

# FY 2024 Site Sustainability Plan



This page is intentionally blank.

## Table of Contents

<b>LIST OF TABLES AND FIGURES .....</b>	<b>III</b>
<b>I. EXECUTIVE SUMMARY AND EXECUTIVE SUMMARY TABLE .....</b>	<b>1</b>
<b>II. PERFORMANCE REVIEW AND PLAN NARRATIVE .....</b>	<b>10</b>
Energy Management.....	10
Water Management.....	15
Fleet Management.....	21
Clean & Renewable Energy .....	23
Acquisition & Procurement.....	26
Investments: Improvement Measures, Workforce, & Community .....	27
Fugitives & Refrigerants.....	31
Adaptation & Resilience.....	33
<b>APPENDIX A: LIST OF ACRONYMS &amp; ABBREVIATIONS .....</b>	<b>37</b>
<b>APPENDIX B: COMPREHENSIVE SCORECARD.....</b>	<b>42</b>

## List of Tables and Figures

---

### List of Tables

Table 1: Planned Net-Zero Emission Buildings .....	13
Table 2: Annual Change Gal/GSF Water Use (FY99-FY23) .....	16
Table 3: Steam and Condensate Infrastructure Requiring Replacement .....	18
Table 4: Projected CFE With Current Funding .....	23
Table 5: Predicted Scenario with Funding .....	24
Table 7: Brookhaven National Laboratory Resilience Portfolio Summary Table .....	33

### List of Figures

<b>Figure 1:</b> Net-Zero Emission Goals .....	12
<b>Figure 2:</b> BNL Site Level Water Balance .....	15
<b>Figure 3:</b> BNL Carbon-Pollution Free Electricity (CFE) Projection .....	25
<b>Figure 4:</b> Daily Typical Electricity Cost/Credit Profile .....	27

## I. Executive Summary and Executive Summary Table

---

Brookhaven Science Associates (BSA) is pleased to submit this annual Site Sustainability Plan (SSP) 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 2,850 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 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.

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. In FY23, BSA established the Energy Management Planning Team with representatives from both science and support directorates. The team continued to maintain solid relationships with the New York Power Authority (NYPA) and local utility providers ensuring cost effective power rates for operating the energy intensive user facilities and general infrastructure. In addition, the team had several meetings with NYPA to discuss collaborating on both BNL and regional renewable energy projects. These relationships are

critical to achieve our sustainability goals and to address the increased energy demand and consumption 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. BNL has discussed upgrading the NSERC in partnership with NYPA and will continue to explore options in FY24.

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, building upon the relationship with NYPA, making the most of opportunities that arise, and concentrating 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.

BNL's Environmental Management System (EMS) uses the Laboratory's requirements management process to direct sustainability requirements to the appropriate organizational managers for implementation. The EMS includes this SSP and its objectives, but also uses a business planning process as a way to establish additional sustainability objectives where appropriate elsewhere in the Laboratory. The EMS relies on the Laboratory's contractor assurance process to provide oversight over implementation and the business planning process as a mechanism for reporting on performance to

senior Laboratory management and the DOE. The process also provides a mechanism for senior management to provide feedback back to the EMS for future improvements.

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:

1. 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 utilization effectiveness (PUE) is reduced, submetering is being added to ensure targets are achieved.
2. 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.
3. 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. The project has achieved Critical Decision 2/3 and is in design and construction. Funding has been allocated for replacement of several central chilled water facility chillers with chillers that meet the Federal Energy Management Program efficiency requirements.
4. 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.
5. 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.

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
<b>Energy Management</b>			
Reduce energy intensity (Btu per gross square foot) in goal-subject buildings by 50% by the end of FY 2030.	Energy Utilization Index (EUI) in goal subject buildings has increased 87% compared to the 2008 benchmark.	Btus for heating up 363% compared to FY08. Maintenance of larger steam distribution leaks is not classified as maintenance. Staff limitations on leak repair are a	<b>High</b>

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
	FY23 goal subject Btus are 668,956 MMBtu.  50% from 2008 would be 184,509 MMBtu, a 72.4% reduction.	key contributor to the increase.	
Achieve a net-zero emissions building portfolio by 2045 through building electrification and other efforts.	Plan in development.	Plan for building electrification projects in development.	<b>High</b>
EISA Section 432 continuous (4-year cycle) energy and water evaluations.	Compliant.	Continue reviews.	<b>Low</b>
Meter individual buildings for electricity, natural gas, steam, and water to adhere to Federal metering guidance.	Significant progress required for steam and water metering.	\$93,000 allocated for condensate and water metering in FY24.	<b>Medium</b>
<b>Water Management</b>			
Reduce potable water use intensity (Gal per gross square foot).	FY23 water use intensity was 72.31 G/GSF sq.ft. vs. FY07 benchmark of 101.16 G/GSF.	Perform Comprehensive Site Water Assessment in accordance with DOE guidance by March 29, 2024.  Initiate CURP Steam/Condensate distribution repairs.  Perform Single Pass cooling Assessment.	<b>Low</b>
Reduce non-potable freshwater consumption (Gal) for industrial, landscaping, and agricultural.	BNL water management plan does not allow for irrigation outside of establishment period for native species.	No further action necessary.	<b>Low</b>
<b>Waste Management</b>			



DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
Reduce non-hazardous solid waste sent to treatment and disposal facilities.	<p>BNL's overall recycling rate for FY23 is 76%.</p> <p>BNL contracted to have its solid waste sent to a Waste-to-Energy facility for disposal instead of landfilling when available and has subsequently sent 75% of its MSW to that facility. If accounted for, BNL then is diverting 99% of its MSW from a landfill.</p> <p>BNL initiated a successful wood pallet recycling program collecting 5 tons of pallets for recycling during FY23.</p>	BNL will continue to identify opportunities for expanding the current recycling program starting with evaluating whether the wood pallet recycling program can be expanded to include plastic pallets.	<b>Low</b>
Reduce construction and demolition materials and debris sent to treatment and disposal facilities.	No demolition Construction & Demolition (C&D) debris was generated during FY23. C&D debris generated during routine Operation and Maintenance (O&M) activities across site have recyclables segregated out before disposal into a C&D dumpster making further reduction difficult.	No demolition C&D debris was generated during FY23. C&D debris generated during routine O&M activities across site have recyclables segregated out before disposal into a C&D dumpster making further reduction difficult.	<b>Low</b>
<b>Fleet Management</b>			
Reduce petroleum consumption.		Continue to expand ChargePoint station access to guests and employees. BNL installed 10 additional ChargePoint stations onsite to support increased government electric vehicle (EV) fleet bringing the total to 14 Level 2 charging stations (28 ports) and six Level 2 charging stations onsite.	<b>Low</b>

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
		<p>Funding has been requested to install ten more ChargePoint stations (20 ports) onsite in FY24.</p> <p>Train all employees that drive government EVs on how to charge plug-in hybrid electric vehicles (PHEV) to reduce fuel consumption.</p>	
Increase alternative fuel consumption.		<p>Flex Fuel vehicles will only have access to E-85 fuel pumps.</p> <p>Purchase more electric vehicles as they become available to meet the Lab’s mission.</p> <p>Geotab Telematics will provide reports on the vehicles capable of transferring to electric based upon usage.</p>	<b>Medium</b>
Acquire alternative fuel and electric vehicles.		BNL received 14 additional electric vehicles for FY23. We will continue to purchase EVs as they become available through the General Services Administration (GSA).	<b>High</b>
<b>Clean &amp; Renewable Energy</b>			
Achieve 100 percent carbon pollution-free electricity on a net annual basis by 2030, including 50 percent 24/7 carbon pollution-free electricity.	<p>Will not comply. Current projections are in FY30 BNL will have 38% carbon-pollution free energy (CFE) on a net annual basis.</p> <p>In FY23, 47% of electricity delivered to BNL was from carbon pollution-free sources of electricity, namely conventional hydro power.</p>	<p>Electric procurement will require negotiation with NYPA to increase CFE allocations to site.</p> <p>Federal Energy Management Program (FEMP) Assisting Federal Facilities with Energy Conservation Technologies (AFFECT) grant proposal was submitted to perform an investment grade audit to assess solar feasibility on campus fields, parking lots, and roadways.</p>	<b>High</b>

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
		A science line-item (SLI) proposal was submitted to develop a 30MW solar array on campus.	
Increase consumption of clean and renewable non-electric thermal energy.	There is currently no consumption of thermal energy that is non-electric, clean, and renewable.	No current plans to consume clean, renewable, and non-electric thermal energy.  Thermal energy (steam) on-site is generated using fossil fuels, significant investment is required to change this, funding to date has not been allocated.	<b>High</b>
<b>Sustainable Buildings</b>			
Increase the number of owned buildings that are compliant with the Guiding Principles for Sustainable Buildings.	BNL currently has nine (9) buildings of greater than 25,000 in size that qualify as a Sustainable Federal Building.	As BNL constructs new buildings that are compliant with the Guiding Principles for Sustainable Buildings, the number of such buildings will increase.  The Science User Support Center (SUSC) building, currently under construction and planned for completion in Summer 2024, was designed to meet the Guiding Principles for Sustainable Buildings.	<b>Medium</b>
<b>Acquisition &amp; Procurement</b>			
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring all sustainability clauses are included as appropriate.	Sustainable clauses are included in contract terms and conditions.  BNL received its eight Green Buy Gold award and third Green Buy Superior Award and Electronic Product Environmental Assessment Tool (EPEAT) Award for electronics purchases.	Make the Sustainable Facilities Purchasing Database tool available to requisitioners via Lab webpages and communicate its availability.	<b>Low</b>
<b>Efficiency &amp; Conservation Measure Investments</b>			

