentiful supply and low cost of water at BNL, water meters are not available at most buildings or major process users. We bill one major process user for water.
- Water-efficient Landscaping: BNL's minimal formal landscaping is compatible with the local climate and rainfall. BNL does not routinely irrigate lawns and landscape.
- Toilets and Urinals: BNL currently specifies low consumption toilets and flushometers (1.6 gallons per flush (gpf) for toilets, 1.0 gpf for urinals) for new constructions, renovations, and maintenance.
- Faucets and Showerheads: BNL specifies low-flow, WaterSense faucets and showerheads for new constructions, renovations, and maintenance.
- Boiler/Steam Systems: BNL has a district steam-system and Central Steam Facility. Depending on the season, 75-85% of the steam exported from the facility returns as condensate. This is excellent return for a large district steam-system, the condensate return conserves water and energy.
- Single-Pass Cooling Systems: BNL has reduced water flow through single-pass cooling systems that discharge to the sanitary sewer system. The marked success of these efforts is reflected in the 55% water use intensity reduction.

- Cooling-tower Systems: To reduce water use in once-through cooling systems, BNL has 32 recirculating evaporative cooling towers that only utilize potable water after blow downs and to make up evaporative losses. To maximize cooling efficiency and minimize water use, BNL controls the blowdown rates on the large towers to maintain the "cycles of concentration" between four and six.
- Water Reuse and Recycling: Over 80% of BNL's water consumption (except evaporation and drift at cooling towers) is recharged back to the ground (where the well water came from). All BNL's process water (e.g., make-up and cooling) currently is obtained from the Laboratory's potable-water system and is accounted for in accordance with Executive Order 13834 "Efficient Federal Operations."
- Sewage Treatment Plant Effluent Recharge: A modification to convert BNL Sewage Treatment Plant from surface water discharge (Peconic River) to groundwater recharge/recycling was completed in September 2014. Purified wastewater (effluent) from BNL operations is currently being recharged and recycled to groundwater.

All new construction and renovation at BNL will continue to utilize water-efficient processes and plumbing fixtures to conserve water.

Well No. 12 is in an area of the BNL site with low-iron groundwater. Return of Well No. 12 to operation reduced the need operate BNL's high-iron wells – Well Nos. 4, 6, and 7. This in turn will reduce the duty on BNL's Water Treatment (i.e., Iron Removal/Filter) Plant, and reduce the number of backwash cycles and backwash wastewater.

We continue to expect that increased "main-mission" science program activities, with their need for accelerator cooling, will tend to increase water consumption due to evaporative cooling. This is not an issue at BNL, though it may be at DOE facilities located in arid climates. Groundwater recharge via annual precipitation is orders of magnitude greater than evaporative losses from BNL cooling towers.

Waste Management

This category focuses on the site's approach/vision for addressing waste management, pollution prevention (source reduction), diversion measures (e.g., recycling, composting), and construction and demolition (C&D) waste reduction.

Current Performance

BNL is currently diverting a wide variety of waste streams, consistently performing above DOE's 50% goal, with a ten-year average of 69% (See Figure 7). The generation rates of both recyclables and Municipal Solid Waste (MSW) have been declining for several years with the largest decrease occurring while the Lab operated at a reduced capacity due to COVID-19 impacts. Both last year and this year saw small increases in recycled material collection compared to 2020 as staff returned to working onsite. BNL expects that further site expansion activities and increases in staff will increase associated recycling and MSW generation rates as well as C&D generation rates created by site improvements and the growth of Discovery Park.

BNL did not open the site's waste hauling contract for rebid as anticipated during 2022 but is doing so during the first quarter of 2023. This will allow BNL to evaluate achieving net-zero waste status by diverting MSW from landfills to a Waste-to-Energy facility.

Regarding composting efforts, BNL no longer has a cafeteria, instead providing food service by non-contracted food trucks and self-serve kiosks resulting in little opportunity for composting as there is no central collection point for food waste. Site clearing activities associated with the construction of the new Science and User Support Center (SUSC) produced 75 tons of trees that were shredded and composted for use as mulch onsite during 2023.

BNL's environmentally sustainable remedial efforts are reflected in this year's recycling data. BNL's Groundwater Group reactivates and reuses activated carbon from non-radioactive groundwater cleanup activities saving both the cost of purchasing new carbon and the disposal costs for the used carbon.

The Pollution Prevention Opportunity Program provided funding for the line organizations to implement new hazard reduction or sustainability ideas. Environmental Protection Division (EPD) provided $20,000 for seven projects that provided an environmental benefit. Projects included PFAS-free firefighting foam, bio-preferred spill control equipment, equipment to better capture and report helium use, portable powerpacks to replace use of a gas generator for field activities, and bio-based ear plugs. The program's ranking system was revised to give higher priority to proposals that result in a measurable waste reduction.

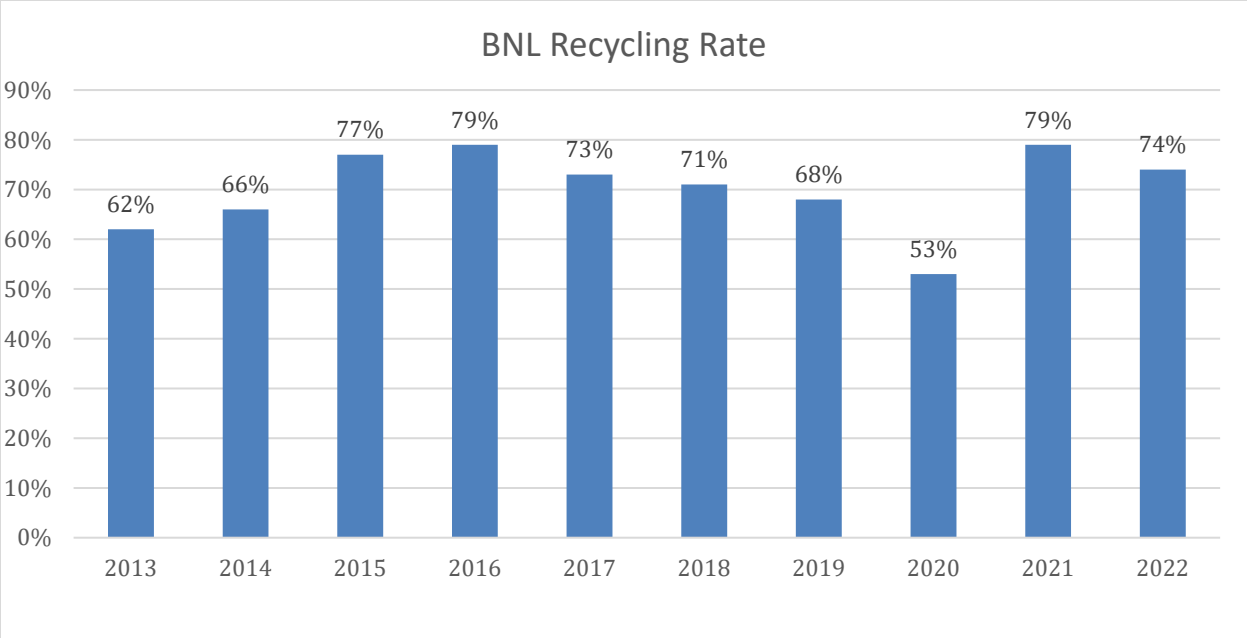


Figure 7: BNL's Recycling Rate

Plans and Projected Performance

In line with expectations from federal executive orders on sustainability, as well as the anticipated revision of DOE O 436.1, BNL will develop institutional Environmental Management System (EMS) objectives that support continued waste reduction by first addressing source reduction through sustainable purchasing. Those objectives will be addressed in the Acquisitions and Procurement section. New recycling options will also be considered. A Lab-wide team will be formed to provide input and drive enthusiasm around reducing the use of single-use plastics and/or improving BNL's plastic recycling program.

Further efforts at waste reduction based on recycling will occur when BNL's recycling contract is rebid. For 2023, BNL will better assess and define what waste streams are eligible for recycling, focusing on single-use plastics such as plastic pipette tips that are currently disposed of as MSW. A new wood pallet recycling program was implemented late 2022 which will be included in next year's recyclability numbers. C&D reduction efforts will be challenging as site expansion will increase overall generation rates. Typically, glass, metal and wood are segregated for recycling during demolition projects. BNL will evaluate if sheet rock can also be collected for recycling during future building demolitions.

Fleet Management

This category focuses on the site's approach and vision for addressing fleet optimization, and strategies used to reduce petroleum use and increase alternative fuel use.

Current Performance

With the Executive Order 14057 in place, BNL took the initiative to purchase 10 more Level 2 charging stations with a plan to install 5 of them in the beginning of FY23. With the activation of the Level 2 charging stations in September 2021, our membership increased from 7 users to 35. With the increased participation, it decreased our greenhouse gas emissions by 345 kg to ~10,000 kg. BNL will continue to monitor which vehicles have the capability to be replaced with full electric models to meet the Executive Order requirements.

In March of 2022, BNL installed Geotab Global Positioning System (GPS) units in every government vehicle to get a better scope of usage and sustainability measures. The GPS units measure usage, driving behavior, and idling times.

Other initiatives that BNL has been implementing to increase Sustainability are Spot Checks, car washing, and Preventative maintenance compliance. The spot checks done at BNL check government vehicles to ensure none are idling while unoccupied, tire wear, damage, and WEX card and accident report storage. The Spot Check pass rate has increased 30% year-over-year (YOY). In March of 2022, BNL signed a mobile car wash vendor to come onsite to wash our government vehicles to prevent rust and wear on the vehicles. FY22 ended in 100% preventative maintenance compliance to increase vehicle efficiency.

With all the initiatives we are taking, there are some drawbacks to them. The Electric grid may not support where we need more charging stations and supply chain issues with vehicle acquisitions is unknown.

Plans and Projected Performance

With BNL's plans to install more charging stations, the Fleet Supervisor is working to replace eight of the cargo vans and hybrid sedans that are due for replacement to full electric vehicles in FY23. The options are limited this year due to supply chain issues and availability. The Fleet Supervisor will use the GSA recommendations to make the appropriate transfer to electric on a case-by-case basis to meet the Executive Order requirements.

The Bike Share Program was initiated in FY22 and plans to expand program in FY23 are underway to encourage alternate transportation options across campus.

The Lab's onsite shuttle service will continue business with an online reservation system for Long Island Railroad (LIRR) transfers to decrease unnecessary trips to the train station if there are no customers to transport. With the students that came back onsite for the summer of FY22, the Supervisor saw a need for planned routes during the busy season to decrease duplicate requests. This strategy will enable the transport of more people at designated times while reducing the amount of trips and gas emissions in comparison to previous years.

Fleet Management Program Subsection

BNL's Fleet Supervisor reports directly to the Federal Fleet Manager, Tom Back, for fleet maintenance, utilization, procurement, and mission support needs. Executive Order 14057 has changed the mission by requiring BNL's fleet acquisitions to be to be 100% zero emission vehicles (ZEV) by 2030. The goal is to acquire a ZEV, when available, in the same class as the previous vehicle being replaced.

The BNL Fleet Supervisor has created a virtual government vehicle training for all employees that operate government vehicles onsite. The training covers everything from proper safety procedures to operations of a vehicle. The Fleet Supervisor has been collaborating with other Labs to learn their best practices in electric vehicle (EV) training and lessons learned for BNL's future acquisitions.

