

# **FY 2025 Site Sustainability Plan**



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## I. Executive Summary and Executive Summary Table

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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 3,000 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 FY24, BSA matured 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's Energy Management program remains dedicated to securing affordable and reliable power for the laboratory. In FY24, the team worked closely with the Brookhaven Site Office (BHSO), the NYPA, and the Long Island Power Authority (LIPA) to re-execute the sale-for-resale agreement for the 15 MW allocation of low-cost NYPA hydropower. At the time of writing, the agreement had received approvals from the Governor, DOE Headquarters, and LIPA, with final signatures pending.

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 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 FY25.

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 and Operations (F&O) Directorate, Information Technology Division (ITD), and the DOE 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 BNL has 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, 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 the project has achieved Critical Decision (CD) 2/3 and is in construction and on schedule. 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 is nearly complete on the Science and User Support Center (SUSC), and 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.	Limited progress due to aging district steam.	Where funding is allocated, implement ECMs to reduce energy intensity in goal-subject buildings.	High
Achieve a net-zero emissions building portfolio by 2045 through building electrification and other efforts.	No progress to date. Seeking solutions to Scope 1 emissions, and a path to 100% Carbon Free Electricity (CFE) to eliminate Scope 2 emissions.	Investigate electrification of Steam Boiler 1A to reduce heating emissions in a 100% CFE scenario.	High
EISA Section 432 continuous (4-year cycle) energy and water evaluations.	Compliant.	Continue compliance cycle, improve steam metering to increase evaluation accuracy.	Low
Meter individual buildings for electricity, natural gas, steam, and water to adhere to Federal metering guidance.	In progress.	Continue to expand steam metering infrastructure until complete, then begin water metering.	High
<b>Water Management</b>			
Reduce potable water use intensity (Gal per gross square foot).	FY24 water use intensity was 80.54 G/GSF vs. FY07 benchmark of 101.16 G/GSF.	Over the next decade, potable water use will increase significantly due to increased heat reject for High Emission Mission Specific Facilities.	High
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 changes.	Low
<b>Waste Management</b>			
Reduce non-hazardous solid waste sent to treatment and disposal facilities.	BNL's overall recycling rate for FY24 is 84%.  The overall landfill diversion rate (recycling + waste-to-energy) is 94%.	As described in the acquisition section, BNL will pilot recycling options for nitrile gloves and laboratory plastics with a company that has developed a direct closed-loop program for	Low



DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
	Only 6% (100 tons) of BNL's nonhazardous waste was sent to a landfill.	these waste streams.	
Reduce construction and demolition (C&D) materials and debris sent to treatment and disposal facilities.	A total of 190 tons of concrete and asphalt from building demolition were collected for crushing and reuse and 60 tons of metal collected for recycling out of a total of 992 tons of landfilled C&D waste. The resulting recycling rate is 18%.	There will be numerous buildings demolished during FY25. Communication regarding recycling improvements will be communicated and encouraged directly to the project managers for these projects.	Low
<b>Fleet Management</b>			
Reduce petroleum consumption.		Provide ChargePoint station access to guests and employees. BNL installed 14 Level 2 Charging stations on-site to support the increase in government EV fleet bringing the total to 18 Level 2 charging stations and 5 Level 1 stations. Funding has been provided to install more charging stations in FY25.	Low
Increase alternative fuel consumption.		Flex Fuel vehicles will only be assigned E-85.	Medium
Acquire alternative fuel and electric vehicles (EVs).		A total of 23 EVs ordered and received 14 EVs for FY24. BNL will continue to receive more EVs as they become available through the General Services Administration (GSA).	High
<b>Clean &amp; Renewable Energy</b>			
Achieve 100 percent carbon pollution-free electricity on a net annual	Study complete. Unfunded, high risk non-attainment.	Given current load growth projections, BNL currently has no viable path to 100% CFE. The	High

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
basis by 2030, including 50 percent 24/7 carbon pollution-free electricity.		<p>site has performed feasibility studies for wind and solar. An aggressive FY24 solar feasibility study resulted in achieving only 7.2% of the annual electric consumption forecasted for 2030 at an unfunded cost of \$81M. The Lab would also have to invest \$12-14M/yr in environmental attribute certificate (EAC) procurements beginning in FY30.</p> <p>While there are plans to revisit wind and execute a new feasibility study in FY25, achieving these goals are further exacerbated due to the sheer amount of additional electrical energy that will be consumed by the new EIC.</p>	
Increase consumption of clean and renewable non-electric thermal energy.	No performance regarding non-electric thermal energy to date.	No planned activities.	High
<b>Sustainable Buildings</b>			
Increase the number of owned buildings that are compliant with the Guiding Principles for Sustainable Buildings.	The BNL SUSC currently under construction is scheduled for substantial completion by January 2025.	<p>The EIC Project is in progress at BNL. The facility will require approximately 12 new support facilities, all of which are planned to be compliant with the Guiding Principles for Sustainable Buildings.</p> <p>Conventional facility design is in the preliminary stage. The project design is not baselined.</p>	Low
<b>Acquisition &amp; Procurement</b>			
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring all sustainability clauses are included as appropriate.	<p>Sustainable clauses are included in contract terms and conditions.</p> <p>The SFTool Product Database had been made available to staff for help in</p>	<p>BNL will apply for the Green Buy Award.</p> <p>BNL will evaluate labware made of bio-based plastics or recycled plastics. Several scientists are</p>	Low