<b>DOE Goal</b>	<b>Current Performance Status</b>	<b>Planned Actions &amp; Contributions</b>	<b>Overall Risk of Non-Attainment</b>
Implement life-cycle cost effective efficiency and conservation measures with appropriated funds and/or performance contracts.	No current active performance contracts.	No planned performance contracts.	<b>High</b>
<b><i>Electronic Stewardship</i></b>			
Electronics stewardship from acquisition, operations, to end of life.	BNL received an EPEAT Award from the Green Electronics Council for its purchases of environmentally sustainable electronics.	BNL will continue to provide the highest rated EPEAT products to BNL staff for purchase via an on-line service portal.  BNL will apply for the EPEAT Award.	<b>Low</b>
Increase energy and water efficiency in high-performance computing and data centers.	At the time of update power utilization effectiveness (PUE) averages platinum level efficiency (1.3).	BNL will continue to monitor PUE to ensure platinum level performance.	<b>Low</b>
<b><i>Adaptation &amp; Resilience</i></b>			
Implement climate adaptation and resilience measures.	Progress was made on all proposed Resilience Solution projects in FY23 and BNL's Office of Emergency Management (OEM) continued to integrate climate resilience into its day-to-day risk management processes. Details are provided in the narrative section.	Continue making progress on executing the resilience solutions being tracked in the Dashboard module and evaluate if there are other projects that can be implemented to improve resiliency against identified climate change hazards.	<b>Low</b>
<b><i>Multiple Categories</i></b>			
Reduce Scope 1 & 2 greenhouse gas emissions.	45% reduction from FY08 baseline owing to 15MW hydro allocation negotiated in 2011.  (FY08 198,085 MtCO <sub>2</sub> e vs. FY23 107,299 MtCO <sub>2</sub> e)	Repair of condensate leaks to reduce Scope 1 emissions.  SLI submitted for 30 MW on site solar array.*  AFFECT grant for investment grade audit to study open field,	<b>Medium</b>

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
		<p>parking lot, and roadway solar submitted to FEMP.</p> <p>New York State (NYS) Climate Leadership and Community Protection Act (CLCPA) targets grid supply of 70% CFE by FY30.</p> <p>*Attainment entirely dependent on NYS CLPA performance or DOE/Power Purchase Agreement (PPA)/Utility Energy Service Contract (UESC) funding for on-site solar projects.</p>	
Reduce Scope 3 greenhouse gas emissions.	33% reduction from FY08 baseline due to hydroelectric power use and employees embracing working from home.	<p>Consider reintroducing staff to the benefits of ridesharing via a Monday Memo article.</p> <p>Continue to engage with NY State, the Metropolitan Transportation Authority (MTA), Long Island Railroad (LIRR), and Suffolk County/Brookhaven Town officials regarding plans for the relocation of the Yaphank rail station closer to BNL.</p>	<b>Low</b>

## II. Performance Review and Plan Narrative

---

### Energy Management

*This category focuses on efforts to reduce energy intensity, non-fleet fuel use, and increase electrified buildings. This category also discusses site metering and benchmarking efforts, building a Net-Zero Energy Building portfolio and conducting energy evaluations, and implementing an energy management system.*

#### Current Performance

##### High-Energy Mission-Specific Facilities (HEMSF)

HEMSF have a significant impact on sustainability metrics.

##### *Collider-Accelerator Department (C-AD)*

In past decades, the schedule for C-AD has been focused on running more powerful equipment during the winter months and shoulder seasons, when power is less expensive, local congestion is lower, and Scope 2 electric emissions are lower due to regional loads being able to be maintained without the use of diesel generator peaker plants. In FY23, 24, and 25, there will be a shift in the operation of the machine to the shoulder and summer months. As a result, electric power drawn in the summer months has and will continue to dramatically increase resulting in higher costs and higher Scope 2 emissions compared to previous years. Fortunately, this schedule is temporary, and when the new EIC is commissioned, run times will go back to shoulder season and winter months.

##### *All HEMSFs*

With many areas dependent on district steam for heating, it is a challenge to de-carbonize the site. The result is that sustainability metrics, particularly those related to site emissions, are negatively impacted by HEMSF.

##### Initiatives, Projects, and Actions to Improve Efficiency

##### *Critical Utilities Rehabilitation Project (CURP)*

The site is currently undergoing a CURP. This initiative will address many of the largest steam distribution system leaks. The goal of the several projects in CURP is to increase the amount of hot condensate returning to Central Steam Facility (CSF) from the site, thus reducing the amount of fuel required to create steam. Currently, condensate returns in peak winter months hover around 63%, meaning the distribution network is 37% inefficient with regards to recovering heat from the site back to the plant.

##### *Demand Response*

The site had the successful implementation of a demand response protocol in FY23. The protocol for demand response was set up in the Automated Logic Controls (ALC) Energy Management Controls System

(EMCS) and is written to shed electric load in three tiers. All three tiers progressively increase the cooling setpoint in site-wide office areas by an additional 1°F site-wide, with the click of a button. Each protocol is activated when any of three benchmark conditions is exceeded: site chilled water loads increase above a benchmark capacity, outdoor air temperature rise above a specific value, or when Day Ahead Market (DAM) electricity costs exceed a certain value. The program has proven the successful load shedding of up to 3 MW site wide.

### *Thermal Energy Storage*

The Central Chilled Water Facility (CCWF) is equipped with a 3.1-million-gallon thermal energy chilled water storage tank. The capacity of the tank allows the site to shed a maximum of two chillers for as many as eight (8) hours at any given moment. Since December of 2022, the site has been tracking energy costs on the DAM and using the tank to shed chillers during the daily energy cost peaks. The storage tank is then recharged at night when energy costs decrease. During FY23, \$1.2M in energy costs were avoided using the storage tank, and a significant load is able to be shed during the peak summer periods.

### *Retro-commissioning and Fault Diagnostic Detection (FDD)*

Rolled out in the spring of FY23, the successful implementation of a retro-commissioning program for the site's ALC system has yielded measurable results towards energy efficiency. During the spring, all cooling economizer controls, chilled water differential pressure controls, and air handling unit cooling controls on the ALC system were retro-commissioned. The efficient operations of building specific cooling equipment results in a drop in chilled water flow, at peak load conditions, from 16,000 gpm to below 15,000 gpm in FY23, an over 6% improvement in peak site performance. Shoulder season performance was even better with shoulder season chilled water flow to the site dropping from an average condition of 8,000 gpm in FY22 to an average condition of 7,000 gpm in FY23; a roughly 12% efficiency improvement.

The site will continue to add to the success of the retro-commissioning program by retro-commissioning the heating equipment controlled by ALC in advance of the FY24 heating season.

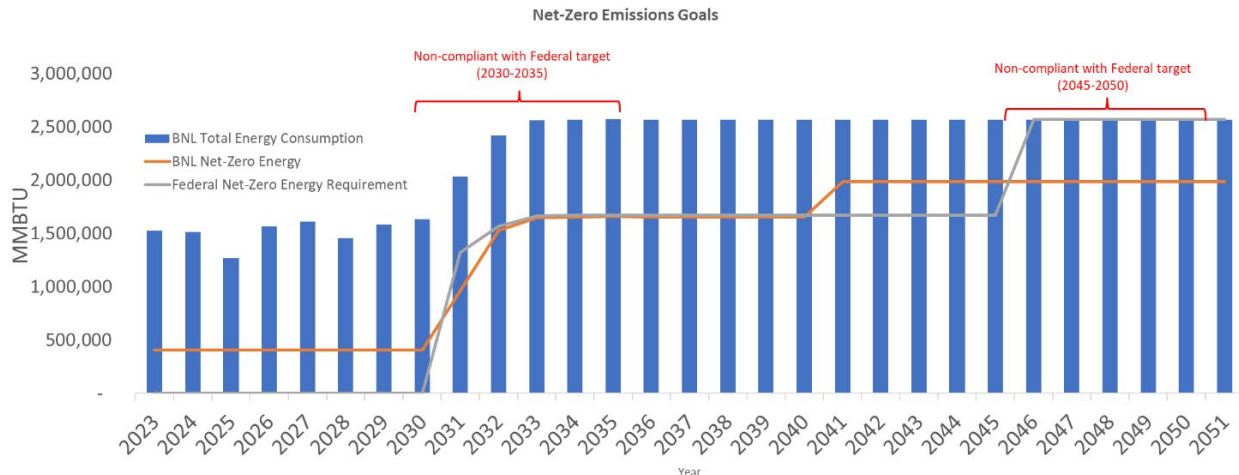
A FDD system is being rolled out in facilities controlled by the ALC EMCS. The FDD algorithms are used to detect heating, ventilation, and air-conditioning (HVAC) system inefficiencies before they become large issues, improving operational efficiency of building HVAC equipment throughout BNL with plans for expansion. When issues are detected, they are logged in reports which get sent out to facility project manager, the production division, and BNL's controls service contractor for corrective action. The system is comparable to retro-commissioning but uses artificial intelligence as a means of identifying root-cause issues.

### Net Zero Emission Buildings (NZEB)

There are currently no Net Zero Emission Buildings at BNL.

### *Current Projections Given Available Funding for NZEB*

The current projection for net-zero emissions is that BNL will not achieve the net-zero goal, as shown in the following chart.



**Figure 1: Net-Zero Emission Goals**

The largest barrier to net-zero is the site’s dependence on the CSF for heating. This facility utilizes fossil fuel boilers to produce high pressure steam to satisfy most campus heating, hot water, humidification, and process heating loads. Steam is distributed through a distribution network that is decades beyond the expected life. As the system deteriorates further, site maintenance staff are unable to maintain the leaks as most of the leak maintenance repairs have been classified as Davis Bacon covered work. The emissions of this plant, the deteriorating distribution system, and the availability of insufficient construction funding to make repairs are the largest of many barriers to achieving net-zero emissions on site.

### Electrification Retrofit Projects

There are currently no electrification projects planned until FY30. There are currently no electrification retrofit projects planned that involve converting building systems that directly use fossil fuels to systems that use electricity. Development of these types of projects will not advance without additional funding support or the initiation of a new UESC project.

### Deep Energy Retrofits

There are currently no Deep Energy Retrofit projects planned until FY30. Development of these types of projects will not advance without additional funding support or the initiation of a new UESC project.

## **Plans and Projected Performance**

### High-Energy Mission-Specific Facilities (HEMSF)

One highlight will be the EIC, with all new buildings being designed to be all-electric. The HEMSF will increase the site’s electric load by roughly 60 MW. As the New York grid transitions to CFE, this load will become the Lab’s first net-zero HEMSF. On the current path, the costs tied to the increase in electricity consumption will not be insignificant, higher costs will likely impede the ability for other areas of the Lab to decarbonize.



## Initiatives, Projects, and Actions to Improve Efficiency

To improve efficiency to achieve goals such as a 50% reduction in site EUI, significant investment in existing infrastructure must be made either through grant funding, Utility Energy Service Contracts, and SLI projects. The current programs are very effective but will not go far enough to making these goals achievable.

Currently there are no UESCs or other initiatives, projects, and actions in the works to make such goals possible.