The onsite repair facility installed 240 Geotab GPS units in all the government vehicles. Geotab has the capability of tracking idling vehicles and the costs associated with idling to track the impact. Trending data from the GPS units will be available next year. The new units also track driving behavior. Therefore, unsafe driving can be tracked, which potentially leads to increase emissions.

The results are not yet available from the June 2021 Vehicle Allocation Methodology (VAM) survey. However, the Fleet Supervisor used data from the survey to better understand the fleet and vehicle usage. This information will help in identifying driver's needs and right-size the fleet to increase usage and performance.

BNL currently has six plug-in hybrid vehicles and one hybrid Electric vehicle. Based on the FY23 replacement recommendations provided by the U.S. General Services Administration (GSA), the Fleet Supervisor will consider which vehicles are capable to transition to ZEV in order to meet the current Executive Order. BNL currently has six Level 1 charging stations and four Level 2 charging stations. Five more charging stations are projected to be installed in FY23. Campus installation sites will be based on the electrical grid, infrastructure, and need. BNL is promoting more personal electric vehicle purchases by offering onsite employees the opportunity to charge their electric vehicles while at work at minimal cost. Currently, there are 34 onsite employees registered for this incentive and utilization is expected to grow.

BNL is currently using Maximo to manage fleet and the maintenance history. However, the system is not specifically curated for fleet management which has demonstrated several obstacles in reporting. Therefore, the Fleet Supervisor is in the process of acquiring a new Fleet Management System, Fleetio. This system integrates with our current Geotab GPS system and can also integrate with other fuel systems. The Fleetio reports has the potential to assist with FAST reporting needs, including maintenance, accident, and fuel costs. Additionally, the Fleetio reports are fully customizable to adapt to the department's needs. Fleetio has the ability create sustainability goals from data collected by the system.

Clean & Renewable Energy

This category focuses on site efforts towards utilizing renewable and clean energy resources.

Current Performance

44% (120,747 MWh) of BNL's FY21 electricity was clean hydropower provided by the New York Power Authority.

BNL purchased of 24,000,000 kilowatt hours (kWh) of RECs for 2022, with Green-E vendor Anew Environmental, to meet the "Renewable Energy" minimum requirement of 7.5%. The 24 million kWh of REC's represents 8.7% of the total site electric consumption.

BNL's RECs have been and will continue to be purchased through a competitive solicitation process. Each solicitation includes the latest DOE requirements, including the required in-service dates. It is important to note the price of RECs more than quadrupled compared to previous years. By most accounts the price of RECs will continue to increase in the future as market pressure increases demand.

BNL's 816 kW NSERC facility produced 644,479 kWh in FY22 that were consumed by BNL's facilities. The RECs are retained by BNL and are not sold. The output for FY22 increased from FY21 because there was a shutdown to address operational issues as well as failed components but was not back to FY20 levels because some of the FY21 shutdown ran into FY22.

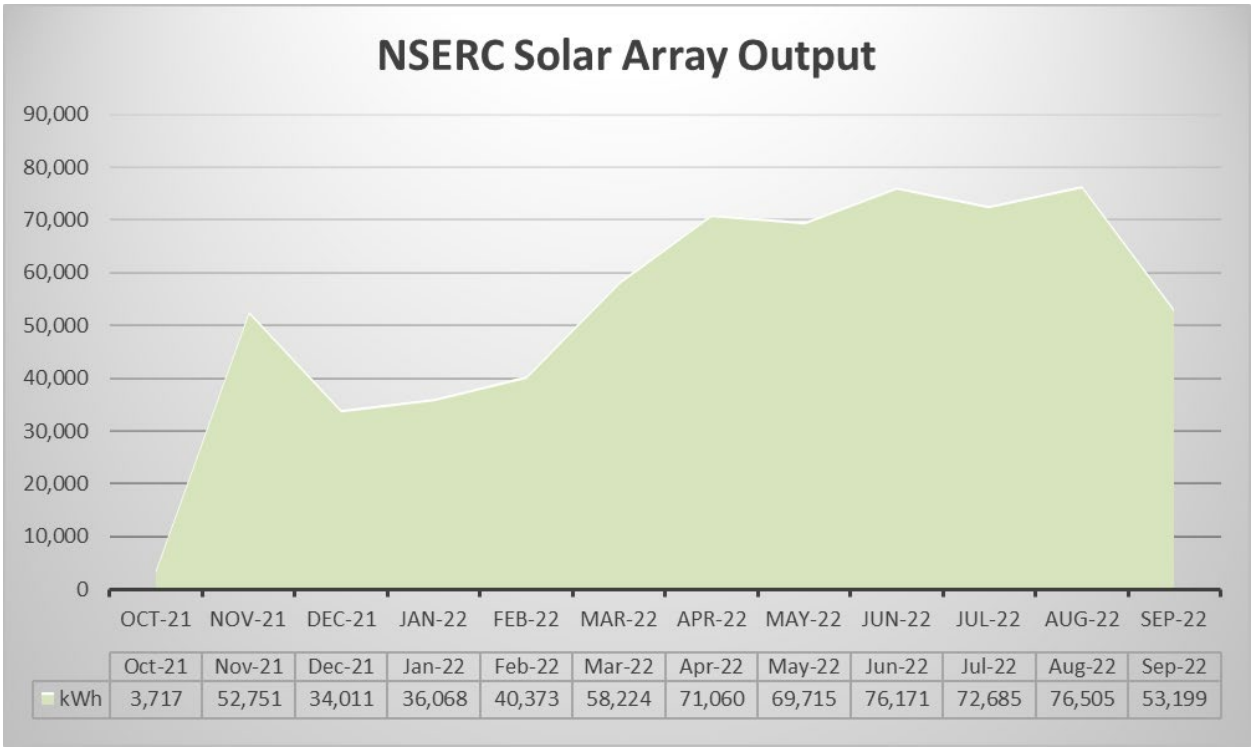


Figure 8: NSERC Solar Array Output

FY22 is the 10th year of BNL's hosting the LISF, a 32 MW Solar PV generation system that provides power to LIPA. Even though BNL does not receive any of the power generated from the LISF, it provides clean, renewable energy to the local area and region.

As discussed in previous SSPs, an evaluation of combined heat and power (CHP) was last completed in 2016. The report highlighted the potential to reduce GHGs by approximately 50,000 MtCO2e per year and act as an on-site source of "clean energy." There are other benefits associated with CHP including providing increased resilience in the event of impacts from weather or other events that could affect the electric grid. However, current and estimated low energy costs in the future continue to prevent CHP from being economically viable at this time.

Plans and Projected Performance

BNL will continue to operate the NSERC facility and provide for further expansion when sufficient funds are identified. REC purchases will continue for the foreseeable future to meet the latest renewable energy and clean energy goals.

BNL continues to regularly evaluate alternative energy opportunities. LIPA recently issued a Request for Proposal (RFP) for utility scale battery storage on Long Island to facilitate planned 9,000 MW of offshore windfarms and 3,000 MW of battery storage. BNL has been selected and is having high-level discussions regarding hosting utility scale batteries.

The most recent renewable energy assessment that included the BNL site was completed by National Renewable Energy Laboratory (NREL) in 2016. The report concluded that even though the site is over 5,000 acres, given the existence of the 32-MW LISF on the BNL site and that much of the land is forested and in environmentally sensitive areas (core Pine Barrens), BNL continues to be concerned about clearing additional large tracts of land for another renewable energy (RE) project.

The NREL report also states, "PV, biomass, LFG, and SHW do not appear economically viable currently. Should the cost of electricity increase or escalate at a rate higher than what is assumed in the model or should the price of RE decreases or new incentives become available, then it is possible additional RE projects could become cost-effective." NREL did suggest consideration of small wind turbines. However, given the Federal Aviation Administration's (FAA's) determination that large (300 ft. high) ones would pose an aviation problem in the area, as well as concerns from BNL's neighbors, this option is not currently being pursued.

BNL's low energy rates and high construction costs have thus far precluded renewable energy projects from being economically viable. Renewable energy systems, especially solar hot water, are considered in all new construction and major building renovations. To date, it has been difficult to find cost effective projects, even with the new office building, the SUSC. During the design several renewable concepts were evaluated including solar hot water heating and a solar wall for pre-heating. Unfortunately, they proved too expensive and were not included.

BNL continues to pursue opportunities to implement a true microgrid on site. The ≈1 MW NSERC facility is intended as one of the first segments that will we ultimately plan to be combined with energy storage. BNL is continuing discussions with energy storage providers and various governmental agencies to explore options such as hosting large utility scale battery storage systems on site as mentioned. NSERC is also being considered as a clean energy source to feed power to hydrogen generating electrolyzers.

On the positive side, the CLCPA goals include 100% zero emission electricity by 2040 thus virtually eliminating BNL's electric consumption emissions.

Sustainable Buildings

This category focuses on all aspects pertaining to sustainable building initiatives such as Sustainable Buildings, formerly referred to as High Performance Sustainable Buildings, as well as building inventory changes.

Current Performance

Guiding Principles (GPs)

The 2020 version of the GPs referenced the compliance metrics in Executive Order 13834; however, Executive Order 13834 was revoked and replaced with Executive Order 14057 (December 8, 2021). Whereas previous versions of the GPs stated a metric of a percentage of buildings that needed to meet the GPs (i.e., 15% of buildings greater than 5,000 square feet [Ref. 2008 GPs/Executive Order 13423 Implementation Instructions]; 15% of buildings greater than 5,000 square feet [Ref. 2016 Guiding Principles/Executive Order 13693 Implementation Instructions], 15% of buildings greater than 10,000 square feet), the metrics of Executive Order 14057 relative to sustainable buildings is to provide a measure of the percentage of buildings (new and existing) – regardless of size – and the percentage of GSF that qualifies as a Sustainable Federal building.

Metric: Percentage of buildings that qualify as a Sustainable Federal Building: **5.9%**

Metric: Percentage of gross square footage that qualifies as a Sustainable Federal Building: **26.5%**

Of the 110 buildings on site having a footprint of greater than 5,000 square feet, 17 buildings qualify as Federal Sustainable Buildings and 93 buildings do not qualify as Federal Sustainable Buildings. The barriers to meeting the GPs in the buildings that do not qualify as Federal Sustainable Buildings are feasibility and costs. A 2011 study of 26 non-qualifying buildings identified 21 candidates as either "potential" or "plausible" to qualify as Federal Sustainable Buildings with significant capital investment, while five (5) buildings were non-viable candidates regardless of capital investment. To achieve qualification for the 21 buildings would have required a capital investment of greater than $103 Million in 2011 dollars ($137 Million in 2022 dollars). A rough-order-of-magnitude estimate to qualify all viable buildings at BNL as Federal Sustainable Buildings would require a capital investment of $400 Million-$500 Million in 2022 dollars.

Additionally, the 17 buildings that qualify as Federal Sustainable Buildings were qualified to the 2008 GPs. In accordance with the 2020 GPs, the qualifying grandfathered buildings will be evaluated no later than 2024 to comply with the quadrennial evaluation requirement.

New Building Design

All buildings designed from 2007 were designed to meet the New York State Energy Code. In addition, BNL incorporates these principles into major renovations. As such, these buildings, some of which also obtained Leadership in Energy and Environmental Design (LEED) certification, either meet or exceed the GPs. BNL does not have any leased facilities. The Modernization Project Office's (MPO's) Design Standards

(MPO Procedure 100E) includes requirements to ensure that all new construction is at least 30% more efficient than ASHRAE 90.1.