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
	<p>identifying sustainable products.</p> <p>BNL received its eighth Green Buy Gold award for 12 priority products in 8 categories. BNL also received its fourth Green Buy Superior Award recognizing BNL for receiving eight Green Buy Gold awards.</p>	<p>currently testing these items in their labs.</p> <p>BNL is asking machine shop staff to evaluate a bio-based product replacement for polytetrafluoroethylene (PTFE) Mold Release Spray.</p> <p>Building 703 West Lab upgrade will incorporate Environmentally Preferable Purchasing (EPP) materials.</p>	
<b>Efficiency &amp; Conservation Measure Investments</b>			
Implement life-cycle cost effective efficiency and conservation measures with appropriated funds and/or performance contracts.	<p>Site continues to install occupancy-controlled thermostats.</p> <p>Site continues to operate site-chilled water storage tank to reduce emissions</p> <p>Site Demand response activated multiple times in FY24 to conserve energy.</p> <p>Steam trap surveys were executed for four facilities in FY24.</p> <p>In FY24, Chiller #8 was overhauled, greatly improving chiller efficiency.</p> <p>There are no active performance contracts.</p>	<p>Site heating retro-commissioning is planned for all heating controls in FY25.</p> <p>Site cooling retro-commissioning is planned for all cooling controls in FY25.</p> <p>Site will complete steam trap repairs from FY24 surveys and execute steam trap surveys in seven more facilities.</p> <p>Site plans to overhaul four chillers in FY25 to improve central cooling efficiencies.</p> <p>Site plans to install all cooling tower retrofit kits purchased in FY24 to improve cooling efficiencies across the site.</p> <p>UESCs are being evaluated.</p>	<b>Medium</b>
<b>Electronic Stewardship</b>			
Electronics stewardship from acquisition, operations, to end of life.	BNL received an EPEAT Award from the Green Electronics Council for its purchases of	BNL will continue to provide the highest rated EPEAT products to BNL staff for purchase via an on-line service portal.	<b>Low</b>

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
	environmentally sustainable electronics.	BNL will apply for the EPEAT Award.	
Increase energy and water efficiency in high-performance computing and data centers.	Data center is currently meeting Platinum requirements.	Sustain Platinum performance.	Low
<b>Adaptation &amp; Resilience</b>			
Implement climate adaptation and resilience measures.	Progress was made on all Resilience Solution projects being tracked in FY24 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.	Low
<b>Multiple Categories</b>			
Reduce Scope 1 & 2 greenhouse gas emissions.	BNL's current projections dramatically increase Scope 2 emissions through 2030 and beyond if not offset by the progress in the grid becoming cleaner. BNL continues to make repairs to Steam distribution system to increase condensate returns thereby reducing Scope 1 emissions.	Studies to electrify steam are in planning via the most recent AFFECT Grant Application.	High
Reduce Scope 3 greenhouse gas emissions.	With increasing numbers of employees returning to on-site work, increased travel, and increased use of rental vehicles during travel, along with the need to operate sPHENIX in purge mode during the FY24 Relativistic Heavy Ion Collider (RHIC) run, Scope 3 greenhouse emissions	Reintroduction of ridesharing to staff through message on BNL intranet, updates to the ridesharing page, and efforts to coordinate rides for those in need.  Continue to engage with NY State, the Metropolitan Transportation Authority (MTA), Long Island Railroad	Medium

DOE Goal	Current Performance Status	Planned Actions & Contributions	Overall Risk of Non-Attainment
	increased in FY24 compared to FY23.	(LIRR), and Suffolk County/Town of Brookhaven officials regarding plans for the relocation of the Yaphank rail station closer to BNL.	

## II. Performance Review and Plan Narrative

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### 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 peaking power plants. In FY23 and F24, there was a shift to summer operations to accommodate completing as much of the Relativistic Heavy Ion Collider (RHIC) mission as possible before transition to the EIC. The shift has increased site-wide power costs by increasing the unforced capacity (UCAP) of BNL from approximately 35 to 57 MW; UCAP is similar to a ratchet peak demand charge in other electric markets. The shift also resulted in higher Scope 2 emissions intensity, as the demand peaks occur during summer months when the carbon intensity of the grid is higher due to the requirement of the grid to run its high emission peaking plants to ensure grid stability. In FY25, the RHIC run will follow a schedule similar to the previous two 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 is addressing some 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 60%, 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 that was expanded in FY24. 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 3.2-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 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 FY24, \$1.32M in energy costs were avoided using the storage tank, and a significant load is able to be shed during the peak summer periods.

### *Enhanced Controls Projects*

In FY24, BNL continued to phase out and upgrade the original Barber-Coleman control systems from the late 20<sup>th</sup> century. These control systems in most cases were operating without feedback to properly control the spaces resulting in increased duty cycle of equipment and wasted energy. The controls team completed the design and upgrade of the Heating, Ventilation, and Air Conditioning (HVAC) controls in Building 729, integrating them into the campus-wide ALC system. In addition, the ALC system was expanded into Building 1004b, and the EIC design now includes ALC controls to better integrate C-AD into the campus-wide network of building automation.

The BNL Controls Team began piloting occupancy-controlled thermostats for Variable Air Volume (VAV) systems in FY23. The successful pilot resulted in the broader implementation of occupancy-controlled thermostats to more accurate control setpoints and schedules in hybrid and regular workspaces. In FY24, occupancy-controlled thermostats were added to Buildings 488, 1005s, 703, and 030.

In FY24, the site was less successful implementing the retro-commissioning program for the site's ALC system, compared to FY23. However, repairs from FY23 continued to allow systems to operate efficiently. The efficient operations of building-specific cooling equipment resulted 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 that continued in FY24. 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, with levels reaching similar results in FY24; the continuation of a roughly 12% efficiency improvement.

The site shifted resources to continue to add to the success of the retro-commissioning program by retro-commissioning the heating equipment controlled by ALC in advance of the FY25 heating season and committing to a full retro-commissioning of ALC controlled cooling equipment in FY25.