## Net Zero Emission Buildings

### *Electron Ion Collider (EIC)*

All facilities tied to the new EIC will be designed to run solely on electricity. Currently, no other buildings are being designed as all-electric facilities.

**Table 1:** Planned Net-Zero Emission Buildings

Anticipated Building Name or Descriptor	Estimated Building Gross Square Footage	Actual/Anticipated Construction Completion Year
1012C Kicker PS	11,061	2027
1012D 400 MeV Linac	9,812	2027
1002H Injection Linac	17,948	2029
1004G Cooling/Kicker	4,421	2027
1006G Cryo	4,738	2027
1010C RF PA	40,844	2028
1010D DI Pumphouse	5,037	2027
1010E Cryo	5,325	2027
1001A PS	4,284	2027
1003A PS	4,284	2027
1005T PS	6,405	2027
1007A PS	9,034	2027
1009A PS	4,284	2027
1011A PS	4,284	2027

### *Discovery Park – Science User Support Center (SUSC)*

In FY23 BNL submitted a proposal to the FEMP for funding under the AFFECT grant to install a parking lot PV array that is large enough to offset all Scope 1 emissions from the facility. If funded, the nearly \$10M project will result in SUSC being the first net-zero emissions facility at BNL.

### *On-site Renewable Energy Development*

In FY23 BNL submitted a proposal to the FEMP AFFECT grant to perform an investment grade audit on all campus open space, including parking lots, roadways, and open fields, to assess the feasibility of installing

PV arrays. If funded, the results of the study will provide BNL with a roadmap for the development of on-site solar energy generation on several hundred acres of federal land. It is the goal that development of these systems will provide significant offsets to on-site scope 1 emissions and support affordable power generation ensuring the loads of EIC and other HEMSf can be met sustainably.

In addition to the above, BNL has put forth a SLI proposal to develop a 30MW array on site with the same goal.

#### *Other Plans*

To achieve NZEB or a net-zero emissions site, additional investment in the site imperative. Such plans do not currently exist, but may include a UESC to investigate and fund projects such as:

1. Campus wide heat pump implementation to replace through to wall units and electrify heating, benefits would include:
  - a. R-22 reduction (maintenance and refrigerant)
  - b. Scope 1 emissions reduction
  - c. Efficiency gains on both heating and cooling
2. Electrification of Boiler CSF 1A, benefits would include:
  - a. Reduce Scope 1 emissions, nearly eliminating them for parts of the year
  - b. Significant cost savings (\$/Btu)
  - c. Inch closer to net-zero campus come the 2045 target year
3. Upgrade remaining Barbara Coleman (BC) Controls, benefits would include:
  - a. Reduced maintenance cost
  - b. Improved resiliency, and energy efficiency
4. Modernize Northeast Solar Energy Research Center, potential benefits would include:
  - a. Double the full load output of the existing PV system
  - b. Improved monitoring
5. Second stratified chilled water storage tank for load shedding, benefits include:
  - a. Similar savings to the first tank ~1M/yr
  - b. Improved central chilled water facility plant resiliency
  - c. Reduced Scope 2 emissions (less demand for peaker plants)
6. Deep energy retrofits
  - a. Building 911 Stands out (chillers, windows, BC controls)
  - b. Building 703 (envelope BC)
  - c. Building 555 (Dedicated Outdoor Air System [DOAS] units, non-operational labs, reclassify areas, 16 labs that are storage)
  - d. Building 510
7. Demo of buildings like 526
  - a. Reduce site EUI by eliminating parasitic load of an unoccupied buildings

Currently, no UESC or other funding avenues have been advanced beyond the planning phase to address the potential impacts of the above listed projects.

## 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

#### Alternative Water

BNL does not currently utilize gray water, harvested rainwater, reclaimed water, or process discharge water to offset the use of fresh surface and groundwater sources. However, BNL does manage runoff and treat wastewater very effectively. With stormwater included, BNL is a net contributor to the local aquifer. The site water balance, which accounts for all pumped water (aquifer discharge) and outfall water flows (aquifer recharge), is shown in the following figure.

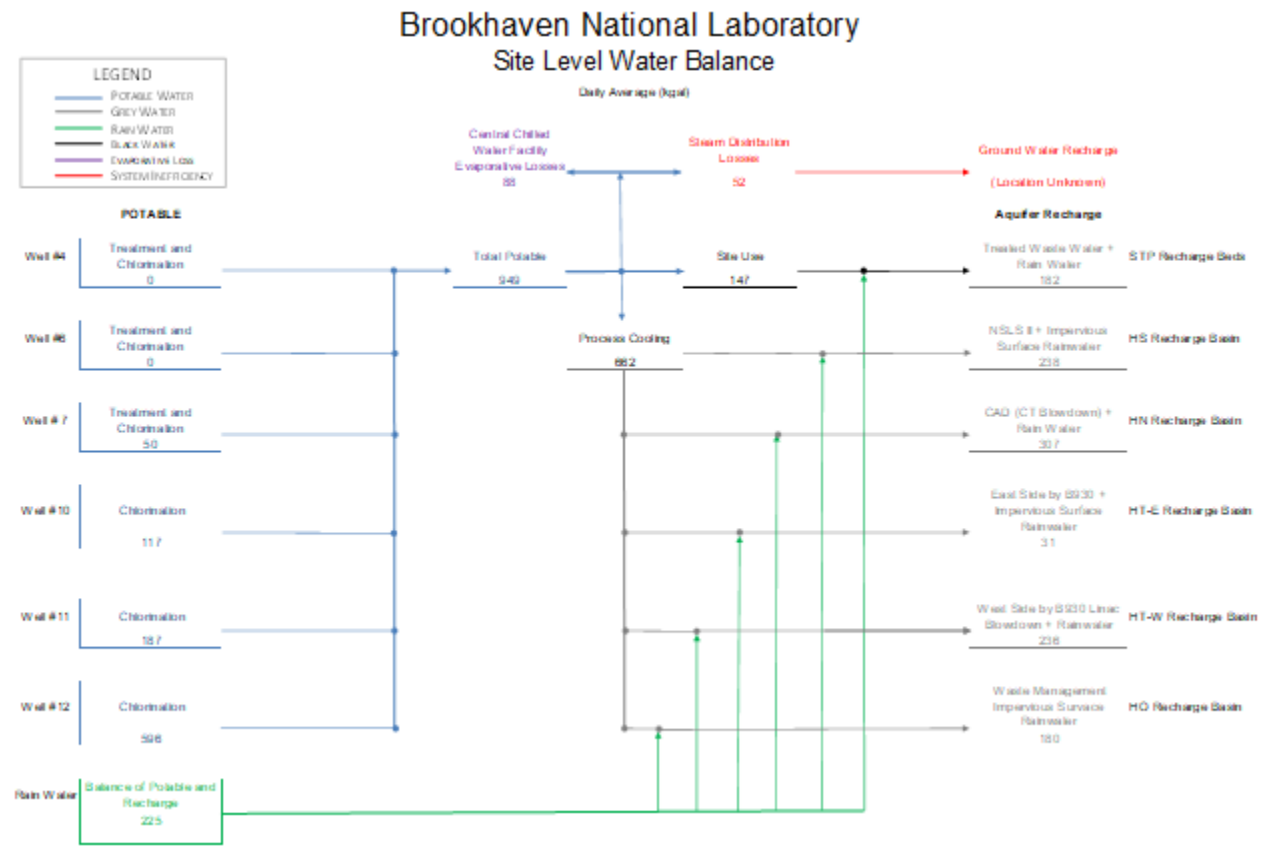


Figure 2: BNL Site Level Water Balance

Evaluations and Conservation Measures

As its own water utility, BNL’s potable water cost is much lower than the local utilities’ cost. The variable cost of water production is currently about \$3.79 per thousand gallons. Site water usage has improved continuously since the 1999 and 2007 benchmark years. The following table shows the facility usage data since the benchmark years.

**Table 2:** Annual Change Gal/GSF Water Use (FY99-FY23)

<b>FY</b>	<b>kGal</b>	<b>GSF</b>	<b>G/GSF</b>
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
FY23	346,402	4,790,451	72.31

Site water efficiency continues to improve owing to the adoption of the following FEMP best management practices (BMPs) for water efficiency.

*BMP #2 – Information and Education Programs*

BNL’s water-related public information (Consumer Confidence Report) and education programs have emphasized the excellent quality of BNL’s potable water supply and sought to minimize the employee’s

desire and use of expensive and untested environmentally unfriendly bottled water using Single Use Plastics.

#### *BMP #4 – Water Efficient Landscaping*

BNL's policy is to use only native species as part of its landscaping. The use of native species provides the site with water efficient landscaping that can survive in the local climate with no permanent irrigation necessary beyond a plant's establishment period.

#### *BMP # 5 – Water-Efficient Irrigation*

BNL's policy is to have no permanent irrigation systems on site.

#### *BMP #6 - 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 construction, renovations, and maintenance. However, in some cases, such as waterless urinals, the equipment did not operate properly, was unsanitary or was not able to be properly maintained. Therefore, the items were removed and replaced with conventional fixtures.

Major new buildings have either been Leadership in Energy & Environmental Design (LEED) Certified or are built as per the Guiding Principles "Silver" certified and have included water conserving fixtures. It should be noted that only about 10% of BNL's water use is for human consumption and sanitation.

#### *BMP #7 – Faucets and Showerheads*

BNL specifies low-flow faucets and showerheads for new construction, renovations, and maintenance. However, the older buildings do not typically have these high-efficiency items.

#### *BMP # 8 – Boiler/Steam Systems*

BNL has a district steam system and CSF. Certain losses are unavoidable (e.g., humidification, sterilization, food preparation, potential for oil contamination). The network of steam and condensate distribution piping in many areas is in excess of 40 years old, with an expected life of only 25 years according to industry experts. As a result, the network of steam distribution and condensate return is riddled with leaks. BNL is constantly working to identify leaks, and where funding allows, replace entire sections of piping to address these areas of both water and energy inefficiency.

In FY23, a CURP was funded to invest in major infrastructure repairs of the distribution system. The current state of the project is 50% design documentation.