Net Zero Buildings

Executive Order 14057 requires that design new construction and modernization projects greater than 25,000 gross square feet and entering the planning stage after January 31, 2022 to be net-zero emissions by 2030. BNL has one building in the planning phase – the Integrated Site Operations and Maintenance Facility (ISOMF) – with the opportunity to be designed and constructed as a net-zero building.

Metric: Annual percentage and gross floor area of net-zero emissions new construction projects: 0% and 0 GSF.

Climate-Resilient Design and Management

The MPO has a *Climate Resiliency Evaluation* procedure (revised in June 2022) that requires that all large new construction projects (i.e., new buildings, building additions, or Level 3 alterations) to consider present and future climate conditions in assessing environmental impacts on the project. The design criteria are based upon the latest version of the "Climate Resiliency Design Guidelines" prepared by the New York City Mayor's Office of Recovery and Resiliency with respect to increasing temperatures, frequency of heat waves, and precipitation.

Leased Facilities

BNL does not have any leased facilities.

Plans and Projected Performance

Guiding Principles (GPs)

Although overall site funding will drive the exact schedule, as new buildings are constructed to be fully compliant with the GPs and old non-compliant buildings are demolished, the percentage of buildings that are compliant with the GPs will further increase.

New Building Design/Renovation Design

In accordance with the *Executive Order 14057 Implementation Instructions*, all new construction and modernization projects greater than 25,000 square feet and entering the planning stage after January 31, 2022, shall be designed, constructed, and maintained to meet and, wherever practicable, exceed Federal sustainable design and operations principles for new construction and modernization projects in accordance with the GPs. In addition, all renovation projects of existing buildings must use, to the greatest extent technically feasible and practicable, sustainable design and operations principles for existing buildings in accordance with the GPs.

BNL is currently seeking funding for the ISOMF, a 70,000 to 120,000 GSF building that will be designed to meet the GPs and which will eliminate approximately 11 non-energy efficient buildings encompassing approximately 100,000 GSF of space.

Net Zero Buildings

In accordance with the Executive Order 14057 Implementation Instructions, all new construction and modernization projects greater than 25,000 square feet entering the design phase in fiscal year 2022 and beyond are to be designed to be net-zero emissions by 2030, and where feasible, net-zero water and waste buildings.

The proposed ISOMF building is anticipated to be constructed as a net-zero facility. The project will address BNL's site sustainability goals as well as the Administration's expectations for federal facilities with respect to carbon pollution-free electricity, net-zero emissions buildings, and net-zero emissions from federal procurements of construction materials. It will provide a publicly accessible, proof of concept that can inform the residential and commercial construction industry and serve as a testbed for future demonstration of cutting-edge energy saving building technologies and systems. Low maintenance landscape and building orientation strategies will be employed to maximize sustainability.

Strategies for Design (42 USC 6834)

42 USC 6834 established Federal building energy efficiency standards and fossil fuel consumption reductions for new Federal buildings and Federal buildings undergoing major renovations, with a 100% reduction by 2030.

The proposed ISOMF building will be designed to achieve the 100% fossil fuel consumption reduction as a net-zero facility. The project will incorporate advanced building technologies such as geo-thermal ground source heat pumps, advanced photovoltaics, energy (battery) storage, and advanced building system metering and controls. Solar energy would be utilized for the charging requirements of the new electric vehicle fleet.

Climate-Resilient Design and Management

Climate resilient design will be considered for large new construction projects (i.e., new buildings, building additions, or Level 3 alterations).

Net-Zero Emissions Subsection

In New York State, there is a push to have carbon free electricity by 2040. BNL understands that we are a large consumer in New York State and that the efficient design of our systems will contribute to the success of New York State accomplishing this goal. As such, we are designing all our controls systems to meet the ASHRAE 36: Best in Class HVAC Control Sequences standard. As we modernize and review our existing control sequences, we are also working towards complying with ASHRAE 36. For example, the controls team has started incorporating CO2 sensors and occupancy control sequences into air handling units that can modulate the percent of outside air entering a space. As another example, the controls team is reviewing chiller unloading curves and re-writing programming to optimally stage chillers to Integrated Part-Load Value (IPLV) and reset condenser waters so that chillers can run on the spectrum of the lowest kW/ton for any load requirement.

BNL is being faced with a new challenge in FY23. One of our high emissions mission specific facilities, the Collider-Accelerator Department (C-AD), will be running experiments in the summer months, increasing our load during peak periods, compared to previous years. This increase during the NYISO peak will

increase congestion in Zone K and result in the grid being more dependent on localized gas turbines for power generation. To reduce fossil fuel consumption BNL is working with multiple stakeholders throughout the Lab to shift demand to off-peak hours with less congestion in the following ways. The Energy Management group is working with Facility Project Managers to retro-commission air handling systems with economizers, Energy Management is working trades to test all chilled water valves at the facility level and air handler cooling coil level to ensure leaky valves are not overcooling spaces. In addition to these steps, the Energy team will be working with chiller plant operations to re-institute load shifting/shedding by charging the chiller water storage tank at night and using during the daily high congestion intervals to minimize the grid's need for firing gas turbines and working with key stakeholders during heat waves to encourage working from home to set back facilities. These measures do not take us to Net-Zero, but they bring BNL closer by contributing to a reduction in Scope 2 emissions, and further contribute to climate justice by reducing costs tied to high congestion in the under-privileged areas within NYISO Zone K.

Acquisitions & Procurement

This category focuses on all relevant sustainable acquisition clauses, recent sustainable purchases, and efforts to improve your supply chain GHG emissions.

Current Performance

During this past year, BNL received the GreenBuy Gold award for the sustainable acquisition of eighteen products in seven different categories. BNL also won the GreenBuy Superior Award which is given when a facility wins Green Buy Awards five times indicating that BNL continues to have effective processes in place to maximize or drive acquisition of sustainable products.

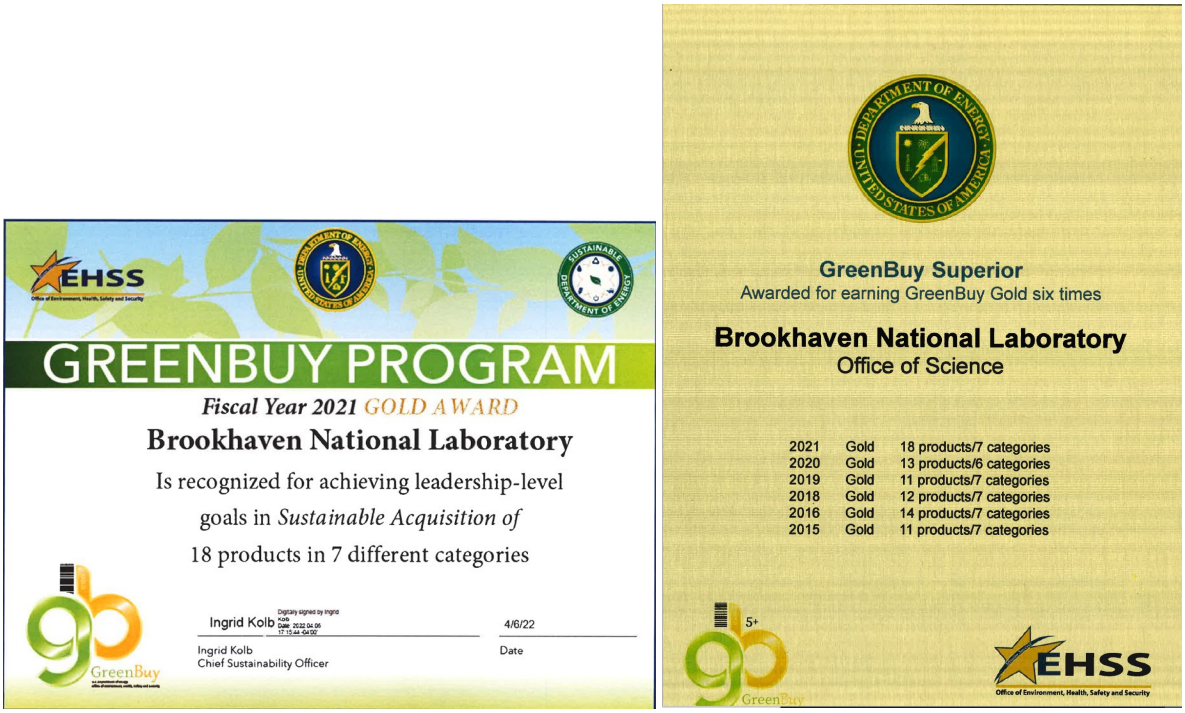


Figure 8: BNL's GreenBuy Awards

BNL has incorporated contract clauses within its vendor contracts that designate environmentally preferred products (EPP), services, and equipment. These contract clauses include the preference of:

- Energy efficient (ENERGY STAR or FEMP-designated);
- Water efficient (WaterSense);
- Bio-based (USDA BioPreferred);
- Environmentally preferable (including Electronic Product Environmental Assessment Tool [EPEAT]-registered products);
- DOE's Priority;

- Non-ozone depleting (Significant New Alternative Policy [SNAP]) chemicals or other alternatives to ozone-depleting substances and high global warming potential hydrofluorocarbons;
- Recycled content, including paper containing 30% post-consumer fiber; and
- Non-toxic or less toxic alternatives products (Safer Choice labeled).

BNL's sustainable acquisition strategy for new construction is built into the Lab's Project Management Process. The Lab captures EPP purchasing requirements in the construction subcontractor's contract terms and conditions to ensure use of EPP conforming products. For projects > 50M, the Lab evaluates the projects using the High-Performance Sustainable Building (HPSB) process to incorporate sustainable design concept including the use of environmentally sustainable building materials. Smaller projects are evaluated during various project review design phases. For example, pre-planning for construction or maintenance work by the F&O Directorate is initially screened via an Environmental, Security, Safety & Health (ESSH) Evaluation form (i.e., 500A Form), to which EPP considerations have been added. This screening step allows an opportunity to ensure that EPP contract provisions are met for all product categories, from bio-based items, low-solvent paints, energy efficiency, SNAP chemicals, recycled content building materials, office furniture, water efficient products, etc.

BNL's uses the Coupa (formerly Vinimaya) system ("E-Buy") for most purchases of the items that fit into the above product categories. The tabular matrix of commonly purchased items (based on the manufacturer's part number) that are EPP compliant has been updated with additional products. The system can use the manufacturer's part number and scan all of the catalogs to come up with the most efficient pricing from each vendor. BNL has the ability to review product descriptions for compliance against sustainability requirements.

BNL assists E-Buy requisitioners on requests and maintains a listing of "Commonly Purchased Items" guide of EPP-compliant products as well as a link to sustainable purchasing requirements on Procurement and Property Management's (PPM's) webpage. The guide helps requisitioners easily identify compliant E-Buy items and their responsibilities as it pertains to the program. As mentioned, requisitioners can also save identified, commonly ordered items in the system for future reference and ordering. However, challenges in performance will continue until complete EPP conformance is part of the online catalog product descriptions. Improved online product descriptions would remove a significant barrier to purchasing conformance created when a requisitioner must interact with the vendor (chat/call) to determine conformance.

BNL's E-Buy training is used to communicate EPP requirements to new and existing users. The Procurement Division audits E-Buy purchases for EPP conformance, an effort currently directed primarily at office products. PPM contracts include EPP purchasing performance reports from vendors, but the information received is not detailed enough to allow BNL to measure actual performance.