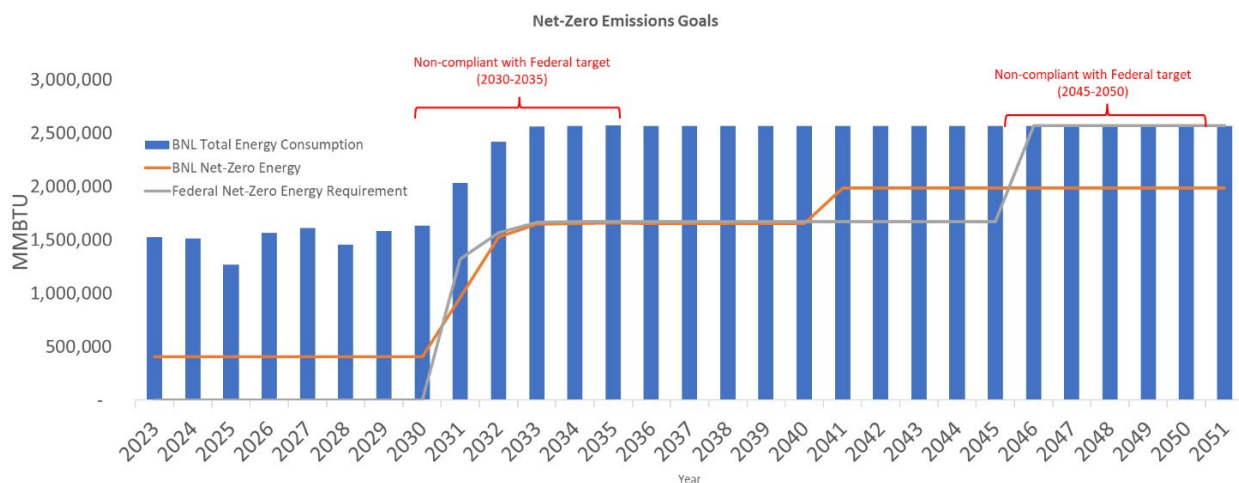
The fault detection and diagnostic (FDD) system continues to be rolled out in facilities controlled by the ALC EMCS. The FDD algorithms are used to detect HVAC system inefficiencies before they become large issues, improving operational efficiency of building HVAC equipment throughout BNL with plans to be expanded. When issues are detected, they are logged in reports which get sent out to the Facility Project Managers, the Production Division, and BNL's Controls Service Contractor for corrective action. The system is comparable to retro-commissioning but uses advance algorithms as a means of identifying root-cause issues. In FY24, the FDD system was expanded to include Building 490, Building 488, and Building 515 NET Wing. In addition to expanding the system, the new Air Conditioning (AC) shop leads were trained on using the FDD system to identify root cause issues and to advance preventative predictive maintenance activities on-site.

### 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.

#### Deep Energy Retrofits

There are currently no Deep Energy Retrofit projects planned from now until FY30.

### **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, with much of the internal heating being carried by waste heat of process loads. The HEMSF will increase the site's electric load by roughly 60 MW. As the New York grid transitions to carbon-pollution free electricity (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 be significant, higher costs required to meet programmatic needs will likely impede the ability for other areas of the Lab to decarbonize. Furthermore, because the demand for electric energy will be so high, BNL cannot achieve 100% CFE without leaning on the local electric grid to first decarbonize. New York State is not currently on track to meet the Climate Leadership Community Protection Act's (CLCPA) goal of a 70% CFE grid by 2030, or 100% CFE grid by 2035. Moreover, qualifying renewable energy certificates (RECs) and environmental attribute certificates (EACs) that include all of the federally defined prerequisites to qualify as CFE do not yet exist; this is discussed more broadly in a later section of the SSP. As a result, HEMSF will have a negative impact on Scope 2 emissions through to 2030 100% CFE date.

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

To improve efficiency to achieve goals such as a 50% reduction in site Energy Utilization Index (EUI), significant investment in existing infrastructure must be made either through grant funding, Utility Energy Service Contracts (UESCs), 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

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

Anticipated Building Name or Descriptor	Estimated Building Gross Square Footage	Actual/Anticipated Construction Completion Year
1001A PS	11,194	2028
1003A PS	11,194	2028

1004G Cooling/Kicker	4,080	2028
1005T PS	16,527	2028
1006G PS	5,979	2028
1007A PS	11,194	2028
1009A PS	24,184	2028
1010C RF PA	54,961	2029
1010D DI Pumphouse	8.262	2029
1010E Cryo	5,979	2028
1011A PS	11,194	2028
1012C Kicker PS	5,915	2028
1012E 400 MeV Linac	3,682	2028

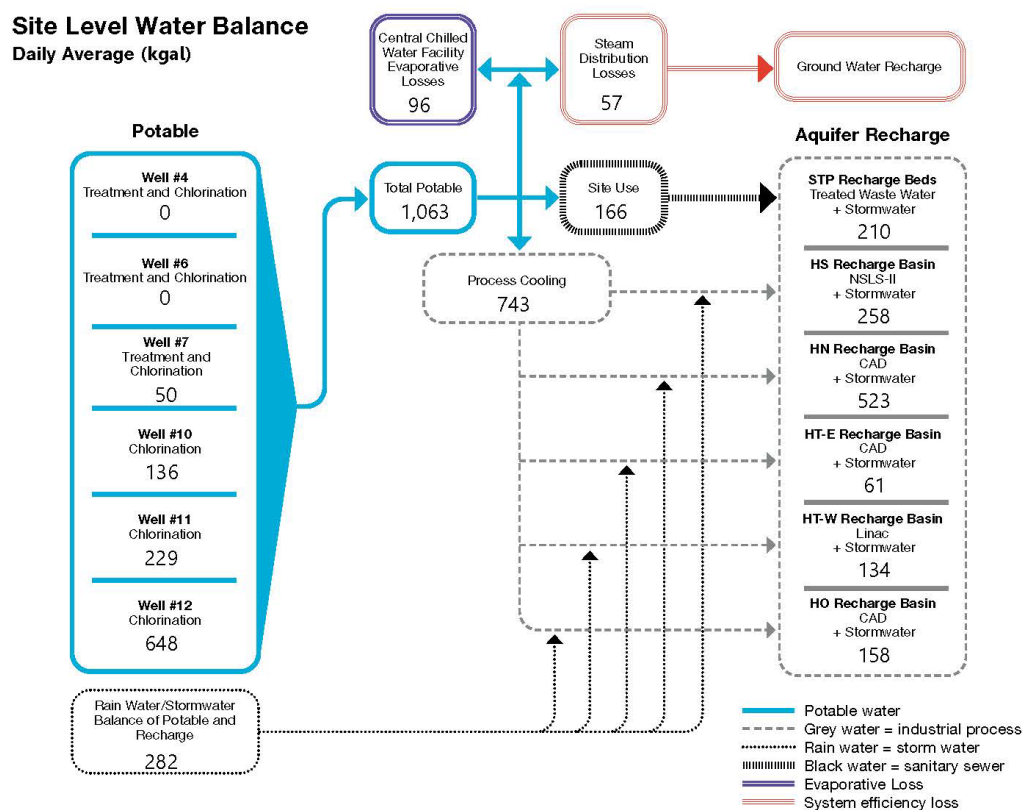
## Water Management

*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

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. 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 Best Management Practices

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
FY24	387,868	4,815,914	80.54

In FY24, BNL updated its Water Management Plan and completed a thorough internal site water assessment spanning from October 2023 to March 2024. The purpose of the Water Management Plan is to provide information about current water uses, chart a course for water efficiency improvements, conservation activities, and water-reduction goals using industry best management practices (BMP) and those identified by the Federal Energy Management Program (FEMP). This site water assessment served to reaffirm the efficacy of existing best practice policies while also shedding light on areas for possible improvements.