**Table 3: Steam and Condensate Infrastructure Requiring Replacement**

Description	Piping Size
Partial line West of MH-55 from B488	2" C
Partial line South of MH-10 to MH-22	4" C
Entire line between MH-35 to B830	2" C
Entire line between MH-52 and MH-23/MH-23A	4" C
Entire line between MH-36 and B832	1-½" C
Entire line between MH-33 and MH-34	4" C
Entire line between B498 and B479	3" C
Future Leak to be Identified by BNL's E&U Dept.	4"
Replace steam and condensate pipe between MH17 and B801	3"
Replace steam and condensate piping between MH-1 and MH-6	10" steam, 4" condensate

BNL will continue to actively work to identify opportunities for improvement of this distribution network.

*BMP #9 – Single-pass Cooling Equipment*

BNL's policy is to not allow single-pass cooling equipment in any construction or renovation projects. The vast majority of single-pass cooling equipment have been decommissioned and replaced with air-cooled equipment or evaporative cooling equipment.

The Lab's EMS (ISO-14001 registered) has also assisted with the identification of systems that use once-through cooling as having an "environmentally significant aspect" requiring operational controls/substitution.

*BMP #10 – Cooling Tower Management*

BNL has 30+ cooling towers with flow rates over 300 gpm. There are many smaller towers located around the site. BNL controls the blowdown rates on the large towers such that the "cycles of concentration" is maintained between four and five. This is optimum to conserve water, minimize water treatment chemical usage, and minimize fouling potential on heat transfer surfaces. BNL cooling towers are specified to minimize drift, which is wind-driven water loss (Evaporation is proportional to heat load on the tower).

*BMP #11 – Commercial Kitchen Equipment*

Not applicable at the time of preparing this document.

*BMP #12 – Laboratory/Medical Equipment*

Equipment used in laboratories can use significant amounts of water, offering the opportunity for substantial water savings by making a few small changes to how and when the water is used by the equipment.

Water-consuming equipment in laboratories includes water purification systems, sterilization and disinfection systems photographic and x-ray equipment, vacuum systems, glassware washers, and vivarium equipment.

As a policy, BNL has established a user-friendly method to report leaks and fix them immediately, and encourages users, and cleaning or custodial crews to report problems.

#### *BMP #14 – Alternative Water Sources*

As a policy, BNL's stormwater systems are designed to eliminate stormwater run-off beyond the site boundary. The main geological outflow from the site is the Peconic River, which flows into the Peconic Bay, where once mixed water is no longer fresh water that can recharge the local aquifer. The site's stormwater infrastructure redirects stormwater and process water, such as cooling tower blowdown, from entering the river via a network of bioswales and underground piping to the site's outfalls.

### **Plans and Projected Performance**

#### Alternative Water

Currently no plans exist to add alternative water uses to the site. BNL projects to continue to capture stormwater in recharge basins and continue to be a net recharger of the local aquifer.

#### Evaluations and Conservation Measures

Site water efficiency will continue to improve into the future as BNL continues to implement FEMP BMP for water efficiency. Specific evaluations and plans are as follows.

#### *BMP #1 – Water Management Planning*

In FY24, BNL will undergo a comprehensive evaluation to understand the site's current water use and costs. This part of the evaluation includes collecting utility data and conducting facility surveys to gather critical information on water uses. This information will be compiled into a "water balance," which is a comparison of the water consumption of major end-uses to the total water supply. The water balance will provide important information on major water uses that can help to target efficiency opportunities and provide insight on potential system losses.

The outcome of the water balance will inform and assessment of efficiency solutions, an assessment of alternative water projects, and a life cycle cost analysis of the above.

#### *BMP #3 – Distribution System Audits, Leak Detection, and Repair*

BNL is actively working on expanding the potable water metering system and will be investing \$93,000 in metering infrastructure for potable water and condensate/steam systems in FY24.

#### *BMP # 8 – Boiler/Steam Systems*

BNL recognizes that the boiler/steam system is operating with approximately 37% make-up water demonstrating the system is inefficient at returning condensate back to the CSF.

The goal of the aforementioned CURP projects is to address some of the inefficiencies in the steam distribution system to reduce the make-up water requirements at the plant. While improvements are expected, the project will not go far enough to eliminate system leaks.

Maintaining a distribution system that is decades beyond its usable life is a challenge, and with the current work categorization of system maintenance, as construction, inhibits the ability of on-site staff to repair leaks when they arise. Unfortunately, limitations set forth by the work categorization will continue to challenge the team's ability to address issues as they inevitably arise in the aging steam distribution system.

#### *BMP #9 – Single-pass Cooling Equipment*

As part of the FY24 water audit, BNL will be working to identify any single pass cooling equipment that has not been previously identified and/or upgraded. Once identified, BNL will begin to queue work to replace these systems that contribute to inefficient water use on site.



## Fleet Management

*This category focuses on the site's approach and vision for addressing transitioning to one hundred percent acquisition of light duty vehicles to Zero Energy Vehicles by 2027, fleet optimization, and strategies used to reduce petroleum use and increase alternative fuel use.*

### Current Performance

With Executive Order 14057, ten more Level 2 charging stations were purchased in FY23 with plans to install ten more stations in FY24. Charging station membership increased from seven (7) users to seventy-six (76) since the September 2021 activation of the Level 2 charging stations. The additional participation demonstrated a decrease of onsite greenhouse gas (GHG) emissions from 345 kg to ~30,000 kg. In FY23, the government fleet had 3,787kg GHG emission savings. BNL will continue to monitor the specific vehicles which have the capability to be replaced with full electric models to meet the Executive Order requirements.

The BNL Fleet Supervisor created an in-person training for EVs. The training covers everything from proper safety procedures to the operations of an EV. This is in addition to the virtual training for all government vehicle drivers. The Fleet Supervisor has been collaborating with other labs to learn their best practices in EV training and lessons learned for BNL's future acquisitions.

BNL is continuing to use 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. Geotab also offers an analysis on what vehicles in the fleet can be converted to electric vehicles. This data can be used to assist in making the best selection for each vehicle based on its driving history. Other initiatives that BNL implemented to increase sustainability are Spot Checks, onsite car washing, and preventative maintenance compliance. The spot checks done at BNL check government vehicles to ensure there is no idling while unoccupied, tire wear, damage, WEX card, and accident report storage.

The Vehicle Allocation Methodology (VAM) survey will be done on a yearly basis versus every five years with 20% of the fleet to right size the fleet. The information provides further clarity on the individual vehicles and usage. This information will help in identifying drivers' needs and right-size the fleet to increase usage and performance.

BNL is currently using a new Fleet Management System, Fleetio. The past system was not curated for fleet management which has presented several obstacles in reporting. This system integrates with the current Geotab GPS system in addition to other fuel systems. The Fleetio reports have the potential to assist with Federal Automotive Statistical Tool (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 to create sustainability goals from data collected by the system.

## **Plans and Projected Performance**

Thirty-six vehicles are projected for the GSA FY24 replacement cycle. DOE requires each new acquisition to be EV only and justifications will be required for any non-EV acquisition. Options will be limited in FY24 due to supply chain issues, availability, and the CY23 UAW strike activities. The Fleet Supervisor will work with GSA on recommendations for EV replacement options.

The Lab's onsite shuttle service will continue business with an online reservation system for LIRR transfers to decrease unnecessary trips to the train station. The Fleet Supervisor implemented a pilot route system during the FY23 summer season to decrease duplicate requests. This strategy enables the transport of more people at designated times while reducing the number 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.

BNL currently has eight PHEVs, two Hybrid vehicles, and eight Electric vehicles. Based on the FY24 replacement recommendations provided by GSA, the Fleet Supervisor will consider which vehicles are capable for transition to ZEV to meet the current Executive Order requirements.

The BNL Fleet Supervisor created an in-person training for Electric Vehicles. The training covers everything from proper safety procedures to operations of a vehicle. This will be in addition to the virtual training for all government vehicle drivers. The Fleet Supervisor has been collaborating with other labs to learn their best practices in EV training and lessons learned for BNL's future acquisitions.

BNL currently has six Level 1 charging stations, four Level 2 charging stations, and ten additional Level 2 stations have been installed in FY23 for activation in FY24. Ten more charging stations were requested for purchase in the Consolidated Unfunded Requirements List (CURL) to support more electric vehicles. Campus installation sites will be based on the electrical grid, infrastructure, and EV distribution. 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 76 onsite employees registered for this incentive and utilization is expected to grow. A challenge in supporting the EV program is the capability of the electrical grid supporting station installations in locations they are most needed. Supply chain issues are also of concern to attain future EV acquisitions.

## Clean & Renewable Energy

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

### Current Performance

#### Carbon-Free Electricity (CFE) Procurements

There is currently no internal plan to increase CFE through grid CFE purchases. BNL's existing electric procurements are under contract with NYPA through 2030, any increase in CFE through grid supplied purchases will be tied to the grid shifting toward CFE, a process external to BNL. Currently, the grid goal is to hit 70% CFE by 2030, as defined by the NYS CLCPA. Due to favorable electric rates resulting from the grandfathering of benefits originally negotiated in the 1980s, BNL is not in a place to renegotiate its electric procurement contract.

BNL can track and measure on-site CFE. Any on-site CFE that is installed will be sub-metered for consumption and be part of our integrated MV-90 xi data collection engine. All data will be tracked in BNL's account database and accounted as a net producer of energy.

There are currently no funding allocations approved for on-site CFE generation and BNL is not projected to meet CFE goals. The following table illustrates the projected CFE under the current funding scenario.

**Table 4: Projected CFE With Current Funding**

Metric		FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30
<b>1</b>	<b>Total annual CFE (MWh) (a+b+c+d)</b>	25,501	27,290	29,090	23,020	25,530	28,580	37,050	366,450
<i>a</i>	<i>Grid-supplied CFE</i>	25,501	27,290	29,090	23,020	25,530	28,580	37,050	366,450
<i>b</i>	<i>Onsite CFE</i>	0	0	0	0	0	0	0	0
<i>c</i>	<i>Purchased CFE</i>	0	0	0	0	0	0	0	0
<i>d</i>	<i>Legacy CFE from EPAAct 7.5% cap</i>	0	0	0	0	0	0	0	0
<b>2</b>	<b>Total annual electricity usage (MWh)</b>	255,015	272,900	290,900	230,200	255,300	285,800	370,500	523,500

Achieving 100% CFE by 2030 is possible, if funding is made available for on-site CFE generation the above scenario will change.