BNL 2022 improvements include an upgrade to the E-buy system from Vinimaya to Coupa which provides for an enhanced user interface and additional features to further promote E-buy use. BNL will continue to identify new items and work with product owners to replace the current products with EPP alternatives.

BNL's sustainable acquisition strategy for new construction is built into the Lab's Project Management Process. The Lab captures EPP purchasing requirements in contract terms and conditions to ensure use of EPP conforming products. For projects > 50M, the Lab evaluates the projects using the HPSB process to incorporate sustainable design concept including the use of environmentally sustainable building

materials. Smaller projects are evaluated during various project review design phases. For example, pre-planning for construction or maintenance work by the F&O Directorate is initially screened via an Environmental, Security, Safety & Health (ESSH) Evaluation form (i.e., 500A Form), to which EPP considerations have been added. This screening step allows an opportunity to ensure that EPP contract provisions are met for all product categories, from bio-based items, low-solvent paints, energy efficiency, SNAP chemicals, recycled content building materials, office furniture, water efficient products, etc. BNL's EPD assessed project-related activities during the 2021 Sustainability Assessment and identified numerous opportunities to improve Lab communications around sustainability that can help increase performance by increasing awareness as well as developing tools and guides that help requisitioners identify conforming products.

Biobased purchases are tracked manually by collecting and adding together purchasing receipts because the Lab's current purchasing system can't identify EPP conforming items in its database. The cost to resolve this limitation is prohibitive. BNL is in the process of evaluating a new purchasing software system with plans of implementation within the next three years that will include improvements in capture and tracking of EPP purchasing information.

Plans and Projected Performance

During 2023, BNL will continue to develop guidance to provide to the lab community around E-Buy purchasing capabilities to include expanding the catalog, exploring process alternatives to reducing barriers to expanded E-Buy use, and the ability to capture sustainable purchasing requirements in product descriptions. BNL will also continue to update the Commonly Ordered Items page, update the E-Buy training specific to EPP purchasing requirements, and provide support to requisitioners across the Laboratory in this area. In support of sustainability-related federal executive orders, BNL will also assess its chemical holdings for products that contain PFAS chemicals, identify these products and seek replacements.

Further, for 2023, BNL has created a specialized position and is hiring a Category and Supply Chain Analyst whose role will include the responsibility for activities/strategies to promote and advance EPP purchasing.

At present, the PeopleSoft purchasing system currently in use at the Laboratory is limiting in the amount of and types of data that is able to be collected in this area making much of the effort in data and metrics tracking and highly manual-the primary roadblock to further success in this area. While BNL is anticipating a new system that can be designed to better manage EPP-related data, implementation is a few years away; however, inclusion of EPP requirements is a priority.

A Laboratory team consisting of volunteers from across the Lab will be formed to generate ideas and enthusiasm for reduction of single-use Laboratory plastics first by source reduction, second by recycling. Use of single-use water bottles will be evaluated and targeted for reduction.

BNL will have a future an opportunity to improve EPP purchasing conformance when an anticipated new purchasing software system is implemented. Anticipated improvements include improved EPP product identification in catalog product descriptions and/or better capture of EPP information in BNL's internal system, improving our ability to measure performance and target areas for improvement.

Investments: Improvement Measures, Workforce, & Community

This category focuses on efforts to implement identified Efficiency & Conservation Measures (ECM) through appropriations, performance contracts, or other funding mechanisms, and discuss sustainability-related training or education provided for employees. This section also highlights implemented ECMs and funding needed beyond planned activities as well as typical operation costs for meeting sustainability goals. This year a subsection has been added to discuss investment efforts to continually enhance workforce capabilities and support the site's community, especially environmental and energy justice communities.

Current Performance

Efficiency & Conservation Measure Investments

Internally funded energy conservation and sustainability related initiatives include continuation of best practices, with continued emphasis on temperature setback during unoccupied periods.

As discussed previously, some were initially surprised at the minimal (≈0.3%) reduction in energy use intensity (EUI) between FY19 and FY20, and an increase of ≈3% from FY20 to FY21. The expectation was a reduction due to the minimal staffing on site. However, the buildings needed to be maintained at their normal conditions for those working on site, and to ensure proper environmental conditions for the building and equipment. Furthermore, in many cases outside air use was increased due to COVID and in some cases additional filtration was added. Both increase energy use.

Consistent with past efforts BNL continues to implement small lighting and water conservation projects by using the latest, most efficient equipment as part of on-going maintenance efforts.

Energy and water evaluations are completed annually per EISA 432 requirements. The information is placed into a database for BNL's use as well as into EPA's Portfolio Manager program. Potential projects are reviewed to determine if they are cost-effective. Small cost-effective projects are sometimes implemented with operating funds. Unfortunately, in FY22 once again due to the limited site presence during the COVID/MinSafe mode little to no progress in the area occurred. When larger, cost-effective projects are identified they have been and will be directed to areas that may have funding available, or to a UESC or Energy Savings Performance Contract (ESPC) effort.

Energy Performance Contracts

Unfortunately, the economics of this 2nd UESC project discussed in the FY22 SSP were unfavorable for investment. BNL has not progressed on any additional UESC project as this effort is on hold. Currently other options are being evaluated, including a potential internally phase funded effort, a rescoped effort, and revisiting the estimated future energy costs due to the most recent regulations and laws in New York State and Executive Orders at the Federal level that will increase energy costs for the foreseeable future.

Investments

Funding continues to be difficult for energy conservation and sustainability related projects in the current budget constrained environment. BNL, like other DOE sites, has been increasingly trying to take advantage of third-party financing options that utilize cost savings to pay for the projects. However, while BNL's low-energy rates are a tremendous benefit in operating the large research facilities, when combined with our high construction costs it extremely difficult to find economically favorable projects for these financing options.

Payments for BNL's current UESC project will be complete in FY23, freeing up funds for other energy conservation initiatives.

Workforce & Community Investments

- Community Engagement: One of the main ways that BNL sustains constructive relationships and provides opportunities for transparent, two-way communications with key local and diverse stakeholder groups is through its Community Advisory Council (CAC). Established in 1998, the CAC is an independent and diverse group of approximately 27 community organizations that represent environmental groups, local civics, schools, businesses, and other community leaders. It meets six times a year and covers a range of topics such as climate literacy, climate change adaptation, environmental justice, the Lab's progress in attaining its Sustainability Plan, ongoing clean-up efforts of emerging contaminants and groundwater protection.
- Open Houses: The Lab also hosts four open houses for the public (in non-COVID restricted times) called Summer Sundays which provide opportunities for thousands of science-interested stakeholders to interact with Lab scientists and be introduced/re-introduced to the Laboratory's cutting-edge research. Historically, the DOE-SC and BHSO participate in these outreach programs to communicate the vital role DOE plays in funding science. These visits, tours, and open houses are other ways Brookhaven engages with the local community and enhances climate literacy.
- Workforce Development Programs: The Lab's Office of Educational Programs (OEP) provides high school and undergraduate students with opportunities to work alongside Lab scientists, conduct research using world-class DOE facilities, and learn about opportunities to pursue careers in DOE mission-based research. Relationships with minority serving institutions and minority faculty have strengthened the impact of the Interdisciplinary Consortium for Research and Educational Access in Science and Engineering (InCREASE) program. InCREASE members continue to be ambassadors for the Lab and DOE by bringing minority students to the Laboratory and serve as collaborators on a number of funding proposals.
- Workforce Development Programs: OEP has positioned BNL as a leader within New York State, and nationally by providing leadership for the Long Island Science Technology Engineering and Math (STEM) Hub to increase the effectiveness of science, engineering, technology, and mathematics education. Beyond preparing the next generation science and engineering workforce, the STEM Hub engages many high-tech industry and academic partners on Long Island broadening the awareness of BNL/DOE work and the possibilities for collaboration, particularly for advancement of the Discovery Park initiative.
- Workforce Development Programs: More recently, the educational programs staff have been directly involved in building collaborations with Minority Serving Institutions (MSIs) such as Howard University, Alabama A&M, Hampton, and other Historically Black Colleges and Universities (HBCUs)

with a focus on projects such climate adaptation, atmospheric research, battery storage and renewable energy.

Plans and Projected Performance

Efficiency & Conservation Measure Investments and Contracts

As discussed, the economics of the potential second UESC II effort are currently considerably less cost-effective than the previous UESC. The all-in electric rate for FY22 was $57.79/MWh which was up 47% from the FY21 historic low of $30.31/MWh. This increase, combined with the high volatility in natural gas and fuel oil costs, will result in BNL revisiting the cost-effectiveness of energy/GHG savings projects over the course of FY23.

The requirements of the New York State CLCPA energy rates/costs are expected to increase substantially in the relative near future. Furthermore, BNL's large electric demand increase (more than double the existing) associated with the E-IC project will have a major impact on electricity rates/costs. BNL will also continue to evaluate ECMs in the context of these anticipated changes in FY23.

BNL will re-evaluate the UESC II initiative, as well as other potential energy and GHG projects using updated energy cost escalation factors.

Workforce & Community Investments

BNL will continue to operate the current programs and will expand and develop programs which foster the following:

- Develop working relationships with HBCUs and MSIs for growing scientific capabilities and diversity within BNL. Pursue collaborations with Howard University; continue and grow collaborations with City College of New York (CCNY); consider additional institutions that can provide synergistic benefits with BNL.
- Ensure a sustained pipeline of highly skilled and diverse STEM workers by supporting workforce development programs by collaborating with external organizations to bring BNL STEM resources to bear on regional STEM workforce development. Encouraging our scientific departments to develop and deploy programs and internship opportunities for under-represented minority students.
- Continue outreach and educational programming to local tribal organizations by offering internships and educational programming.

Indirect Emissions

This category focuses on all information pertaining to the site's business travel and commute data, including participation in regional and local planning.

Current Performance

Upon receipt and review of anticipated guidance from DOE on Scope 3 emissions, there are six applicable upstream indirect emission categories (i.e., Categories 1-5 and 8, Purchased goods & services, Capital goods, Fuel and energy-related emission not included in Scope 1 & 2, Transportation & distribution activities, Waste generated in operations, and Leased assets) where the Laboratory will focus its efforts on how to best influence emission reductions aligned with new DOE long-term Scope 3 emission reduction targets. Because BNL does not sell goods or services, the five defined Scope 3 downstream emission categories in the Corporate Value Chain (Scope 3) Accounting and Reporting Standard are not applicable to BNL.

Performance Status

BNL continues to track its Scope 3 Greenhouse Gas Emission in relation to the previously established Scope 3 greenhouse gas reduction goal established under Executive Order 13514. The figure and accompanying table below illustrate that, Scope 3 emissions are up 23.5% from FY21 (10,238 $MtCO_2e$), and 37.2% lower than the FY08 baseline value.