Some highlights of the assessment include BNL's stormwater and wastewater management processes to recharge the subterranean aquifer allowing BNL to be a net recharger to the aquifer, a policy promoting native plant species and prohibiting irrigation, cooling tower management practices optimizing cycles of concentration, and the communication protocols allowing for the quick identification and repair of leaks.

Several opportunities for improvement identified in the assessment include high make-up water rates at the Lab's CSF caused by a deteriorating steam distribution infrastructure beyond its useful life, single pass cooling towers still in use, and a lack of building level metering infrastructure that would allow for a more detailed study of individual building water use.

The current status of these opportunities for improvement and some other BMPs identified in the Water Management Plan are summarized below:

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

As mentioned above, BNL completed a comprehensive evaluation to understand the site's current water use and costs. This part of the evaluation included the collection of utility data and conducting facility surveys to gather critical information on water uses. This information was 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 provided important information on major water uses that helped target efficiency opportunities and provided insight on potential system losses.

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

BNL invested approximately \$100,000 in metering infrastructure for potable water and condensate/steam systems in FY24.

#### *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 #8 – Boiler/Steam Systems*

BNL has a district steam system and CSF. Certain losses are unavoidable (e.g., humidification). The network of steam and condensate distribution piping in many areas is in excess of 60 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. 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.

In FY23, a CURP was funded to invest in major infrastructure repairs of the distribution system. In FY24 designs were completed with construction between MH-1 and MH-6 (10" steam, 4" condensate) beginning in late FY24 and continuing into FY25.

**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.

BNL has identified several single pass cooling systems that could be retrofitted during the site water assessment performed in FY24. The single pass cooling systems exist as follows:

**Table 4: Single Pass Cooling Systems**

Location	Application
Bldg. 463	Biology -80C Freezers
Bldg. 515	CRAC units
Bldg. 902 West	Magnet Div. specialized power supplies
Bldg. 911/912	H10 house cooling system
Bldg. 911	Multi pole system
Bldg. 911	Power room pumps for Westinghouse
Bldg. 911/951	Fast Pulse Quad
Bldg. 912	Room 1-18 CES (800 sq. ft.)
Bldg. 930	Tenth station LINAC
Bldg. 930/946	Beam Stop cooling station

The following retrofit options will be further studied and applied as applicable and as funding allows to help maintain water efficiency across facilities:

- To maximize water savings, eliminate single pass cooling by modifying equipment to operate on a closed loop that recirculates water, a minimum of five cycles of concentration, instead of discharging it to the Sewage Treatment Plant (STP).
- If modification of equipment to a closed-loop system is not feasible, add an automatic control to shut off the entire system during unoccupied night or weekend hours. This option will be considered only when shutdown has no adverse impact on indoor air quality.

#### *BMP #10 – Cooling Tower Management*

BNL has invested in multiple cooling tower rehabilitation projects which focus about replacing fill, and hot deck metering orifices, as well as making other ancillary repairs in order to bring older towers back to good working standards. Towers involved in rehabilitation projects include the CCWF south towers, satellite chilled water facility cooling Towers, Tower 901A, Tower 902W, Tower 928, Tower 930, and Berkner Hall's cooling tower. Note that cooling towers are named for the buildings they serve.

#### **Plans and Projected Performance**

BNL's water conservation program has achieved dramatic reductions in water use since the mid-1990's. The Lab will continue to evaluate water conservation measures and, as funding allows, address the priority opportunities for improvement identified in the March 2024 Site Water Assessment including:

- Steam Distribution Leak Repairs;
- Retrofitting Single Pass Cooling; and
- Advanced Metering.

It should be noted that over the next decade, potable water use will increase significantly due to increased heat reject for HEMSFs (i.e., EIC). This will significantly increase the risk of non-attainment for this goal.

## 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

In accordance with Executive Order (EO) 14057, 14 more Level 2 charging stations were installed in FY24 with plans to install more stations in FY25. One of the Level 2 stations is Americans with Disabilities Act (ADA) accessible. Charging station membership increased from 76 users to 120 since September 2023. The additional participation in personal Electric Vehicles (EVs) and government EVs, demonstrated a decrease of on-site greenhouse gas emissions from ~30,000 kg to ~80,000 kg. In FY24, the government fleet had a 4,842 kg greenhouse gas emission savings which saved 800 gallons of gas.

BNL uses ChargePoint for our EV charging program. ChargePoint provides BNL the servicing of the stations and BNL manages the user's account and pricing to create a seamless experience. BNL uses the connection code feature and various pricing policies to ensure proper pricing for government fleet and personal vehicles while managing who has access to the stations. Campus installation sites will be based on the electrical grid, infrastructure, and EV distribution.

BNL received 13 zero emission vehicles (ZEVs) in FY24 out of the 21 ordered. BNL will continue to monitor the specific vehicles which have the capability to be replaced with full electric models to meet the EO requirements.

The BNL Fleet Supervisor received the Secretary of Energy Achievement Award in collaboration with other DOE Labs for our strategy in meeting the EO 14057 by ordering ZEVs.

BNL is continuing to use Geotab Global Positioning System (GPS) units in every government vehicle to facilitate meeting sustainability requirements. The GPS units measure usage, driving behavior, and idling times. Geotab also offers an analysis of 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, on-site car washing, and preventative maintenance compliance. During the spot checks performed at BNL, the government vehicles are checked to ensure there is no idling while unoccupied, as well as to look for tire wear, damage, WEX card, and accident report storage.

### Plans and Projected Performance

Due to the General Services Administration (GSA) converting over to a new system (GSAFleet.gov), BNL has observed a delay in the replacement ordering and the projection of next year's replacements. BNL will continue to order any ZEVs that meet mission requirements. DOE requires each new acquisition to be ZEV only and justifications will be required for any non-ZEV acquisition. Options will be limited in FY25 due to supply chain issues and availability. The Fleet Supervisor will continue to work with GSA and DOE on recommendations for ZEV replacement options each year.