### Plans and Projected Performance

BNL has plans to increase CFE via on-site generation, however there is currently no funding available to do so. Unfunded plans, necessary to meet CFE goals, are shown in the following table. Because these are

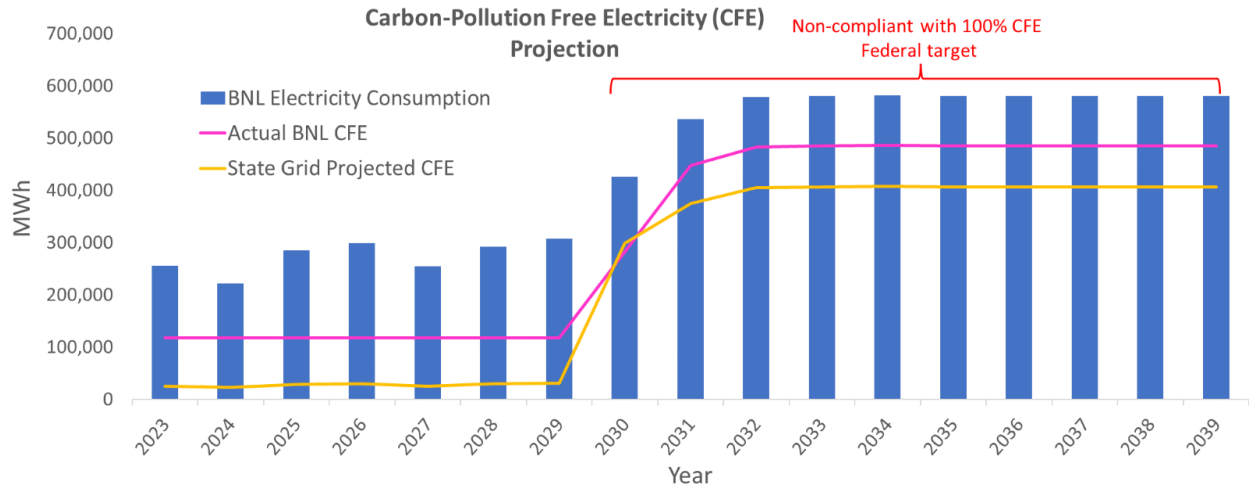
not currently funded items, BNL is not reporting the contributions of such projects to the achievement of CFE goals.

Until funding is allocated to such projects, BNL will report that the 100% CFE goal will not be achieved. The below table represents a scenario that could be possible if funding is injected, or a UESC project to inject funding into on-site CFE is initiated in FY24.

**Table 5: Predicted Scenario with Funding**

Program Office	Site/Lab/Plant	Brief Description of Onsite CFE Generation and Storage Projects/Actions	Anticipated Start (FY)	Anticipated Completion (FY)	Notes (Key Milestones)
Office of Science	Brookhaven National Lab	Assumption: SLI project is approved to add 30 MW on site generation  <i>Risk of Nonattainment: High – SLI not yet funded</i>	2025	2026	56% CFE
Office of Science	Brookhaven National Lab	Assumption: 20 MW on-site solar generation in parking lots identified by the IGA proposed in the open AFFECT application  <i>Risk of Nonattainment: High – AFFECT IGA not yet approved</i>	2027	2028	63% CFE
Office of Science	Brookhaven National Lab	Assumption: Develop on-site solar farm with 60 MW capacity  <i>Risk of Nonattainment: High – Not yet funded</i>	2031	2032	100% CFE

The following figure illustrates BNL’s current trajectory for CFE by 2030. This figure assumes the projects in the table above, noted with a high risk of nonattainment, are not funded, and that the existing NYPA contract is not modified to increase CFE procurement.



**Figure 3: BNL Carbon-Pollution Free Electricity (CFE) Projection**

## Acquisition & Procurement

*This category focuses on all relevant sustainable acquisition clauses, recent sustainable purchases.*

### **Current Performance**

BNL includes all sustainable acquisition requirements from DOE's Priority Products List and the Federal Acquisition Regulation into all contract terms and conditions. BNL provides training on these requirements to procurement staff.

BNL was recognized for its performance in sustainable purchasing by the receipt of its eighth Green Buy Gold award for 15 priority products in 6 categories. BNL also received its third Green Buy Superior Award recognizing BNL for receiving five Green Buy Gold awards in a row. BNL also received the EPEAT Award for electronics purchases, given by the Green Electronics Council.

### **Plans and Projected Performance**

BNL will make the SFTool product search feature available to all employees for use in identifying Environmentally Preferable Purchasing (EPP) conforming products and communicate its availability and provide support for use of the tool.

Major projects, such as the planned demolition of building 197 and ongoing construction of the SUSC will incorporate the current sustainability clauses into the construction contracts.

The largest obstacle in this area is our in-house purchasing software that provides little information for requisitioners looking for conforming products. The purchasing system also doesn't identify EPP purchases and can only produce limited performance data. Some of the data reported still requires manual compilation of data. Therefore, our performance is likely much better than reported. Lack of performance data also makes it difficult to identify trends and areas for improvement. A new purchasing system is expected at some point in the future that may provide an opportunity for improvement.

## Investments: Improvement Measures, Workforce, & Community

*This category focuses on efforts to implement identified Efficiency & Conservation Measures (ECMs) through appropriations, performance contracts, or other funding mechanisms. Additionally, this category discusses investment efforts to enhance workforce capabilities and support environmental and energy justice efforts in the site's community.*

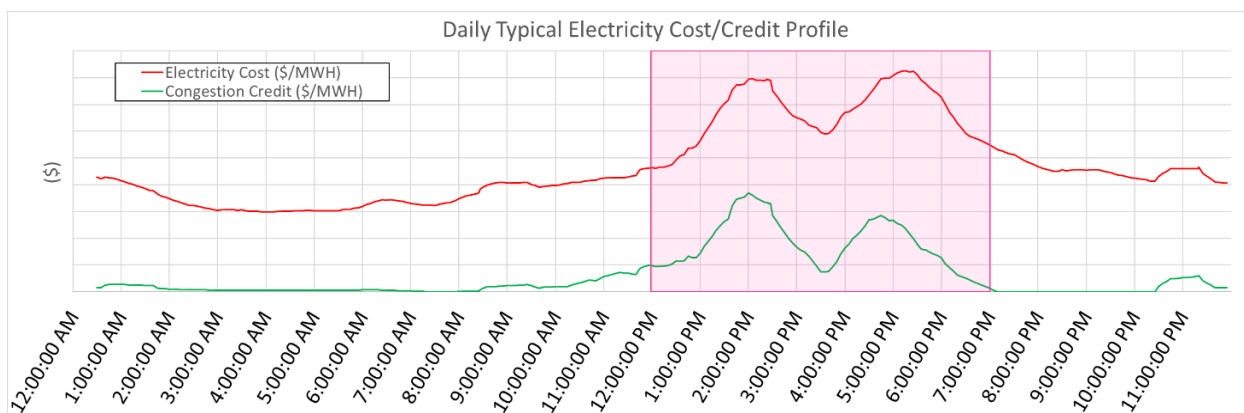
### Current Performance

#### Improvement Measures

There are currently no active or planned UESCs that would support investment in implementing energy conservation measures.

In FY23 the site identified low-cost/no-cost energy efficiency measures that were implemented to reduce emissions and energy costs. The first measure was an operational change at the CCWF involving the use of BNL's 3.2M gallon chilled water storage tank.

To inspire change, BNL's electricity procurement methods were explained to operators using the following figure.



**Figure 4: Daily Typical Electricity Cost/Credit Profile**

The chart above shows how energy costs/credits change hourly throughout any given day.

This is important for the following reasons:

- Energy at BNL is purchased hourly at market costs (red line), when we use more energy during the expensive hours that cost gets spread out to the entire lab community and the cost of doing science at BNL increases.
- BNL has an additional benefit, when we don't use energy we receive a credit back on our bill for that unused energy, these are called congestion credits (green line).
- Actual dollar values depend on market conditions but, generally, between 12:00pm and 7:00pm energy is the most expensive and the congestion credits have the highest value to BNL.

What this means for the CCWF:

- During the daily peak, using the chilled water storage and minimizing the use of the chillers will save the Lab community hundreds of thousands of dollars.
- Long Island has a high energy cost, when we do our part to minimize that cost, we stay competitive with other Labs, and keep ourselves in business.

The site operators were then trained on how to load hourly electric costs on the New York Independent System Operator (NYISO) website. Operators use this information each day to charge the storage tank when site electric costs are low (typically at night) and discharge the storage tank when site electric costs are high (variable times throughout the year). The act of this intentional use of thermal energy storage saved the site a verified \$1.4M in electric costs from December through September in FY23.

The other low-cost/no-cost measure that was implemented on site was a demand response program, to curtail electric load during the peak summer hours, again using the NYISO hourly electric prices. The three-tier curtailment approach, which is better explained in the Energy Management section of this report, yielded a verified savings of 250,000 kWh and \$20k over 22 hours of curtailment. One additional benefit of demand response is the reduction in BNL dependence and impact on the load of NYISO zone K (Long Island) peaker plants. The peaker plants are diesel generator power plants creating Scope 1 emissions in environmentally disadvantaged communities.

### Workforce and Community

BNL is currently home to many scientists, engineers, researchers, and administrators highly educated in the many areas of climate literacy. In FY23, there was no targeted programming to promote climate literacy within the BNL workforce.

BNL is committed to increasing environmental justice efforts and creating avenues for participation for disadvantaged and marginalized communities in environmental decision making. Brookhaven uses community involvement, science education, and workforce development programming to address Justice 40 Initiatives. To facilitate stakeholder input, Stakeholder and Community Relations' (SCR's) Stakeholder Relations Office, in coordination with the Environmental Protection Division (EPD), participates in or conducts on- and off-site meetings which include discussions, presentations, roundtables, and workshops. Stakeholder Relations and EPD staff attend local civic association meetings, conduct Laboratory tours, and coordinate informal information sessions and formal public meetings, which are held during public comment periods for environmental projects. The Lab also opens its doors to the public for free every year through its Summer Sundays open house program. The program is a unique opportunity for the public to come meet scientists, participate in hands-on science activities, visit world-class research facilities, enjoy science shows, and more.

In 2022, the Lab launched a new program, Science in the Community, to bring its programs into the field and make them more accessible, especially to disadvantaged communities. All the Lab's Science in the Community programming is free and features hands-on activities for students. One such program, which has been offered annually for the last two years and is expected to continue, is our partnership with the Jones Beach Energy and Nature Center. The Lab offers programming on Earth Day and features a special emphasis on the importance of renewable energy, climate solutions and preserving the environment.