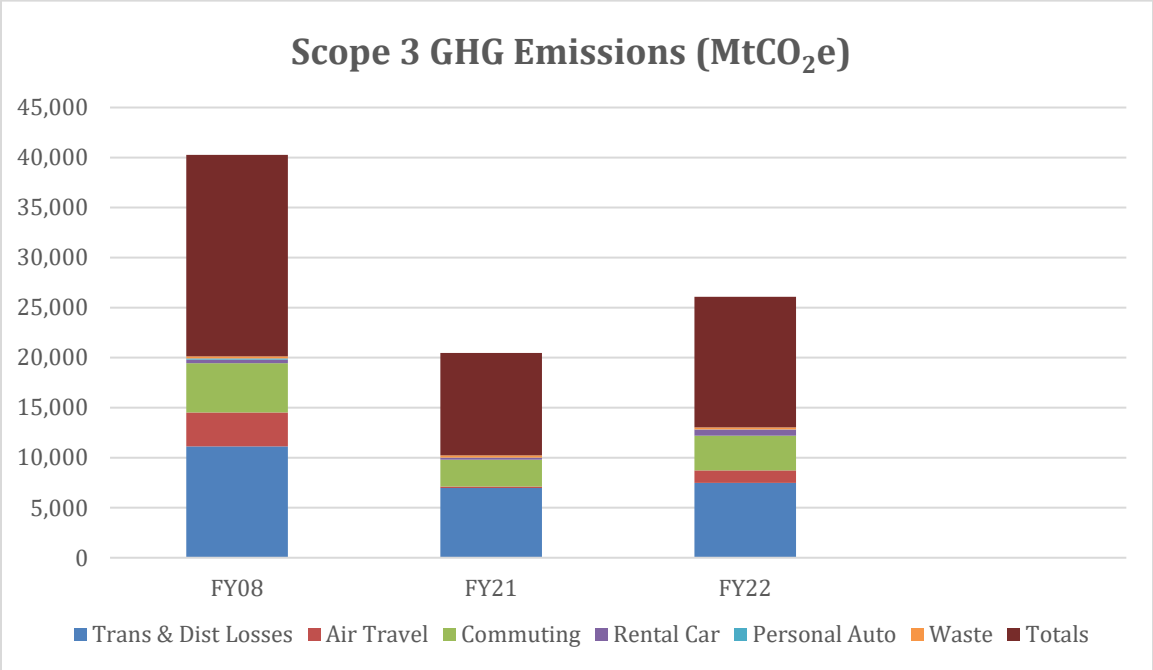


Figure 9: Scope 3 GHG Emissions

Table 2: Scope 3 GHG Emissions

Source	FYO8 $MtCO_2e$	FY21 $MtCO_2e$	FY22 $MtCO_2e$
Trans & Dist Losses	11,124	6,971	7,477
Air Travel	3,399	150	1,247
Commuting	4,928	2,680	3,447
Rental Car	347	199	612
Personal Auto	126	8	7
Waste	212	230	219
Totals	**20,136**	**10,238**	**13,039**

The increase from FY21 is primarily due to a more than eight-fold rise in air travel GHG emissions, a 15% increase in commuting GHG's, and a 7.3 % jump in transmission & distribution GHGs. The transition from "Limited Operations with Maximum Telework," to "Normal Operations with Telework" on March 14 played an important part in the increases in Air travel GHGs and Commuting GHG, as 88.8% of the air travel trips occurred after March 14th, and the average number of employees working onsite increased from 1,200 to 1,500 employees after March 14th.

FY22 commuting GHG emissions were estimated using employee residency zip code records to determine the average daily counts of the number of employees roundtrip commuting distance and the daily average number of employees entering the site via the main and north gates every Monday. The weighted average number of employees reporting to work each day was determined to be 1,363 based on Safeguard & Security average counts of 1200 employees for the period from 10/1/21-3/14/22 and 1500 employees from 3/15-9/30/22. It was assumed that all employees commuted alone.

Managers and supervisors are expected to follow a set of criteria to determine if employee requests for travel are appropriate and feasible. Four criteria that must apply to all travel requests are:

- The travel is essential to fulfilling the mission of the Laboratory.
- The number of personnel visiting the same location is the minimum required to fulfill the objectives of the trip.
- The required information to be obtained from the trip cannot be obtained effectively by other means such as correspondence, meeting/conference records or by telephone or virtual meetings/conferences.
- The travel will have a minimal impact on the travelers work while they are away on domestic/foreign travel.

Each of these criteria plays a role in reducing the number of approved domestic and foreign trips thereby helping to minimize business travel GHGs.

The Laboratory's flexible work arrangements continue to be very popular. Since the transition from Limited Operations with Maximum Telework," to "Normal Operations with Telework" on March 14, approximately 47 percent of employees telework daily.

Currently, the Laboratory has four Charge Point Level 2 electric vehicle charging stations each with two charging ports, three of which may be used by employees, guests and facility users, and visitors from 7

am to 5 pm. In addition, employees can also utilize recharge their vehicles at six Level 1 locations from 7 am to 5 pm. Users must register to utilized Level 1 and Level 2 charging stations. Level 1 station users pay a monthly fee to cover estimated usage and administrative costs, while Level 2 users pay for the actual kilowatt-hours used plus and $0.12 administrative per charge. More than thirty employees are registered to use the vehicle charging stations.

BNL continues to maintain close interaction with NY State, the Metropolitan Transportation Authority (MTA), LIRR and Suffolk County/Brookhaven Town officials regarding plans for the relocation of the Yaphank rail station. New York State budgeted $20M for the relocation of the Yaphank rail station. A planning study for the relocated station has recently been completed. The rail station will be relocated in the North Shirley industrial park east of William Floyd Parkway and just south of the Long Island Expressway roughly 4 miles from the Laboratory. The new rail station will be convenient drop off point for many of the 5,000 users and guest researchers visiting the Laboratory annually and will support reductions in commuter GHGs.

Plans and Projected Performance

Combined electricity purchases of conventional power and hydropower are projected to rise 8.5% from the FY22 total to 299,396 MWh in FY25 and by more than 95.9% to 540,796 MWh in FY30 when testing of the EIC is expected to begin. Using e-Grid 2022 transmission and distribution (T&D) loss factors and Northeast Power Coordinating Council, Inc. (NPCC) Long Island total output and NPCC Upstate non-baseload output emission rates, estimated T&D GHG emission will increase to 8,109 MtCO2e in FY25 and to 14,468 MtCO2e in FY30.

Since many of the 500 new employees hired from the onset of the pandemic in 2020 are not familiar with the Laboratory's Ride Share Program, EPD will work with the Media & Communications Office to prepare a Monday Memo segment to describe the program and its benefits.

EPD plans to work with the US Green Building Council Drive Electric Long Island Education & Outreach Subcommittee to set up an electric vehicle display as part of the Earth Day 2023 celebration activities. Employees will have an opportunity to ride & drive one of the Office of Emergency Management (OEM) electric vehicles on display.

Fugitives & Refrigerants

This category focuses on efforts to reduce GHG from fugitive emissions or refrigerants.

Current Performance

A variety of activities and operations at BNL use greenhouse gases for different purposes. The largest user of greenhouse gases at BNL is the Tandem Van de Graaff Facility. The two Tandem accelerator vessels with a combined storage volume of 16,050 ft3 are filled with an insulating gas mixture consisting of 46%v SF_6, 44%v N_2, 6%v CO_2, and 4%v O_2. Annually, there are some emissions of SF_6 and CO_2 due to insulating gas leaks and the transfer of insulating gases during periodic maintenance of the Tandem accelerators.

The table below provides a summary of the sources of BNL fugitive greenhouse gas emissions in FY22.

Table 3: Fugitive GHG Emissions

Source	Activity	Gas	GHG Emissions ($MtCO_2e$)
Tandem Van de Graff	Insulating gas leaks	SF_6	990.75
		CO_2	0.00
	Accelerator gas transfers	SF_6	8.07
STAR Experiment	Detector gas purging	CH_4	6.41
		CO_2	0.05
		HFC-134a	1,037.30
		SF_6	380.58
Fleet Vehicle Repair	Fleet Motor Vehicle A/C Leaks	HFC-134a	0.34
		HFO1245yf	0.00
Refrigeration/AC Equipment	Gas Leaks	R-410A	6.63
LEReC Accelerator DC Gun	SF_6 service cart compressor leak	SF_6	0.00
Current Landfill	Methane generation	CH_4	30.92
Wastewater Treatment Plant	Effluent discharges	N_2O	0.63

The bulk of BNL's process and fugitive GHG emissions (besides those from insulating gas leaks of SF_6 from the Tandem Van de Graaff accelerator vessels) were due to periodic purging of carrier gases used in STAR detector subsystems during the FY22 Relativistic Heavy Ion Collider (RHIC) experimental run. During the STAR experimental run, the Time-of-Flight detector operated in a recirculation mode for 160 days recirculating 86.5 % of the detector gases reducing its HFC-134a emissions by 317 pounds (300 $MtCO_2e$).

The Facilities and Operations Directorate has a Refrigerant Management Plan designed to ensure that their HVAC technicians comply with all applicable provisions of 40 CFR 82 Subpart F during service and repair of all refrigeration and air conditioning equipment. By following this plan, emissions of chlorofluorocarbons, hydrochlorofluorocarbons, and hydrofluorocarbons due to leaks of these

refrigerants are kept to a minimum. Annual preventative maintenance inspections of large refrigeration & A/C equipment (i.e., refrigerant charges > 50 lbs.) mitigate hydrofluorocarbon emissions due to refrigerant leaks.

The Energy & Utilities High Energy Equipment Management Plan is a proactive plan to manage leaks of sulfur hexafluoride (SF_6) used as a gaseous dielectric in the Laboratory's gas-insulated switchgear and circuit breakers. No SF_6 leaks have been discovered during scheduled preventative maintenance inspections of SF_6 gas-insulated switchgear and circuit breakers.

During an internal assessment of the Non-Radioactive Emissions Program conducted in March, a focus of the assessment was to determine the extent to which the Aim Act Hydrofluorocarbon (HFC) Production & Consumption Phasedown will impact current and anticipated future uses of the phasedown regulated HFCs.

Staff in the Energy Science & Technology Department noted they have used HFC-23 in their reactive ion etching process since 2008 and based on their rate of use existing supplies are anticipated to last 10-plus years.

Staff in C-AD explained that HFC-134A is used on two of their STAR experiment detector systems. Since the STAR Experiment is expected to end around 2025 and the conclusion of the RHIC program, and the HFC phasedown schedule shows a 40% reduction from 2024-2028, the Department anticipates that HFC-134A will be available for the duration of the STAR experiment.

The EIC is still in the project design phase and EIC staff is taking the HFC phasedown into consideration during future planning of detector systems and planned chillers. Staff noted they intend to use gas recirculation to limit HFC releases in new detector systems.

Plans and Projected Performance

Using funds made available via the Site Planning & Infrastructure Management Group FY21-FY25 Consolidated Unfunded Requirements List (CURL) a 255-ton HCFC-123 centrifugal chiller in Bldg. 901A is expected to be replaced with a new 256-ton Trane R-514A centrifugal chiller in the spring of 2023. R-514A is a low global warming potential (GWP of 2.8) hydro-olefin blend refrigerant that Trane is using to replace HCFC-123 chillers.

Funding has been allocated through the Critical Utility Rehabilitation Project (CURP) to replace two Central Chilled Water Facility 1200-ton Trane CFC-11 centrifugal chillers with two Trane R-514A centrifugal chillers. These chillers are expected to be replaced in the next two to three years. Since all new chillers must meet Federal Energy Management Program efficiency requirements for water-cooled electric chillers, the replacement of these chillers will affect reductions in purchased electricity use and associated Scope 2 GHGs.