BNL's on-site shuttle service will continue business with an online reservation system for Long Island Railroad (LIRR) transfers to decrease unnecessary trips to the train station. In FY24, we increased the transportation of passengers by approximately 2,000 employees for each on-site shuttling and the train reservations. The Fleet Supervisor continued to utilize the route system during the FY24 summer season to decrease duplicate requests and in addition added one more shuttle van to increase efficiency. 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. With attendance increasing each year and the opening of the new building, the SUSC, BNL was approved by DOE for an increase in fleet to lease an accessible ADA 32 passenger bus. BNL will order the bus when GSA's vehicle ordering is open for requests in FY25. The bus will help transport larger groups of people on-site and to the train, reducing the number of trips.

### **Fleet Management Program Subsection**

BNL's Fleet Supervisor reports directly to the DOE Consolidated Service Center (CSC) Fleet Manager, Tom Back, for fleet maintenance, utilization, procurement, and mission support needs. EO 14057 requires BNL's fleet acquisitions to be to be 100% ZEV by 2035. The goal is to acquire a ZEV, when available, in the same class as the previous vehicle being replaced.

BNL currently has nine Plugin Hybrid Electric vehicles, two Hybrid vehicles, and twenty-one Electric vehicles. The Fleet Supervisor will continue to consider which vehicles are capable of transitioning to ZEV to meet the current EO requirements in FY25 when ordering vehicles.

The BNL Fleet Supervisor created in-person training for Electric Vehicles. The training covers everything from proper safety procedures to operations of an electric 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 ZEV training and lessons learned for BNL's future acquisitions.

The Vehicle Allocation Methodology (VAM) survey is now being performed at a local level by the SC-CSC Fleet Manager to right size fleet. It will no longer be performed by an outside contractor. BNL will continue to identify drivers' needs and right-size fleet to increase usage and performance.

BNL currently has five Level 1 charging stations and eighteen Level 2 charging stations. More charging stations are planned to be installed in FY25. BNL is promoting more personal electric vehicle purchases by offering on-site employees the opportunity to charge their personal electric vehicles while at work at minimal cost. Currently, there are 120 on-site employees registered for this personal vehicle 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.

BNL is continuing to use a new Fleet Management System, Fleetio. The past system was not curated for fleet management, which had presented several obstacles in reporting. This system integrates with the Geotab GPS system in addition to other fuel systems. The Fleetio reports are assisting with Federal Automotive Statistical Tool (FAST) reporting needs, including maintenance, accident, and fuel costs. Additionally, the Fleetio reports are fully customizable to adapt to BNL's needs. Fleetio can create sustainability goals from data collected by the system.

## Clean & Renewable Energy

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

### Current Performance

The site currently has more than 50% of its clean power procurements from CFE sources. However, the power is not bundled with its associated EACs, and the purchase of the EACs are unavailable to BNL in the current market. Even if the EACs were available, the hydro procurement is from sources built before October of 2021, therefore only 7.5% of this power would be allowed to count towards the FY30 CFE goal, given the current language surrounding the goal. Because the EACs are not available BNL purchases renewable energy certificates amounting to 7.5% of its total energy consumption annually. Again, by the letter of the law, even these RECs would not count toward the FY30 goal because they are not purchased within the New York State balancing authority. BNL does not currently have access to RECs for CFE in New York State for projects commissioned after October 2021, because there aren't any in existence.

BNL is actively exploring options to increase its use of CFE through grid purchases and energy attribute acquisitions. However, challenges have emerged, particularly the fact that within the balancing authority of New York there does not currently exist an offering to purchase RECs or power available at the scale required from projects that began service on or after October 21, 2021. As a result, it is not possible to meet these specific requirements. Significant changes within the site's local balancing authority will be necessary for BNL to comply with its ambitious sustainability goals.

Furthermore, funding for the future CFE from offshore wind energy is being supplemented by the New York State Energy Research and Development Authority (NYSERDA). In exchange for supplemental funding, NYSERDA retains exclusive rights to the EACs generated by these projects; as such all power will be de-bundled from the environmental attribute. Moreover, the EACs are planned to be marketed as "Tier 1 RECs." In FY24, NYSERDA announced the sale of Tier 1 RECs at a cost of \$25.07 per REC; currently, only legacy hydroelectric power is included in the Tier 1 REC offering. In 2030, legacy hydroelectric procurement may count for not more than 7.5% of the CFE requirement. All electricity procured by BNL is de-bundled from the EAC. Therefore, by FY30, 100% of electrons flowing to the site must have an additional EAC purchased to count the power as CFE. The only reprieve to this requirement will be new on-site CFE generation.

Regarding on-site generation, a recent solar feasibility study identified BNL's capacity to host 30.35 MW DC (24.7 MW AC) of solar arrays, which may generate approximately 40,000 MWh annually at an estimated installation cost of \$81 million. If fully operational by FY30, this output would cover 7.6% of the forecasted 523,500 MWh demand.

Future projects may also include a revitalization of the LISF, a 32 MW solar facility on-site. However, any revitalization would occur after the FY30 goal, as the land lease agreement does not expire until 2031, so it currently cannot be counted towards the FY30 goal. Even if BNL retained the EACs from this field, the construction ended in FY11 and therefore would not qualify according to federal law.

In an optimistic scenario, BNL could meet its FY30 goal by doing the following:

- \$81 million investment (in FY24 dollars) in on-site solar, which would allow 7.6% of the total goal to be met through on-site production.
- The remaining CFE would be covered by EAC purchases. If available, BNL would need to procure 482,943 Tier 1 RECs from NYSEDA at a cost of \$25.07 per EAC, totaling approximately \$12.1 million.
- As the EIC transitions to full operation, and assuming no additional load growth, 548,500 EACs would be required annually, with a recurring cost of \$13.75 million in perpetuity.

BNL will measure and track its CFE consumption by installing utility grade meters on the load side of all new solar arrays. The EACs will be tracked via spreadsheet to account for all remaining electrical energy consumed.