BNL also has a robust workforce development program which includes many programs specifically designed to give opportunities to students from traditionally underrepresented and underserved



communities. These programs include the following: Science, Technology, Engineering and Math (STEM)-Prep Summer Institute, Alliances for Graduate Education and the Professoriate Predominantly Undergraduate Institutions (AGEP-PUI), Community College Internship (CCI), Student Partnership for Advanced Research and Knowledge (SPARK), Day in the Life of a River, and even a Science at Home program with activities and lessons that students and their parents can do almost anywhere.

## **Plans and Projected Performance**

### Improvement Measures

There are currently no plans to pursue UESCs to support investment in implementing energy conservation measures.

In compliance with DOE O 436.1a, \$1.4M of the verified energy savings has been set aside in FY24 to reinvest these verified savings back into the site operations and maintenance. Reinvestment projects will include the following:

- Cooling tower renovations at the CCWF and the Satellite Chilled Water Facility.
  - Cooling towers are the driving force behind chilled water plant efficiency as these towers drive the heat rejection process required to produce cooling at the chillers. The average life of most critical cooling tower components is 15 years. The savings will be used to replace critical equipment such as spray nozzles, metering orifice, supports, and the fill kits which are the most critical component providing the surface area to reject heat.
  - The control valve actuators at the satellite chilled water facility are beyond their usable life and are no longer sufficiently functioning. Funds will be re-invested to replace these actuators, and the condenser water system will be reprogrammed to allow the facility heat exchanger to provide “free” cooling to the site when atmospheric conditions allow the system to sustain 43°F outlet temperatures saving energy for cooling process loads in the winter months.

If the above projects do not utilize the full funding amount additional projects to save energy will be executed as follows:

- Insulation of steam piping in manholes to improve distribution efficiency and reduce Scope 1 emissions at the CSF.
- Replacement of steam pressure relief valve (PRV) stations to control steam pressure more efficiently in buildings, improving steam distribution efficiency and reducing Scope 1 emissions at the CSF.
- Improve condensate metering infrastructure to better track facility steam use and identify areas to study to improve building level steam efficiency.

### Workforce and Community

BNL is in the process of developing a more formal policy to address energy justice, environmental justice, and Justice40. A committee is being developed to support the integration of these initiatives as part of the scientific mission and general operations of BNL. The policy will address investment and outreach in local neighboring communities, federally identified tribal communities, as well as other disadvantaged communities.

BNL is currently home to many scientists, engineers, researchers, and administrators highly educated in the many areas of climate literacy. To improve educational outreach to staff whose expertise is less aligned with climate literacy, our goal is to build a climate campaign to raise climate literacy and awareness of the current state of climate science. The goal will be reached via the following action items:

- Capitalize on Worldwide Climate Week from April 1 – April 7, 2024 to raise climate literacy and awareness via educational events on campus.
- Capitalize on Earth Day 2024 activities to educate staff on the impact climate change may have on the planet and the many small ways we can mitigate the impacts of climate change.
- Utilize existing campus communications and newsletters to raise climate literacy and awareness.
- Training team will review existing training modules to see if there is an opportunity to add some information with regards to climate change.

## 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 GHGs for different purposes. The largest user of GHGs at BNL is the Tandem Van de Graaff Facility. The two Tandem accelerator vessels with a combined storage volume of 16,050 ft<sup>3</sup> are filled with an insulating gas mixture consisting of 46%v SF<sub>6</sub>, 44%v N<sub>2</sub>, 6%v CO<sub>2</sub>, and 4%v O<sub>2</sub>. Annually, there are some emissions of SF<sub>6</sub> and CO<sub>2</sub> 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 GHG emissions in FY23.

**Table 6:** Fugitive Greenhouse Gas (GHG) Emissions

Source	Activity	Gas	GHG Emissions (MtCO <sub>2</sub> e)
Tandem Van de Graff	Insulating gas leaks	SF <sub>6</sub>	3,102.57
	Accelerator gas transfers	SF <sub>6</sub>	72.60
		CO <sub>2</sub>	0.01
STAR Experiment	Detector gas purging	CH <sub>4</sub>	0.00
		CO <sub>2</sub>	0.03
		HFC-134a	890.84
		SF <sub>6</sub>	292.68
sPHENIX Experiment	Detector gas purging	CF <sub>4</sub>	10,890.79
Fleet Vehicle Repair	Fleet Motor Vehicle A/C Leaks	HFC-134a	5.55
		HFO1245yf	0.00
Refrigeration/AC Equipment	Gas Leaks	R-410A	0.00
LEReC Accelerator DC Gun	SF <sub>6</sub> service cart compressor leak	SF <sub>6</sub>	0.00
Current Landfill	Methane generation	CH <sub>4</sub>	28.75
Wastewater Treatment Plant	Effluent discharges	N <sub>2</sub> O	0.73

The majority of fugitive GHG emissions were from detector purging of carrier gases during the Solenoidal Tracker at Relativistic Heavy Ion Collider (RHIC) (STAR) experiment and the sPHENIX experimental runs. As in the past, to reduce carrier gas emissions of HFC-134a during the operational interval from April 24 to May 11 when the gas flow rates were highest, the STAR experimental time of flight (TOF) detector system was operated in recirculation mode wherein 86.5 percent of carrier gases were continuously recirculated. Had the TOF been operating in purge mode during this period where all system gases would have been continuously purged to the atmosphere, HFC-134a emissions would have been 180.7 pounds higher (i.e., 117.2 MtCO<sub>2</sub>e).

Although it was designed to recirculate 95 percent of the 60%v argon and 40%v carbon tetrafluoride (CF<sub>4</sub>) gas mixture used in the sPHENIX time projection chamber (TPC) detector subsystem, detector gas contamination problems encountered during the TPC commissioning phase forced sPHENIX staff to alter gas flow rates and continuously purge gas during the entire experimental run. Staff expect to be able to run in recirculation mode for the FY24 experimental run.

To ensure that comfort cooling and process refrigeration equipment are operating efficiently prior to the start of the cooling season, preventative maintenance inspections of all refrigeration equipment and air conditioning appliances with refrigerant charges of 50 or more pounds are performed. To document preventative maintenance inspections of refrigeration and air conditioning equipment and repairs to address refrigerant leaks or operational deficiencies, the F&O Facility Operations Center Preventative Maintenance (PM) group utilizes the Refrigerant Compliance Manager software.

During the first week of June, BNL's Clean Air Act Subject Matter Expert (SME) met with HVAC staff during a plan of the day meeting to reeducate them on the importance of properly documenting repairs to leaking refrigeration and air conditioning equipment on the Refrigerant Usage Forms in conformance with F&O's Refrigerant Management Plan.

### **Plans and Projected Performance**

The F&O plans to have Sphera staff, the developer of Refrigerant Compliance Manager software, provide HVAC staff training on recent updates to federal regulatory requirements covering the handling, service, and repair of refrigeration and air conditioning equipment that utilize class I and class II ozone depleting refrigerants and high global warming potential Environmental Protection Agency (EPA) Significant New Alternative Policy (SNAP) program approved hydrofluorocarbons.

EPD Environmental Compliance Group staff will continue to follow EPA's proposed rulemaking that appeared in the October 19 Federal Register to draft regulations requiring facilities to conduct leak detection, equipment repair, and material reclamation on air conditioning, refrigeration, and fire suppression equipment containing hydrofluorocarbons (HFCs). If approved, EPD will work with F&O to incorporate the revisions into its Refrigerant Management Plan and to help HVAC staff to understand the revisions.

## 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

The table below was included in BNL’s Vulnerability Assessment and Resilience Plan (VARP) and summarizes the high priority rank resilience solutions whose implementation status was tracked within the DOE Sustainability Dashboard in FY23. These projects were all determined to be feasible, and funding mechanisms were available for implementation.

**Table 7:** Brookhaven National Laboratory Resilience Portfolio Summary Table

Solution	Priority Rank (High, Medium, Low)	Timing	Funding Mechanism	Implementation Status
Critical Response Facilities – Emergency Power	High	Planned start in FY23	Overhead	Identified
Replacement of Chillers at the Central Chilled Water Plant	High	Planned start in FY23 (Design)	Direct - SLI	Funded
New 13.8kV feeder	High	Planned start in FY23 (Design)	Direct - SLI	Funded
Additional Utility Metering	High	Ongoing Program	Overhead (M&R)	Planned
Wildfire Management Program	High	Ongoing Program	Overhead (M&R, IGPP)	Planned

All five projects were successfully implemented in FY23 and below is summary of the status of each project.

#### Critical Response Facilities – Emergency Power

There was a temporary loss of power at BNL that impacted several critical assets and infrastructure. A team was put together to review this event and the After-Action Report/Recovery Plan identified some opportunities for improvement that would qualify as resilience solution options against climate change. In FY23, a team evaluated the existing emergency generators or feasibility of installing temporary or permanent generators at Critical Response Facilities at BNL. This evaluation resulted in some proposed projects being submitted through BNL’s Project, Planning, Programming and Budgeting Process (3PPB) for

funding consideration by the Lab's Policy Council. At the end of FY23, the final CURL was approved and included the installation of an emergency generator at the Lab's main gate security station in FY24, which will add resiliency to an important facility in the event of a loss of power to ensure security and allow for proper site response.

*Anticipated Effectiveness* – In the long run the continued evaluation and installation of emergency power will add resiliency to facilities in the event of a loss of power to allow proper site response and continued mission critical operations.

*Cost* – Will depend on 3BPB approved projects. There was little cost in FY23 and \$480K estimated for FY24.

#### Replacement of Chillers at the Central Chilled Water Plant

Most mission critical facilities use central chilled water as the source for comfort cooling and to support the growing demand of process loads and enable periodic maintenance and resiliency, added back-up chiller capacity was identified as a priority. This project was awarded in FY23 under the CURP and includes the replacement of two aged chillers. By the end of FY23 the project was approaching 50% design review for drawings and field work was initiated to locate depth of utilities and other preplanning activities.

*Anticipated Effectiveness* – Considering that the Lab's existing chillers are beyond their useful life, replacement is an effective solution that will reduce the likelihood of failure potentially impacting site operations, especially when running chillers extensively during heat waves resulting from climate change.

*Cost* – Total project cost is estimated at \$8.1M.