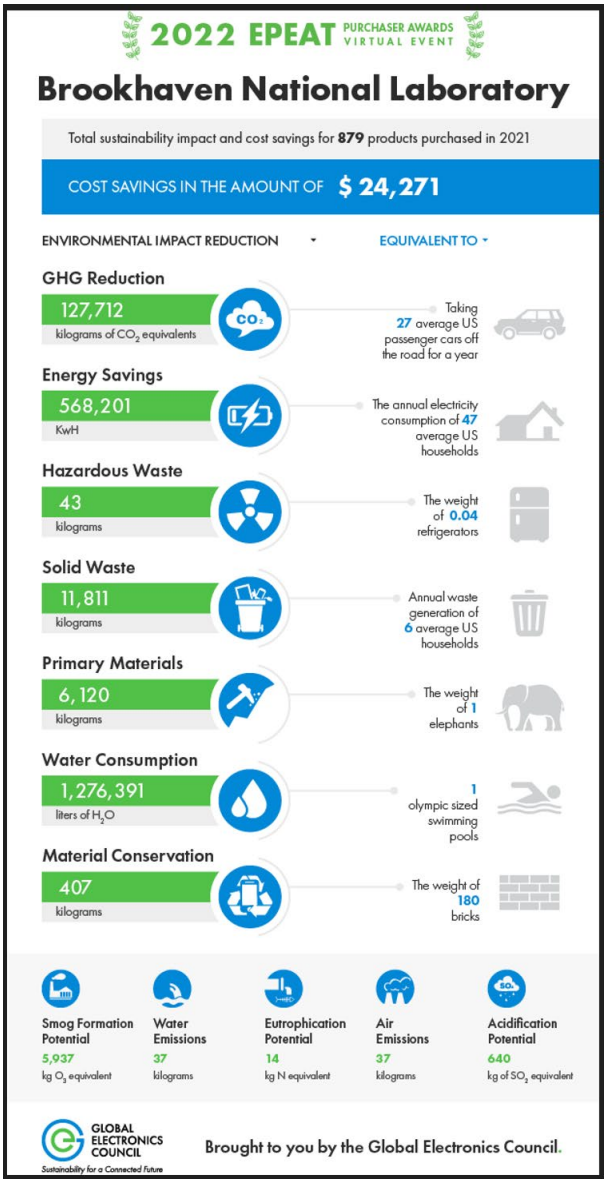
Electronic Stewardship & Data Centers

This category focuses on the acquisition, operations and management, and disposal of electronics, as well as efforts to consolidate and optimize high performance computers (HPCs)/data centers with a particular focus on energy and water efficiency.

Current Performance

Acquisitions and Electronic Asset Disposal

BNL's ITD Division offers staff a variety of computer options that have been preselected to meet EPEAT Gold criteria driving high conformance to purchasing requirements as most employees purchase computers from preapproved stock. A certain number of computers are exempt based on scientific use and related high-power computing needs. All servers that will be purchased for the new BNL computing facility fall under the EPEAT exemption for scientific use. BNL has a high EPEAT conformance rate evidenced by the receipt of the 2022 EPEAT Gold Award.



BNL tracks computer components through its PeopleSoft program to ensure full utilization of these products throughout their lifespans. The average age of a BNL computer prior to disposal is approximately six years, which is 50% above the average retirement age of four years. Usable computers and peripherals are sent to an on-site warehouse where departments can go to acquire computers as needed. Last year, approximately 494 desktop computers, 262 laptops, 27 tablets and 70 servers were reused internally by BNL personnel as well as numerous other small electronics. Past efforts to donate used computers to external parties for reuse were ended because of the resources needed to meet data security concerns (removal/shredding of hard drives and other data storage devices) prior to donation.

BNL implements an automated power management system on all new computers ensuring power saving options are enabled

for all staff computers. Exemptions are granted for specific computers that are required to run in an "always on" mode for offsite access or data collection needs.

The figure below summarizes the amount of electronic equipment that has been recycled annually by BNL since 2013. Recent increases were driven by hardware changes required for staff to move to cloud-based systems during site-wide systems upgrades as well as an increase in local equipment and system upgrades conducted while work was paused while COVID work-at-home restrictions were in place.

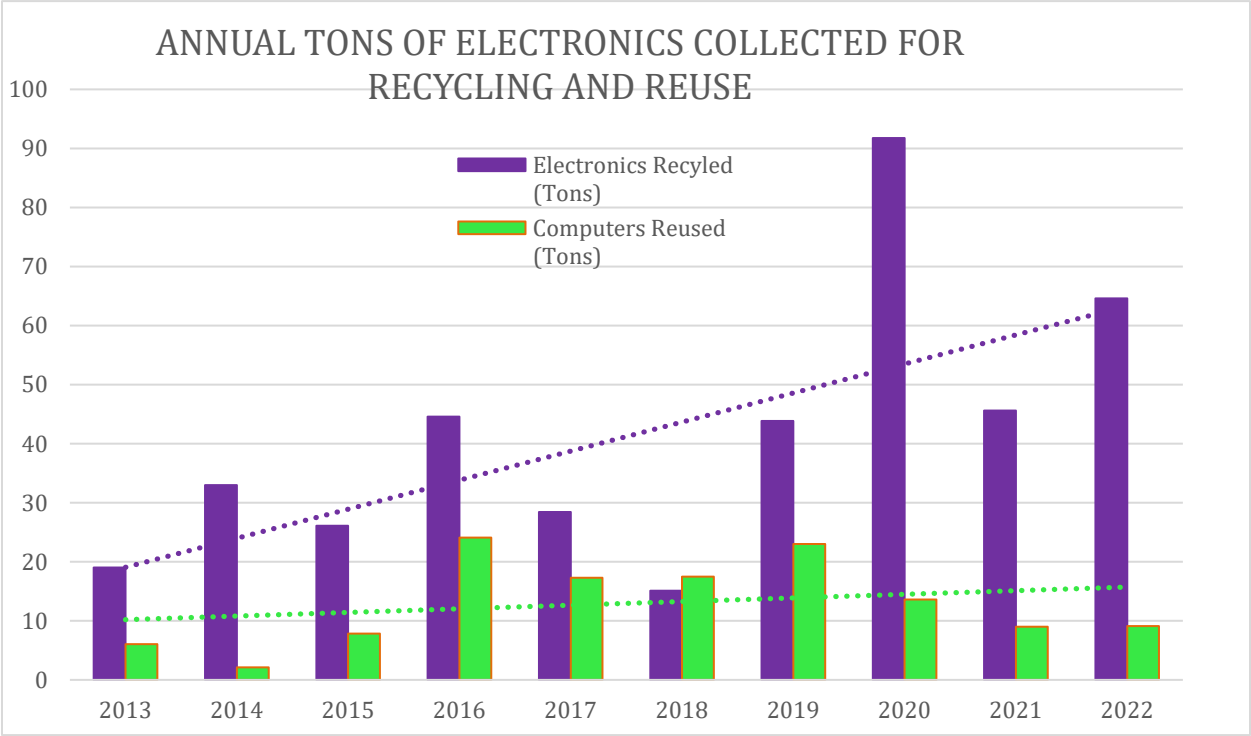


Figure 10: Annual Tons of Electronics Collected for Recycling

Data Centers

As noted in the Energy Management section, BNL currently operates two high-performance data centers. B725 is the newest data center with construction completed to the 2016 GP for data centers. The functional system is not currently meeting the PUE of 1.2-1.4 initially prescribed by the system design. BNL is investing in sub metering for data center loads to better track key performance indicators (KPIs) and in staff resources to optimize the control sequences of the system. In FY22 BNL's efforts have reduced PUE from 2.5 to 1.5 based on a 2-week running average. In FY23 BNL will continue to carefully monitor

operations and adjust setpoints and sequences of operations to bring PUE of the data centers to target levels.

Plans and Projected Performance

Acquisitions and Electronic Asset Disposal

As discussed in the Acquisition and Procurement Section, the future new purchasing system may allow for internal tracking of EPEAT purchasing conformance. Currently, BNL relies on conformance data provided by the vendors as conformance can't be tracked by the current PeopleSoft system. Internal tracking of EPEAT ratings of electronics purchases would allow BNL to provide more flexible access to performance information.

BNL's contract for recycling scrap electronics is being rebid during 2023. The new contract will include a requirement that the vendor be a certified e-Steward or R2 recycler to ensure BNL's electronic waste is managed in the most environmentally responsible way.

Data Centers

As noted in the Energy Management section, FY23 BNL will continue to carefully monitor operations and adjust setpoints and sequences of operations to bring PUE of the data centers to target levels.

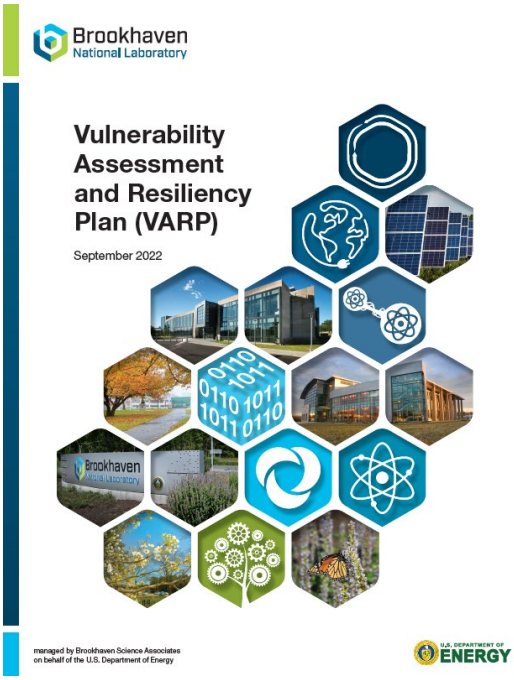
Climate Adaptation & Resilience

This category focuses on site efforts to increase site adaptation and resilience to address the impacts of climate change. Resilience is the ability to adapt to changing conditions and withstand or recover from disruption. Adaptation refers to actions taken to reduce risks from changed climate conditions (e.g., even current conditions) and to prepare for impacts from additional changes expected in the future. Resilience and adaptation efforts help sites manage risks to DOE assets, infrastructure, operations, and personnel.

Current Performance

To increase site adaptation and resilience to address the impacts of climate change, BNL prepared a Vulnerability Assessment and Resilience Plan (VARP) in accordance with guidance provided by the DOE Sustainability Performance Division (Guidance Version 1.2, February 2022) and associated Risk Assessment Tool. A VARP planning team was created to help identify critical assets and infrastructure, identify projected climate change and extreme weather hazards and vulnerabilities, and propose and assess climate resilience solutions.

As recommended in the VARP guidance, the BNL VARP planning team used tools like the *National Risk Index* (FEMA) and *Technical Resilience Navigator* (DOE-FEMP) to provide a baseline for understanding historical hazards that could be affected by climate change. However, review and understanding of historical hazard events and local climate trends in the recent past provided the necessary background on projected future climate changes. While the BNL VARP planning team leveraged tools such as the *National Climate Assessment* for the Northeast and 2022 New York *State Climate Summaries* (NOAA) to help determine future climate projections the most useful and applicable information was gathered from a Climate Risk Report for Suffolk and Nassau prepared by the New York State Resiliency Institute for Storms & Emergencies (NYS RISE, 2014).



The VARP was completed by the end of FY22 and downloaded in the DOE Sustainability Dashboard along with proposed resilience solutions that will be implemented in FY23 and beyond. The plan also recognized the following climate adaptation and resilience efforts that BNL has already implemented to protect critical infrastructure and to reduce GHG emissions, enhance overall sustainability, and improve energy efficiency.