**Table 5: Projected CFE With Current Funding**

Metric		FY24	FY25	FY26	FY27	FY28	FY29	FY30
<b>1</b>	<b>Total annual CFE (a+b+c+d)</b>	23,310	22,374	17,822	19,704	21,992	28,344	523,500
<i>a</i>	<i>Grid-supplied CFE<sup>1</sup></i>	0	0	0	0	0	0	0
<i>b</i>	<i>On-site CFE</i>	510	557	557	557	557	557	40,557 <sup>3</sup>
<i>c</i>	<i>Purchased CFE</i>	0	0	0	0	0	0	443,681 <sup>2</sup>
<i>d</i>	<i>Legacy CFE from EPA Act 7.5% cap</i>	21,800	21,817	17,265	19,147	21,435	27,787	39,262 <sup>2</sup>
<b>2</b>	<b>Total annual electricity usage</b>	291,040	290,900	230,200	255,300	285,800	370,500	523,500

<sup>1</sup>New York State goal is to have 70% CFE grid by 2030, recent reporting indicates state is behind on goal. Grid power will be de-bundled with New York State Energy Research Authority owning the EACs from all new CFE projects (mainly offshore wind).

<sup>2</sup>Requires procurement of Tier 1 RECs from NYSEDA.

<sup>3</sup>Requires \$81M in investment in all sites identified by solar feasibility study.

## Plans and Projected Performance

Given current load growth projections, BNL currently has no viable path to 100% CFE. The site has performed feasibility studies for wind and solar. A decade's old wind feasibility study ascertained that wind was not feasible due to Federal Aviation Administration (FAA) regulations restricting turbine height in areas where sufficient wind flux may be available to generate power. Since changes in technology have greatly advanced since the study, BNL plans to revisit wind and execute a new feasibility study in FY25. An aggressive solar feasibility study identified all BNL open spaces and parking lots capable of hosting solar arrays will total 24.7 MW of nameplate capacity and 40,000 MWh of output energy capacity, representing 7.2% of the annual electric consumption forecasted for 2030. Meeting this 7.2% requires \$81M in unfunded investment. BNL cannot meet this goal with all viable areas being covered with solar panels. Achieving the goals are further exacerbated due to the sheer amount of additional electrical energy that will be consumed by the new EIC, the high cost of integrating decentralized solar on-site, and the current state of unavailable new CFE projects.

**Table 6:** Predicted Scenario with Funding

On-site CFE system type (solar, wind, etc.)	Nameplate Capacity (MW)	Funding source(s) (appropriations, performance contract, AFFECT, etc.)	Estimated Year of Completion
Solar	30.35 MW DC (24.7 MW AC)	Not Funded	2030

## 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 12 priority products in 8 categories. BNL also received its fourth Green Buy Superior Award recognizing BNL for receiving eight Green Buy Gold awards. BNL also received the 2024 EPEAT Award for electronics purchases, given by the Green Electronics Council. BNL won the 2023 Green Space Bronze award, the first in the DOE complex to win both GreenBuy and Greenspace simultaneously.



Figure 3: BNL GreenBuy Awards

### Plans and Projected Performance

The following activities are planned for FY25:

- BNL will apply for the Green Buy Award based on 2024 purchases.
- Pilot plastic labware made of bio-based plastics with interested scientists in order to evaluate the products.
- Hold a webinar with a vendor who specializes in closed-loop laboratory supplies providing bioplastics and labware made from recycled plastic as well as a path for recycling and reuse.
- A vendor fair for similar sustainable laboratory plastics is planned for the 2025 BNL Earth Day Celebration.
- Machine shop staff are being asked to evaluate a bio-based product replacement for polytetrafluoroethylene (PTFE) Mold Release Spray.
- The Building 703 West laboratory upgrades will include sustainable design choices in furniture and flooring.

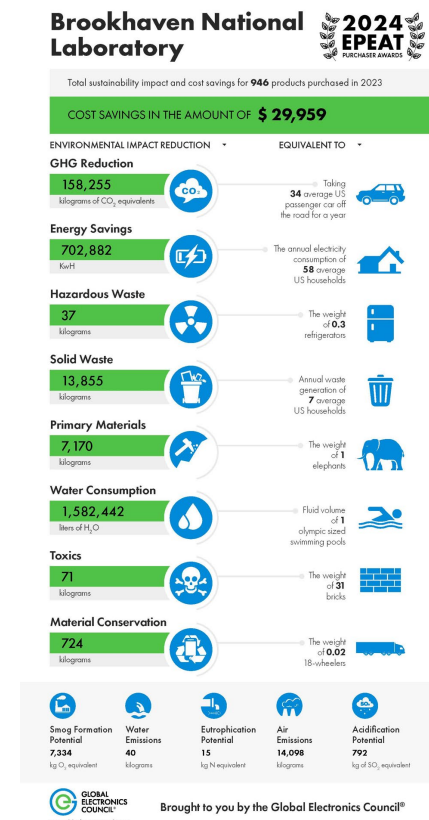


Figure 4: BNL EPEAT Award Summary

The inclusion of the SFTool product search feature for use by staff will make identification of conforming items easier, but issues will remain regarding our ability to get performance information back out of the system.

## 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 UESCs that would support investment in implementing energy conservation measures.

In FY23, the site identified a critical low-cost/no-cost energy efficiency measure implemented to reduce emissions and energy costs. This measure was to monitor pricing and carbon intensity of the electric grid and shed load via the CCWF's 3.2M gallon chilled water storage tank. In FY24 the site continued this practice, shifting load daily and saving the site \$1.32M in power costs.

The site has also continued to implement demand response, a three-tiered load shedding program, managed by the ALC EMCS. The utilization of load shedding takes place during heat waves to alleviate load in the CCWF, and during emission intensive grid operations to reduce emissions and cost. In FY24, the site was able to shed 3MW of load during such intervals reducing operating costs by approximately \$18k.

#### Workforce and Community

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 Relations Office (SRO), in coordination with the Environmental Protection Division (EPD), participates in or conducts on- and off-site meetings through its Speaker's Bureau. 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 Explore Brookhaven 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 2024 the open house program welcomed over 5,200 people to the Lab.

In 2024 the Lab continued the Science in the Community initiative to bring its programs into the field and make them more accessible, especially to disadvantaged communities. For example, the Lab's partnership with the Jones Beach Energy and Nature Center is free and features hands-on activities for students. The Lab offers programming on Earth Day and features a special emphasis on the importance of renewable energy, climate solutions, and preserving the environment. The Lab added to its renewable energy community programming by developing an interactive, miniature model renewable energy home featuring a wind turbine, solar panels, wood-burning stove and geothermal system. The various

interactive features are children-friendly and encourage hands-on learning, while highlighting the importance of renewable energy use. The model home is portable and has been used in Science in the Community programs as well as by the Office of Educational Programs (OEP).