#### Installation of New 13.8kV Feeder

This project was also awarded in FY23 under the CURP and will provide a new 15 kV feeder, consisting of two (2) sets of paralleled cable, from Substation 603 (B603) to the Central Chilled Water Facility (B600). Similar to the chiller replacement project above, the design and engineering process began in FY23 and approaching 50% design review for drawings and field work was initiated to locate depth of utilities and other preplanning activities.

*Anticipated Effectiveness* – Completion of this project will add redundancy and resiliency at the CCWF and the National Synchrotron Light Source-II (NSLS-II), one of the newest, most advanced synchrotron facilities in the world.

*Cost* – Total project cost is estimated at \$11.6M.

#### Additional Utility Metering

This project includes the design and installation of additional metering on the electric, chilled water, potable water, and steam system at BNL.

In FY23 fourteen new buildings, equipment, and cubicle-level electric meters were installed. These meters covered cubicle level metering in two key substations, six additional groundwater treatment wells, and four facilities.

- 638.21 – Switchgear cubicle meter

- 945.00, 945.01 – NSLS II Vacuum Systems B945
- 616.07, 616.08 – Substation cubicle meter
- 974.01 – Radioactive material Storage B974
- 750.02 – Building 751
- 900.03, 900.04, 900.05, 900.06, 900.07, 900.08 - Site PFAS groundwater treatment wells
- 515.12 – Computational Science Initiative

In addition to the meters that were installed, cubicle level meters for 603 and 631 have been purchased, once installed all substation cubicles will be metered.

A calibration of all site level chilled water meters occurred in the spring of FY23. Although site chilled water is 100% metered, the calibration identified six meters that require replacement. The replacement meters were purchased and are pending installation.

*Anticipated Effectiveness* – The installation of additional meters allows for more effective management of key utilities and will add redundancy and resiliency to the overall BNL utility distribution system.

*Cost* – Approximately \$100K was spent in FY23 purchasing and installing new and maintaining existing meters at BNL.

#### Wildfire Management Program

This project includes continued fuels management and prescribed fire management to support site ecology, land preservation, and reduce risks to sitewide critical assets. In FY23, two prescribed fires were successfully planned and conducted for a total of 37 acres and an additional 23 acres were masticated in preparation for prescribed fire. Furthermore, in collaboration with the Central Pine Barrens Commission and the New York State Department of Environmental Conservation (NYSDEC), a landscape level prescribed burn plan that includes 530 acres of the Lab site is in the process of being finalized.

*Anticipated Effectiveness* – This program is continuously developing and if fully implemented, could ensure a high level of ecosystem resilience and protection of critical assets.

*Cost* – Cost for mechanical treatments is approximately \$100K/year. Cost for staff and equipment to implement prescribed fires is shared between BNL, NYSDEC, and Central Pines Barron Commission.

If FY23, BNL's OEM continued to integrate climate resilience into its day-to-day risk management processes. Some examples include:

- The OEM attends training 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 to 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 2023 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 the Threat and Hazard Identification and Risk Assessment (THIRA), which takes climate change and severe weather into account. This document is reviewed annually and updated as needed. It also maintains and updates the All-Hazards Survey annually, which addresses the potential for severe weather and weather-related hazards onsite.

The programs, processes, and resilience solutions described above have improved resiliency against climate change hazards and will continue to be implemented going forward.

## **Plans and Projected Performance**

The plan for FY24 is to continue making progress on executing the resilience solutions being tracked in the Dashboard module and evaluate if there are other projects that can be implemented to improve resiliency against identified climate change hazards. Available funding to implement additional solutions remains the biggest challenge faced by BNL.

Below is a summary of FY24 plans for the identified resilience solutions:

- Critical Response Facilities (Emergency Power) – Complete the design and installation of the emergency backup generator at the Lab’s main gate security station in FY24 (estimated at \$480K). Also, continue to evaluate other emergency power needs to increase resiliency and prepare necessary Project Data Sheets, which are then included in the CURL for funding consideration by the Lab’s Policy Council.
- Replacement of Chillers at the CCWF – Continue with design efforts and initiation of construction activities. The design review process is expected to be completed by the end of the second quarter of FY24.
- New 13.8kV Feeder – Continue with design efforts and initiation of construction activities. The design review process is expected to be completed by the end of the second quarter of FY24.
- Additional Utility Metering – In FY24 \$93K in funding has been allocated to bolster the site’s metering infrastructure. The funding will be used to meter condensate at critical buildings to track steam usage more efficiently, and potable water in buildings to comply with Federal metering guidance objectives.
- Fire Management Program – An additional 23 acres of forest will be mechanically treated in FY24 in preparation for prescribed fire. In total, approximately 100 acres will be ready to be burned given acceptable conditions and sufficient resources in 2024. The Lab is also exploring a partnership with the US Forest Service that would allow for some preventative forest thinning work and small-scale southern pine beetle suppression efforts in the Upton Ecological Reserve.
- Water System Connection (new) - This project is included in the CURP that was awarded in FY23. This project will install emergency water system connection to the local utility provider and will add redundancy and resiliency to the entire BNL potable water system if an emergency arises.

BNL’s resilience planning and projected performance will continue to 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

---

3BPB	Project, Planning, Programming and Budgeting Process
AFFECT	Assisting Federal Facilities with Energy Conservation Technologies
AFV	Alternative Fuel Vehicles
AGEP-PUI	Alliances for Graduate Education and the Professoriate Predominantly Undergraduate Institutions
AGS	Alternating Gradient Synchrotron
ALC	Automated Logic Controls
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
BC	Barbara Coleman Controls
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
C-AD	Collider-Accelerator Department
CAFE	Corporate Average Fuel Economy
CCNY	City College of New York
CCWF	Central Chilled Water Facility
CD	Critical Decision
CEM	Certified Energy Manager
CERG	Continuity of Emergency Response Group
CERN	European Organization for Nuclear Research
CFE	Carbon-Pollution Free Electricity
CFE	Carbon-Pollution Free Energy
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
CCI	Community College Internship
CLCPA	Climate Leadership and Community Protection Act
CMS	Chemical Management System
COOP	Continuity of Operations Plan
CSF	Central Steam Facility
CSI	Computational Science Initiative
CURL	Consolidated Unfunded Requirements List
CURP	Critical Utility Rehabilitation Project

DAM	Day Ahead Market
DBT	Design Based Threat
DCOI	Data Center Optimization Initiative
DOAS	Dedicated Outdoor Air System
DOE	Department of Energy
EBNN	Environment, Biology, Nuclear Science, and Nonproliferation
ECM	Efficiency & Conservation Measures
EIC	Electron-ion collider
EHSS	Office of Environment, Health, Safety & Security
EISA	Energy Independence and Security Act
EMCS	Energy Management Control System
EMI SIG	Emergency Management Issues Special Interest Groups
EMS	Environmental Management System
EO	Executive Order
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
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
FDD	Fault Diagnostic Detection
F&O	Facilities and Operations
FAA	Federal Aviation Administration
FAST	Federal Automotive Statistical Tool
FCA	Facility Condition Assessment
FCE	Facility Complex Engineer
FCM	Facility Complex Manager
FEMA	Federal Emergency Management Agency
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
GWP	global warming potential
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 <sub>2</sub> e	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
NWS	National Weather Service
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
NYPA	New York Power Authority
NZEB	<u>Net Zero Emission Buildings</u>
O&M	Operation and Maintenance
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
PHEV	plug-in hybrid electric vehicles
PM	preventative maintenance
PNNL	Pacific Northwest National Laboratory
PPA	Power Purchase Agreement
PPPL	Princeton Plasma Physics Laboratory
PPM	Procurement and Property Management
PRV	pressure relief valve
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
SCR	Stakeholder and Community Relations
SF <sub>6</sub>	Sulfur Hexafluoride
SLAC	Stanford Linear Accelerator
SLI	Science Laboratories Infrastructure
SLI	Science Line Item
SME	Subject Matter Expert
SNAP	Significant New Alternative Policy
SPARK	Student Partnership for Advanced Research and Knowledge

SPO	Sustainability Performance Office
SSP	Site Sustainability Plan
SSPP	Strategic Sustainability Performance Plan
STAR	Solenoidal Tracker at RHIC
STEM	Science, Technology, Engineering and Math
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
TPC	time projection chamber
UESC	Utility Energy Service Contract
USDA	U.S. Department of Agriculture
VAM	Vehicle Allocation Methodology
VARP	Vulnerability Assessment and Resilience Plan
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  
All Sites  
FY 2023

# Greenhouse Gas Management



## Scope 1 & 2 Greenhouse Gas Emissions

Goal: Reduce direct GHG emissions by 65 percent by FY 2030 relative to FY 2008 baseline  
Interim Target (FY 2023): 0.0%

**Current Performance: 179.2%**

	FY 2008	FY 2022 (PY)	FY 2023	% Change from Baseline	% Change from Last Year
Facility Energy	3,773,959.1	1,973,285.4	11,597,872.4	207.3%	487.7%
Non-Fleet V&E Fuel	41,351.3	41,852.2	1,689,190.0	3,985.0%	3,936.1%
Fleet Fuel	67,084.6	40,817.9	0.0	-100.0%	-100.0%
Fugitive Emissions	798,991.6	164,917.7	207,549.7	-74.0%	25.9%
On-Site Landfills	26,545.4	24,765.1	24,474.3	-7.8%	-1.2%
On-Site WWT	1,405.5	1,418.7	1,512.2	7.6%	6.6%
Renewables	0.8	3,684.6	2,408.0	300,900.0%	-34.6%
RECs	0.0	-361,644.4	-374,646.4	N/A	3.6%
<b>Total (MtCO<sub>2</sub>e)</b>	<b>4,709,338.4</b>	<b>1,889,097.3</b>	<b>13,148,358.6</b>	<b>179.2%</b>	<b>596.0%</b>



## Scope 3 Greenhouse Gas Emissions

Goal: Reduce indirect GHG emissions by 25 percent by FY 2025 relative to FY 2008 baseline  
Interim Target (FY 2023): -21.0%

**Current Performance: 28.7%**

	FY 2008	FY 2022 (PY)	FY 2023	% Change from Baseline	% Change from Last Year
T&D Losses*	186,630.4	87,265.9	282,315.9	51.3%	223.5%
T&D RECs Credit	0.0	-22,073.5	-20,858.0	N/A	-5.5%
Air Travel	146,811.1	68,265.7	113,393.4	-22.8%	66.1%
Ground Travel	23,614.8	14,140.6	26,032.2	10.2%	84.1%
Commute	420,273.9	408,392.2	490,096.6	16.6%	20.0%
Off-Site MSW	16,620.3	35,071.0	130,897.8	687.6%	273.2%
Off-Site WWT	430.0	240.9	277.8	-35.4%	15.3%
<b>Total (MtCO<sub>2</sub>e)</b>	<b>794,380.5</b>	<b>591,302.8</b>	<b>1,022,155.8</b>	<b>28.7%</b>	<b>72.9%</b>