- *Leadership in Energy and Environmental Design (LEED) Certified Buildings*: BNL has four buildings that have achieved LEED certification. They include the Research Support Building (LEED Silver),

Center for Functional Nanomaterials (LEED Silver), NSLS-II Ring and Laboratory Office Buildings (LEED Gold), and Interdisciplinary Science Building (LEED Gold).

- *High Performance Sustainability Buildings (HPSB)*: The Laboratory's MPO ensures that all new construction buildings and major renovations—as well as at least 15 percent of existing building space for buildings greater than 5,000 gross square feet—comply with HPSB Guiding Principles.
- *Utility Energy Services Contract (UESC)*: A UESC contract/project was completed in 2015 with the National Grid which installed energy-efficient lighting, new building controls, and an energy-efficient water chiller. The environmental benefits of this UESC were estimated to include electrical savings of 3,549,114 kWh/year, fuel savings of 89,541 mm British thermal units (Btu)/year, a GHG reduction of 7,022 MT-CO2e, and a building energy intensity reduction of 11 percent. To date, actual energy savings meet or exceed the original estimates. Through a comprehensive Measurement and Verification process, BNL has been able to verify that actual energy savings were within a few percent of the original projections for five years of operation.
- *NYPA Power Contract*: Tenth full year of a ten-year contract with provision to extend up to 15 years that includes 15 MW of renewable (nearly zero GHG) hydropower.
- *Renewable Energy*: Project support continues for the LISF and NSERC facilities and annual purchases of RECs to meet targeted goals.
- *Electric Curtailment Programs*: Through these programs, the Laboratory agrees to reduce electrical demand during critical days throughout the summer when New York Independent System Operator expects customer demand to meet or exceed the available supply. The Laboratory strives to keep electric loads at a minimum during the summer by scheduling operations at the RHIC to avoid peak demand periods. This scheduling reduces the electric demand by approximately 25 megawatts (MW).
- *The Central Chilled Water Facility (CCWF)*: The CCWF continues to utilize a 3.2-million-gallon chilled water storage tank to reduce peak electric demand by producing and storing chilled water during the night.

BNL's OEM is also integrating climate resilience into its day-to-day risk management processes. Some examples include:

- The OEM attends trainings and biannual meetings provided by the National Weather Service (NWS) (who are a part of the National Oceanic and Atmospheric Administration). Additionally, OEM monitors the NWS and National Hurricane Center for all severe weather activities that have the potential to impact the BNL site. OEM provides BNL leadership with timely weather-related data updates used to evaluate the Lab's posture to remain open or close the BNL site.
- OEM analyzes the potential for the Peconic River to flood using the Federal Emergency Management Agency (FEMA) National Flood Hazard Layer, a geospatial database that contains current effective flood hazard data. Both the 100- and 500-year analyses are included in the Site Emergency Plan and the recently updated 2022 All Hazards Survey.
- OEM included Continuity of Operations planning as part of integrating climate resilience per the DOE 150.1B, Continuity of Operations Order.

- OEM maintains a Threat and Vulnerability Assessment Plan, as required, and the All-Hazards Survey, both of which address the potential for severe weather and weather-related hazards onsite.

These programs, processes, policies, and projects have already improved resiliency against climate change hazards and will continue to be implemented along with proposed resilience solution options that will be tracked in the DOE Sustainability Dashboard.

Plans and Projected Performance

As part of the VARP process, BNL identified some resilience solutions whose implementation status will be tracked within the DOE Sustainability Dashboard. In FY23, the following projects were all determined to be feasible, currently planned and funding mechanisms are available for implementation. They will also mitigate impacts from identified climate change hazards, help reduce GHG emissions, and enhance overall sustainability at BNL.

- **Critical Response Facilities (Emergency Power)**: Evaluate the existing generators or feasibility of installing temporary or permanent generators at Critical Response Facilities.
- **Replacement of Chillers at the Central Chilled Water Plant**: Replace Chiller #4 and #2.
- **New 13.8kV Feeder**: Add additional 13.8kV feeder from Building 603 to Building 600.
- **Additional Utility Metering**: Continue to install additional metering on the electric, chilled water, potable water, and steam system.
- **Fire Management Program**: Continue fuels management and prescribed fire management activities.

Going forward, BNL's resilience planning and projected performance will be conducted as part of the established SSP development, evaluation, execution, and reporting process. It is during this process that any new guidance or information received, funding, available technologies, or new climate policies will be reviewed and assessed for future planning.

Appendix A: List of Acronyms & Abbreviations

AFV	Alternative Fuel Vehicles
AGS	Alternating Gradient Synchrotron
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ATF	Accelerator Test Facility
BAS	Building Automation System
BHSO	Brookhaven Site Office
BLCC	Building Life-Cycle Cost
BNL	Brookhaven National Laboratory
BMP	Best Management Practice
BORE	Beneficial Occupancy Readiness Evaluation
BSA	Brookhaven Science Associates
Btu	British thermal unit
C&D	Construction & Demolition Debris
C-AD	Collider-Accelerator Department
CAFE	Corporate Average Fuel Economy
CCNY	City College of New York
CD	Critical Decision
CEM	Certified Energy Manager
CERG	Continuity of Emergency Response Group
CERN	European Organization for Nuclear Research
CFL	Computers for Learning
CFM	Certified Facility Manager
CFN	Center for Functional Nanomaterials
CFR	Code of Federal Regulations
CFR	Core Facility Revitalization
CHP	Combined Heat and Power
CLCPA	Climate Leadership and Community Protection Act
CMS	Chemical Management System
COOP	Continuity of Operations Plan
CSF	Central Steam Facility
CSI	Computational Science Initiative
CURP	Critical Utility Rehabilitation Project
DBT	Design Based Threat
DCOI	Data Center Optimization Initiative
DOE	Department of Energy
ECM	Efficiency & Conservation Measures
EIC	Electron-ion collider
EHSS	Office of Environment, Health, Safety & Security
EISA	Energy Independence and Security Act
EMI SIG	Emergency Management Issues Special Interest Groups
EMS	Environmental Management System
EO	Executive Order
EOC	Emergency Operations Center

EPA	Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPHA	Emergency Preparedness Hazard Assessment
EPP	Environmentally Preferable Purchasing
ERO	Emergency Response Organization
ESCO	Energy Service Company
ESF	Emergency Support Functions
ESPC	Energy Savings Performance Contract
ESSH	Environmental, Security, Safety & Health
EU	Energy & Utilities
EUI	Energy Utilization Index
EV	electric vehicle
F&O	Facilities and Operations
FAA	Federal Aviation Administration
FCA	Facility Condition Assessment
FCE	Facility Complex Engineer
FCM	Facility Complex Manager
FEMP	Federal Energy Management Program
FIMS	Federal Information Management System
FPDS	Federal Procurement Data System
FY	fiscal year
gal	gallons
GHG	Greenhouse Gas
GOCO	Government-Owned, Contractor-Operated
GP	Guiding Principle
gpf	gallons per flush
GPM	Gallons Per Mile
GPS	Global Positioning System
GSA	U.S. General Services Administration
gsf	gross square feet
HASP	Health and Safety Plan
HBCU	Historically Black Colleges and Universities
HEMSF	High-Energy Mission-Specific Facility
HFC	hydrofluorocarbon
HPC	High-Performance Computing
HPSB	High Performance Sustainable Buildings
HQ	Headquarters
HR	Human Resources
HVAC	heating, ventilation, and air-conditioning systems
IESNA	Illuminating Engineering Society of North America
IFM	Integrated Facility Management
IFMA	International Facilities Management Association
IGA	Investment Grade Audit
IGPP	Institutional General Plant Projects
IPLV	Integrated Part-Load Value
ISOMF	Integrated Site Operations and Maintenance Facility
ILA	industrial, landscaping, and agricultural
ISB-I	Interdisciplinary Science Building I

ITD	Information Technology Division
JFK	John F. Kennedy International Airport
kV	kilovolt
kW	kilowatt
kWh/yr	kilowatt hour per year
LBNL	Lawrence Berkley National Laboratory
LCC	Life-Cycle Cost
LDT	light-duty truck
LEED	Leadership in Energy & Environmental Design
LI	Long Island
LINAC	linear accelerator
LIPA	Long Island Power Authority
LIRR	Long Island Railroad
LISF	Long Island Solar Farm
LOB	Laboratory Office Building
M&V	measurement and verification
mmBtu	one million Btu
MPO	Modernization Project Office
MSI	Minority Serving Institution
MSW	Municipal Solid Waste
MTA	Metropolitan Transportation Authority
$MtCO_2e$	metric tons of carbon dioxide equivalent
MW	megawatts
MWh	megawatt hours
NEPA	National Environmental Policy Act
NPCC	Northeast Power Coordinating Council, Inc.
NREL	National Renewable Energy Laboratory
NSERC	Northeast Solar Energy Research Center
NSLS-I	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source II
NYC	New York City
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYISO	New York Independent System Operator
NYSERDA	New York State Energy Research and Development Authority
ODS	ozone depleting substance
OEM	Office of Emergency Management
OH&P	Overhead and Profit
OMB	Office of Management and Budget
OMC	Occupational Medicine Clinic
ORNL	Oak Ridge National Laboratory
PA	Preliminary Assessment
PAP	Performance Assurance Plan
PE	Professional Engineer
PFAS	per- and polyfluoroalkyl substances
PFC	perfluorocarbon
PHENIX	Pioneering High Energy Nuclear Interaction Experiment
PM	preventative maintenance

PNNL	Pacific Northwest National Laboratory
PPPL	Princeton Plasma Physics Laboratory
PPM	Procurement and Property Management
PSC	Public Service Commission
PUE	power utilization effectiveness
PV	photovoltaic
RACF	RHIC ATLAS Computing Facility
RCA	recycled concrete aggregate
RE	Renewable Energy
REC	Renewable Energy Credit
RFP	Request for Proposals
RHIC	Relativistic Heavy Ion Collider
SC	Office of Science
SF_6	Sulfur Hexafluoride
SLAC	Stanford Linear Accelerator
SLI	Science Laboratories Infrastructure
SNAP	Significant New Alternative Policy
SPO	Sustainability Performance Office
SSP	Site Sustainability Plan
STAR	Solenoidal Tracker at RHIC
STP	Sewage Treatment Plant
SUF	Service Usage Forms
SUSC	Science User Support Center
SUV	Sports Utility Vehicle
SWP	Safe Work Plan
T&D	Transmission & Distribution
TEC	total estimated cost
THIRA	Threat and Hazard Identification and Risk Assessment
TJNAF	Thomas Jefferson National Accelerator Laboratory
TOF	time of flight
UESC	Utility Energy Service Contract
USDA	U.S. Department of Agriculture
VAM	Vehicle Allocation Methodology
WWII	World War II
WWTP	Wastewater Treatment Plant
YOY	Year-over-year
ZEV	zero emission vehicle

Comprehensive Scorecard
All Dept / Under Secretaries
All Program Offices
Brookhaven National Laboratory
FY 2022

Greenhouse Gas Management

Scope 1 & 2 Greenhouse Gas Emissions

Goal: Reduce direct GHG emissions by 50 percent by FY 2025 relative to FY 2008 baseline
Interim Target (FY 2022): -40.0%