Brookhaven Lab 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

#### *Utility Energy Service Contracts (UESCs)*

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

#### *Grants and Studies*

In FY24, BNL and FEMP had a kick-off meeting for the Assisting Federal Facilities with Energy Conservation Technologies (AFFECT) award to study heat recovery on campus. The study is anticipated to focus on adding heat recovery to the new EIC, and other areas of campus. Pending the phase of the EIC design process when funding is made available, the focus of heat recovery may shift from the EIC to other loads including the data center.

In the early weeks of FY25, the DOE notified BNL that it had received another AFFECT grant to study decarbonizing the site's CSF. BNL is particularly interested in studying the CSF because the findings will help direct the site's path toward net-zero goals. These findings will provide valuable insights as the site incorporates net-zero strategies into its Utility Master Plan.

#### *Central Steam Distribution*

The central steam distribution network is undergoing substantial repairs targeting the aging distribution network and plant, all of which are contributing to resiliency, energy efficiency, cost savings and Scope 1 emissions reductions.

BNL's efforts to execute site-wide steam traps surveys, repairs, and replacements have many benefits to the site. Most importantly, properly functioning steam traps contribute to energy efficiency because steam traps remove condensate from the steam system without letting steam escape. A properly maintained steam trap system reduces the amount of fuel needed for heating, thus lowering emissions and helping to meet environmental regulations and sustainability goals. A properly maintained steam trap also enhances efficiency by removing condensate minimizing the risk of water hammer, which can be dangerous for personnel and equipment. Also, steam leaks are reduced, decreasing the risk of burns and other heat-related injuries.



In FY24, steam trap surveys took place in four buildings: 490, 464, 515, and 535. The findings indicate poor building performance relating to steam distribution, impacting heating loads and condensate returns to the plant. The procurement of replacement traps is complete, with project execution expected in FY25. The risk of this measure not being attained is high due to high utilization of steam ship personnel absent of these repairs.

In FY25, the site will continue to execute steam trap surveys with surveys in Buildings 400, 463, 488, 703, 725, 902, and 912.

In FY24, the CURP project began work rebuilding manhole one and replacing distribution piping at the CSF north export and main condensate return pipe. Construction has also begun in areas of significant condensate losses and will continue in FY25. Key projects are identified in the following table:

**Table 7: Critical Distribution Repairs**

Description	Piping Size	Trench Feet
Partial line West of MH-55 from B488	2"	100'
Partial line South of MH-10 to MH-22	4"	250'
Entire line between MH-35 to B830	2"	270'
Entire line between MH-52 and MH-23/MH-23A	4"	500'
Entire line between MH-36 and B832	1-½ "	420'
Entire line between MH-33 and MH-34	4"	300'
Entire line between B498 and B479	3"	140'
Entire line between MH-17 and B801	3"	130'

The FY24 efforts on the CURP demonstrate a proactive approach to addressing the resiliency and efficiency of the steam distribution infrastructure associated with the CSF. By targeting areas with significant condensate losses, this project aims to reduce both water and energy waste by improving condensate return, which minimizes the need for makeup water and reduces the energy required to reheat this water into steam.

Each segment of piping scheduled for replacement, as shown in Table 7, reflects a clear prioritization of sections with significant inefficiencies, based on size and length. Addressing these segments—from smaller sections like the 130' line between MH-17 and B801 to the 500' line between MH-52 and MH-23/MH-23A—should notably decrease condensate losses across the system.

Critical distribution repairs such as these will not only improve overall efficiency but will also support long-term sustainability goals by lowering the carbon footprint associated with heating and water treatment at BNL. The reductions in makeup water and softener use, along with the decreased reliance on fossil fuels, directly align with BNL's goals of carbon-free and net-zero operations. These upgrades will likely have a significant cumulative impact on operational efficiency and environmental footprint.

In addition to the steam distribution repair work, in FY25, the site is undergoing an aggressive retro-commissioning on all heating system controls under the management of the EMCS. For each building operation of the following points will be verified: fresh air damper controls, critical sensors, preheat valves, reheat valves, variable air volume boxes, hand heat exchanger valves and control points. Where

minor control-related repairs and calibrations are feasible, the contractor will make the necessary corrections.

Retro-commissioning has many benefits. The primary benefit is energy efficiency because over time heating systems may drift from optimal settings resulting in inefficiencies. The process ensures heating controls are calibrated and properly actuating thereby optimizing energy consumption. Occupants also serve to benefit from enhanced comfort as properly functioning controls allow setpoints to be maintained at optimal levels. Finally, by optimizing the efficiency of the sites heating systems, retro-commissioning may reduce the carbon footprint of heating, aligning with sustainability goals by using less energy and reducing Scope 1 emissions.

### *Site Cooling*

In FY24, the site began undertaking an aggressive effort to improve cooling efficiencies by executing critical rehabilitations and heat rejection at building and central cooling systems throughout site.

First, the site invested in overhauling Chiller 8 in the CCWF. This overhaul included a major bearing replacement and resulted in an improved refrigerant approach internal to the chiller, greatly improving the chiller's thermal efficiency. In FY25 this work will continue with the overhauls of Chillers 5 and 6 in the CCWF. The site has also executed a contract to overhaul both chillers in the satellite chilled water facility.