\* Includes T&D losses for purchased renewable electricity

# Facility Management



## Energy Intensity

Goal: Reduce energy intensity by 50 percent by FY 2030 relative to FY 2021 baseline. Per the FY 2024 Sustainability Strategic Plan, reduce energy intensity by 15 percent by FY 2025 relative to the FY 2021 baseline  
 Interim Target (FY 2023): -24.0%

**Current Performance: 3,540.1%**

	FY 2015	FY 2022 (PY)	FY 2023	% Change from Baseline	% Change from Last Year
Purchased Utilities (MMBtu)	16,145,569.8	14,597,169.1	565,767,530.1	3,404.2%	3,775.9%
Purchased Renewables (MMBtu)	0.0	179,104.5	391,662.1	N/A%	118.7%
Goal-subject GSF	110,759,593.0	106,574,483.0	106,695,950.0	-3.7%	0.1%
<b>Energy Intensity (Btu/GSF)</b>	<b>145,771.3</b>	<b>138,647.4</b>	<b>5,306,285.7</b>	<b>3,540.1%</b>	<b>3,727.2%</b>



## Renewable Electricity

Goal: Use 30 percent renewable energy as a percentage of overall facility electricity use by FY 2025  
 Interim Target (FY 2023): 25%

**Current Performance: 1.7%**

	FY 2022 (PY)	FY 2023	% Change from Last Year	% Compliant
Grid Electricity	4,264,523	135,740,028	3,083.0%	
On-Site Renewable Energy	528	842,882	159,536.7%	
Purchased Green Electricity	52,493	114,790	118.7%	
Renewable Energy Certificates	534,676	509,417		
Bonuses	1,500,811	915,120	-39.0%	
<b>Total Renewable Electricity with Bonuses (MWh)</b>	<b>2,088,507</b>	<b>2,382,209</b>	<b>14.1%</b>	<b>N/A%</b>
<b>Total Electricity Consumed (MWh)</b>	<b>4,317,543</b>	<b>136,697,700</b>	<b>3,066.1%</b>	



### EISA S432 Compliance

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

#### Current Performance:

	Due Date	Covered Energy	Evaluated Square Footage Status	# of Covered Facilities Benchmarked
<b>Current Evaluation Cycle Status</b>				
	# of Identified ECMs	# of Awarded/Funding Approved ECMs	# of implemented ECMs with reported M&V data	\$ value of all implemented ECMs
<b>Current Evaluation Findings</b>				



### 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 2023): 0.0%

#### Current Performance: 2.0%

	FY 2022 (PY)	FY 2023	% Change from Last Year	% Compliant
Grid Electricity	16,956,936	512,382,357	2,921.7%	
Non-renewable Thermal Energy	7,519,038	59,578,698	692.4%	
On-Site Renewable Energy	67,330	67,330	0.0%	
Purchased Green Electricity	179,104	391,662	118.7%	
Renewable Energy Certificates	1,824,313	1,738,130	-4.7%	
Bonuses			N/A%	
<b>Total Renewable Energy with Bonuses (MMBtu)</b>	<b>13,882,776</b>	<b>14,009,151</b>	<b>0.9%</b>	<b>N/A%</b>
<b>Total Energy Consumed (MMBtu)</b>	<b>24,722,409</b>	<b>572,420,048</b>	<b>2,215.4%</b>	



### Potable Water Intensity

Goal: Reduce water intensity by 50 percent by FY 2030 relative to FY 2021 baseline. Per the FY 2024 Sustainability Strategic Plan, reduce water intensity by 16 percent by FY 2025 relative to the FY 2021 baseline. Interim Target (FY 2023): -18.0%

#### Current Performance: 2,540,349.9%

	FY 2007	FY 2022 (PY)	FY 2023	% Change from Baseline	% Change from Last Year
Water Consumption (million gal)	8,688.9	6,738.5	217,472,601.0	2,502,778.4%	3,227,214.7%
Aquifer Recharge (million gal)	322.1	313.5	428.6	33.1%	36.7%
Total GSF	122,416,890.0	125,249,719.0	125,243,309.0	2.3%	-0.0%
<b>Water Intensity (Gal/GSF)</b>	<b>68.3</b>	<b>51.3</b>	<b>1,736,397.5</b>	<b>2,542,209.7%</b>	<b>3,384,690.4%</b>





### Non-Potable Water Consumption

Goal: Reduce potable water intensity by 36 percent by FY 2025 relative to FY 2007 baseline.  
 Interim Target (FY 2023): -26.0%

**Current Performance: -48.4%**

	FY 2010	FY 2022 (PY)	FY 2023	% Change	% Change from Last Year
Industrial	3,171.3	1,090.7	1,496.7	-52.8%	-65.6%
Landscaping	143.3	203.5	208.6	45.6%	42.0%
Agricultural	0.0	8.3	5.3	N/A%	N/A%
<b>Total Non-Potable Water (million gal)</b>	<b>3,314.6</b>	<b>1,302.5</b>	<b>1,710.6</b>	<b>-48.4%</b>	<b>-60.7%</b>



### 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 2023): 16.5%

**Current Performance: 14.7%**

	Building Count	GSF
Guiding Principles Certified	92	7,029,381
Total Applicable*	628	50,880,407
<b>Performance (%)</b>	<b>14.65%</b>	<b>13.82%</b>

\* 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 2023): -20.0%

**Current Performance: -100.0%**

	FY 2005	FY 2023	% Change
Gasoline	5,488,033	0	-100.0%
Diesel	1,751,377	0	-100.0%
Biodiesel*	162,050	0	-100.0%
<b>Total Petroleum (GGE)</b>	<b>7,401,460</b>	<b>0</b>	<b>-100.0%</b>

\* 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 2023): 10.0%

**Current Performance: 0.0%**

	FY 2005	FY 2023	% Change
E-85	401,903	0	-100.0%
Biodiesel*	102,852	0	-100.0%
CNG	69,914	0	-100.0%
Other*	50,035	0	-100.0%
<b>Total Alternative (GGE)</b>	<b>624,704</b>	<b>0</b>	<b>-100.0%</b>

\* 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 2023): -26.0%

**Current Performance: -48.4%**

	FY 2014	FY 2023	% Change
Fleet Fuel GHG (MtCO <sub>2e</sub> )	56.5	0.0	-100.0%
Fleet Miles (x1000)	78,187.4	0.0	-100.0%
<b>Greenhouse Gas Emissions / Mile (gCO<sub>2e</sub>/Mile)</b>	<b>1.0</b>	<b>0.0</b>	<b>-100.0%</b>

# Waste Management



## Municipal Solid Waste

Goal: Divert at least 50 percent of non-hazardous solid waste (excluding construction and demolition debris)  
 Interim Target (FY 2023): 50.0%

**Current Performance: 14.1%**

	FY 2023	%
Off-Site Landfills	138,668.0	72.5%
On-Site Landfills	24,620.6	12.9%
Waste to Energy*	898.9	0.5%
<b>Non-diverted Waste</b>	<b>164,187.5</b>	<b>85.9%</b>
Diverted Waste	20,437.3	10.7%
On-Site Composted	4,937.7	2.6%
Off-Site Composted	1,040.2	0.5%
Waste to Energy Credit	606.2	0.3%
<b>Total Diverted Waste</b>	<b>27,021.3</b>	<b>14.1%</b>
<b>Total Waste (metric tons)</b>	<b>191,208.8</b>	<b>100.0%</b>

\* 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 2023): 50.0%

**Current Performance: 38.5%**

	FY 2023	%
Landfilled C&D Waste	103,688.2	61.5%
Diverted C&D Waste	64,802.8	38.5%
<b>Total C&amp;D Waste (metric tons)</b>	<b>168,491.0</b>	<b>100.0%</b>

# Acquisition



## Sustainable Acquisition

Goal: Ensure 95 percent of new contract actions for products and services meet sustainable acquisition requirements  
 Interim Target (FY 2023): 95.0%

**Current Performance: 0.0%**

	Contracts Reviewed	Contracts Without Opportunity	Contracts Meeting All Requirements	%
<b>Number of Contracts</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0%</b>

# Electronics Stewardship



## Electronics Acquisition

Goal: 100 percent of eligible electronics procurements must be environmentally sustainable (e.g. EPEAT)  
 Interim Target (FY 2023): 95.0%

**Current Performance: 91.5%**

	EPEAT Acquired	Total Acquired	%
Monitors	51,345	54,848	93.6%
Computers	54,615	61,301	89.1%
Imaging Equipment	3,294	3,461	95.2%
Televisions	181	610	29.7%
<b>Total Acquired</b>	<b>126,845</b>	<b>138,560</b>	<b>91.5%</b>



## Electronics Recycling

Goal: Dispose of 100 percent of electronics through government programs and certified recyclers  
 Interim Target (FY 2023): 100.0%

**Current Performance: 94.7%**

	Amount	%
Transferred or Donated	134.857	5.0%
Recycled by Certified Recycler	2,409.049	89.7%
Recycled by non-Certified Recycler	142.263	5.3%
Amount disposed (e.g. landfill)	0.672	0.0%
<b>Total Electronics Waste (metric tons)</b>	<b>2,686.841</b>	<b>100.0%</b>



## Power Management

Goal: Implement and actively use power management features on 100 percent of eligible computers (PCs & laptops) and monitors  
 Interim Target (FY 2023): 100.0%

**Current Performance: 93.2%**

	Total Owned	PM Enabled	Exempt	%
Monitors	332,563	317,821	14,704	100.0%
Computers	280,622	214,684	27,282	84.7%
<b>Total Items</b>	<b>613,185</b>	<b>532,505</b>	<b>41,986</b>	<b>93.2%</b>



## Duplex Printing

Goal: Implement and actively use duplex printing features of 100 percent of eligible printers  
Interim Target (FY 2023): 100.0%

**Current Performance: 43.8%**

Total Owned	Duplex Enabled	Incapable	%
-------------	----------------	-----------	---

**Total Printers**

**54,337**

**21,319**

**5,664**

**43.8%**