Current Performance: -47.7%

	FY 2008	FY 2021 (PY)	FY 2022	% Change from Baseline	% Change from Last Year
Facility Energy	198,085.9	112,766.0	118,858.1	-40.0%	5.4%
Non-Fleet V&E Fuel	265.6	227.8	391.1	47.3%	71.7%
Fleet Fuel	942.4	471.6	0.0	-100.0%	-100.0%
Fugitive Emissions	6,266.9	5,543.8	2,430.2	-61.2%	-56.2%
On-Site Landfills	65.4	32.9	30.9	-52.8%	-6.1%
On-Site WWT	2.1	0.5	0.6	-71.4%	20.0%
Renewables	0.0	0.0	0.0	N/A%	N/A%
RECs	0.0	-17,722.0	-14,177.0	N/A	-20.0%
Total (MtCO2e)	**205,628.2**	**101,320.5**	**107,533.9**	**-47.7%**	**6.1%**

Scope 3 Greenhouse Gas Emissions

Goal: Reduce indirect GHG emissions by 25 percent by FY 2025 relative to FY 2008 baseline
Interim Target (FY 2022): -19.0%

Current Performance: -52.5%

	FY 2008	FY 2021 (PY)	FY 2022	% Change from Baseline	% Change from Last Year
T&D Losses*	10,700.2	4,321.9	4,762.0	-55.5%	10.2%
T&D RECs Credit	0.0	-1,167.4	-933.9	N/A	-20.0%
Air Travel	3,398.7	149.9	1,247.1	-63.3%	732.0%
Ground Travel	473.0	206.6	618.8	30.8%	199.5%
Commute	4,929.0	2,679.7	3,447.4	-30.1%	28.6%
Off-Site MSW	212.8	230.4	219.1	3.0%	-4.9%
Off-Site WWT	0.0	0.0	0.0	N/A%	N/A%
Total (MtCO2e)	**19,713.6**	**6,421.1**	**9,360.4**	**-52.5%**	**45.8%**

* Includes T&D losses for purchased renewable electricity

Facility Management

Energy Intensity

Goal: The latest energy intensity reduction goal, requires a reduction in energy intensity for goal subject facilities by 25 percent by FY 2025 relative to FY 2015 baseline. The prior goal, required a 30 percent reduction by FY 2015 relative to FY 2003 baseline
Interim Target (FY 2022): -17.5%

Current Performance: 56.4%

	FY 2015	FY 2021 (PY)	FY 2022	% Change from Baseline	% Change from Last Year
Purchased Utilities (MMBtu)	718,305.2	705,214.7	1,098,952.3	53.0%	55.8%
Purchased Renewables (MMBtu)	0.0	0.0	0.0	N/A%	N/A%
Goal-subject GSF	2,957,443.0	2,893,822.0	2,893,822.0	-2.2%	0.0%
Energy Intensity (Btu/GSF)	**242,880.5**	**243,696.6**	**379,758.1**	**56.4%**	**55.8%**

Renewable Electricity

Goal: Use 30 percent renewable energy as a percentage of overall facility electricity use by FY 2025
Interim Target (FY 2022): 25%

Current Performance: 4,106.0%

	FY 2021 (PY)	FY 2022	% Change from Last Year	% Compliant
Grid Electricity	0	0.0	N/A%	
On-Site Renewable Energy	0	614	N/A%	
Purchased Green Electricity	0	0.0	N/A%	
Renewable Energy Certificates	24,000	24,000		
Bonuses	605	614	1.5%	
Total Renewable Electricity with Bonuses (MWh)	**24,605**	**25,229**	**2.5%**	**N/A%**
Total Electricity Consumed (MWh)	**0**	**614**	**N/A%**	

EISA S432 Compliance

Goal: Reduce per-mile greenhouse gas emissions by 30 percent by FY 2025 relative to FY 2014 baseline

Current Performance: At Risk of Compliance

	Due Date	Covered Energy	Evaluated Square Footage Status	# of Covered Facilities Benchmarked
Current Evaluation Cycle Status	02/28/2022	65.08% 984,317.94 MMBtu	Completed: 3,079,563 Remaining: 0	0 out of 32

	# of Identified ECMs	# of Awarded/Funding Approved ECMs	# of implemented ECMs with reported M&V data	$ value of all implemented ECMs
Current Evaluation Findings	0	0	0	0.0

Clean Energy

Goal: By FY 2025, use 25 percent renewable energy as a percentage of overall facility electric and thermal energy use.
Interim Target (FY 2022): 0.0%

Current Performance: 7.0%

	FY 2021 (PY)	FY 2022	% Change from Last Year	% Compliant
Grid Electricity	907,780	941,601	3.7%	
Non-renewable Thermal Energy	604,122	621,177	2.8%	
On-Site Renewable Energy	0	0.0	N/A%	
Purchased Green Electricity	0	0.0	N/A%	
Renewable Energy Certificates	81,888	81,888	0.0%	
Bonuses			N/A%	
Total Renewable Energy with Bonuses (MMBtu)	**111,827**	**111,827**	**0.0%**	**N/A%**
Total Energy Consumed (MMBtu)	**1,511,902**	**1,562,778**	**3.4%**	

Potable Water Intensity

Goal: Reduce water intensity by 36 percent by FY 2025 relative to FY 2007 baseline
Interim Target (FY 2022): -30.0%

Current Performance: -48.2%

	FY 2007	FY 2021 (PY)	FY 2022	% Change from Baseline	% Change from Last Year
Water Consumption (million gal)	412.9	304.0	368.8	-10.7%	21.3%
Aquifer Recharge (million gal)	322.1	258.4	313.5	-2.7%	21.3%
Total GSF	4,081,900.0	4,798,953.0	4,798,953.0	17.6%	0.0%
Water Intensity (Gal/GSF)	**22.3**	**9.5**	**11.5**	**-48.4%**	**21.1%**

Non-Potable Water Consumption

Goal: Reduce potable water intensity by 36 percent by FY 2025 relative to FY 2007 baseline.
Interim Target (FY 2022): -24.0%

Current Performance: 0.0%

	FY 2010	FY 2021 (PY)	FY 2022	% Change	% Change from Last Year
Industrial	0.0	0.0	0.0	N/A%	N/A%
Landscaping	0.0	0.0	0.0	N/A%	N/A%
Agricultural	0.0	0.0	0.0	N/A%	N/A%
Total Non-Potable Water (million gal)	**0.0**	**0.0**	**0.0**	**N/A%**	**N/A%**

Sustainable Buildings

Goal: Ensure 17 percent by building count comply with the Guiding Principles for sustainable buildings by FY 2025. Interim Target (FY 2017): 15.0 %
Interim Target (FY 2022): 16.3%

Current Performance: 27.5%

	Building Count	GSF
Guiding Principles Certified	11	1,161,455
Total Applicable*	40	3,514,427
Performance (%)	**27.50%**	**33.05%**

* Applicable means buildings and trailers that are DOE owned or DOE leased where the gross/rentable SqFt is greater than 5,000.

Fleet Management

Fleet Petroleum

Goal: Reduce fleet petroleum use by 20 percent by FY 2015 and thereafter relative to FY 2005 baseline
Interim Target (FY 2022): -20.0%

Current Performance: -100.0%

	FY 2005	FY 2022	% Change
Gasoline	91,140	0	-100.0%
Diesel	24,544	0	-100.0%
Biodiesel*	0	0	N/A%
Total Petroleum (GGE)	**115,684**	**0**	**-100.0%**

* Includes only the diesel content of B20

Fleet Alternative Fuel

Goal: Increase fleet alternative fuel use by 10 percent by FY 2015 and thereafter relative to FY 2005 baseline
Interim Target (FY 2022): 10.0%

Current Performance: 0.0%

	FY 2005	FY 2022	% Change
E-85	0	0	N/A%
Biodiesel*	0	0	N/A%
CNG	26,000	0	-100.0%
Other*	0	0	N/A%
Total Alternative (GGE)	**26,000**	**0**	**-100.0%**

* Biodiesel contains B100 plus the biodiesel content from B20. Other contains LNG, LPG, and electric

Fleet Greenhouse Gas Emissions/Mile

Goal: Reduce potable water intensity by 36 percent by FY 2025 relative to FY 2007 baseline.
Interim Target (FY 2022): -24.0%

Current Performance: 0.0%

	FY 2014	FY 2022	% Change
Fleet Fuel GHG (MtCO2e)	0.7	0.0	-100.0%
Fleet Miles (x1000)	792.0	0.0	-100.0%
Greenhouse Gas Emissions / Mile (gCO2e/Mile)	**1.0**	**0.0**	**-100.0%**

Waste Management

Municipal Solid Waste

Goal: Divert at least 50 percent of non-hazardous solid waste (excluding construction and demolition debris)
Interim Target (FY 2022): 50.0%

Current Performance: 73.8%

	FY 2022	%
Off-Site Landfills	228.6	26.2%
On-Site Landfills	0.0	0.0%
Waste to Energy*	0.0	0.0%
Non-diverted Waste	***228.6***	***26.2%***
Diverted Waste	576.0	65.9%
On-Site Composted	69.0	7.9%
Off-Site Composted	0.0	0.0%
Waste to Energy Credit	0.0	0.0%
Total Diverted Waste	***645.0***	***73.8%***
Total Waste (metric tons)	**873.6**	**100.0%**

* For E.O. 13693, waste to energy does not count as diverted waste, but some credit may be applied

Construction & Demolition

Goal: Divert at least 50 percent of construction and demolition materials and debris
Interim Target (FY 2022): 50.0%

Current Performance: 39.0%

	FY 2022	%
Landfilled C&D Waste	205.9	61.0%
Diverted C&D Waste	131.5	39.0%
Total C&D Waste (metric tons)	**337.5**	**100.0%**

Acquisition

Sustainable Acquisition

Goal: Ensure 95 percent of new contract actions for products and services meet sustainable acquisition requirements
Interim Target (FY 2022): 95.0%

Current Performance: 0.0%

	Contracts Reviewed	Contracts Without Opportunity	Contracts Meeting All Requirements	%
Number of Contracts	**0.0**	**0.0**	**0.0**	**0.0%**

Electronics Stewardship

Electronics Acquisition

Goal: 100 percent of eligible electronics procurements must be environmentally sustainable (e.g. EPEAT)
Interim Target (FY 2022): 95.0%

Current Performance: 97.8%

	EPEAT Acquired	Total Acquired	%
Monitors	384	385	99.7%
Computers	523	541	96.7%
Imaging Equipment	32	32	100.0%
Televisions	0	0	N/A%
Total Acquired	**943**	**964**	**97.8%**

Electronics Recycling

Goal: Dispose of 100 percent of electronics through government programs and certified recyclers
Interim Target (FY 2022): 100.0%

Current Performance: 100.0%

	Amount	%
Transferred or Donated	0.000	0.0%
Recycled by Certified Recycler	105.832	100.0%
Recycled by non-Certified Recycler	0.000	0.0%
Amount disposed (e.g. landfill)	0.000	0.0%
Total Electronics Waste (metric tons)	**105.832**	**100.0%**

Power Management

Goal: Implement and actively use power management features on 100 percent of eligible computers (PCs & laptops) and monitors
Interim Target (FY 2022): 100.0%

Current Performance: 53.0%

	Total Owned	PM Enabled	Exempt	%
Monitors	0	0	0	N/A%
Computers	4,587	2,409	38	53.0%
Total Items	**4,587**	**2,409**	**38**	**53.0%**

Duplex Printing

Goal: Implement and actively use duplex printing features of 100 percent of eligible printers
Interim Target (FY 2022): 100.0%

Current Performance: 0.0%

	Total Owned	Duplex Enabled	Incapable	%

Total Printers	**0**	**0**	**0**	**0.0%**