In the area of heat rejection, the site has begun investing in cooling tower infrastructure. Most cooling towers have a service life of 10-15, many of the towers on-site have a life expectancy on the lower end due to high operating hours year over year, and operating conditions inherent to the site. The project began by identifying seven buildings with cooling towers operating beyond their usable life. In FY24 the procurement of parts for the execution of rehabilitations were complete for the following towers:

**Table 8:** Cooling Towers in Queue for Rebuild

<b>Tower Name</b>	<b>Building Name</b>	<b>Cooling Capacity (Nominal Tonnage)</b>	<b>Circulation rate (GPM)</b>
B488 Cooling Tower	Berkner Hall	275	826
B555 Tower 1	Satellite Chilled Water Facility (SCFW)	400	2,000
B555 Tower 2	Satellite Chilled Water Facility (SCFW)	400	2,000
B600 Couth Cell #5	Central Chilled Water Facility (CCWF)	1700	3,610
B600 Couth Cell #6	Central Chilled Water Facility (CCWF)	1700	3,610
B600 Couth Cell #7	Central Chilled Water Facility (CCWF)	1700	3,610
B600 Couth Cell #8	Central Chilled Water Facility (CCWF)	1700	3,610
B600 Couth Cell #9	Central Chilled Water Facility (CCWF)	1700	3,610
Tower 901A	Van de Greff	320	960
Tower 902W	Magnet Division	1,250	1,500

Tower 928 (RFMG)	Siemens Magnet Power Supply	3,200	4,800
Tower 930 (LINAC)	200 MEV LINAC	2,500	3,000

In FY25, the site is working towards completing a task order agreement contract with the intent of completing the rehabilitations of the above lists of cooling towers and cooling tower cells. The essential maintenance services will have many positive impacts including extended service life of critical infrastructure, energy efficiency improvements by as much as 15%, operation cost and maintenance savings, and enhanced system resiliency and reliability.

In FY25, the site will also continue with its third year of cooling controls retro-commissioning. The cooling controls retro-commissioning focuses on ensuring controls are optimized and properly working to maintain the most efficient cooling. During retro-commissioning, the following are checked: economizer controls, cooling coil valve controls, and dehumidification controls. Properly functioning economizers allow the system to increase outside air during intervals when outside air may be used to meet cooling needs, in place of running compressors and cooling mechanically. Properly functioning cooling coil controls prevent over cooling or uncontrolled cooling in service areas. Finally, dehumidification controls ensure conditions are proper so that process loads can run efficiently.

#### Workforce and Community

To improve education 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 Earth Day 2025 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.
- Feature articles about the Lab's climate research into aerosols and clouds and their impact on climate.
- Organize opportunities to showcase the Lab's mobile Center for Multiscale Applied Sensing which focuses on collecting data in urban and coastal locations and renewable energy locations.
- Highlight the Lab's participation in the Climate Resilience and Adaptation Initiative (Climate READi) and its work with the Climate Lighthouse project, led by City College of New York City, in which BNL partners to help residents better cope with extreme heat. The focus will be on using climate data to improve NYC residents' resilience and to build actionable knowledge among the public.

An environmental justice website is being developed to highlight the Lab's outreach in local communities, with federally identified tribal communities, as well as other disadvantaged communities.

BNL also plans to continue building upon its already successful community outreach initiatives including those listed under current performance.

## Fugitives & Refrigerants

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

### Current Performance

A variety of activities and operations at BNL use greenhouse gases (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 FY24.

**Table 9: 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>	2,068.38
	Accelerator gas transfers	SF <sub>6</sub>	40.33
		CO <sub>2</sub>	0.00
STAR Experiment	Detector gas purging	CH <sub>4</sub>	0.09
		CO <sub>2</sub>	0.07
		HFC-134a	922.43
		SF <sub>6</sub>	359.9
sPHENIX Experiment	Detector gas purging	CF <sub>4</sub>	26970.55
Fleet Vehicle Repair	Fleet Motor Vehicle A/C Leaks	HFC-134a	10.89
		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>	26.42
Wastewater Treatment Plant	Effluent discharges	N <sub>2</sub> O	0.75

The majority of fugitive GHG emissions were from detector purging of carrier gases during the Solenoidal Tracker at RHIC (STAR) experiment and the sPHENIX experimental runs. As in the past, to reduce carrier gas emissions of hydrofluorocarbon (HFC)-134a during the operational interval from April 6 to September 30 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 301.1 pounds higher (i.e., 195.35 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 in FY23 forced sPHENIX staff to alter gas flow rates and continuously purge gas during the entire experimental run. Staff expected to be able to run in recirculation mode for the FY24 experimental run, however, in FY24 staff were having operational difficulties with the detector. Given that the detector is one of the critical detectors for the physics program, staff needed to prioritize stable conditions during experimental runs and the highest priority went to working on the detector during shutdown periods with operating gas.

Comfort cooling and process refrigeration equipment also utilize GHGs. 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 Center Preventative Maintenance (PM) group utilizes the Refrigerant Compliance Manager software.

As the Modernization Project Office (MPO) implements facility improvements and equipment replacements, applicable guidelines and regulations are adhered to, including those pertaining to the HFC phase down and refrigerants with lower GWPs.

During January 2024, 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**

In September 2024, F&O had 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 HFCs.

Replacement of HFCs include A2L and A3 refrigerants. These refrigerants have lower GWPs but have higher flammability than HFCs being phased out. In September 2024, Refrigeration Service Engineers Society (RSES) provided BNL personnel (including HVAC staff, emergency services, operation support and planning division, and environmental protection division staff) training on A2L and A3 refrigerants. Due to the higher flammability of the A2L and A3 refrigerants, special considerations, training, and operational improvements must be implemented for the safe handling and proper storage of the refrigerants.

During FY24, EPD Environmental Compliance Group staff continued to follow EPA's draft rulemaking that appeared in the Federal Register pertaining to draft regulations requiring facilities to conduct leak detection, equipment repair, and material reclamation on air conditioning, refrigeration, and fire suppression equipment containing HFCs. The EPA finalized the rule on October 11, 2024. As such, EPD will work with F&O to incorporate the revisions into its Refrigerant Management Plan and to help HVAC staff to understand the revisions during FY25.

## 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

BNL has experienced extreme weather events over the years and, as a result, has prepared and executed a procedure titled, “Storm Preparation.” This procedure provides guidance on the actions required by the F&O Directorate prior to, during, and after a large storm. The last section of the procedure, Post Storm Event – Recovery, includes responsibility of the General Supervisors and Facility Project Managers to:

- Survey site to determine damage and operational problems;
- Establish a written list of required actions and submit to Facility Complex Manager;
- Contact F&O responsible management for reporting requirements and determinations;
- Contact/callout supervisory and craft personnel to report to site and begin essential repairs; and
- Return facilities to normal operation, where possible.

The table below summarizes the high priority rank resilience solutions whose implementation status is currently being tracked within the DOE Sustainability Dashboard. These projects were all determined to be feasible, and funding mechanisms were available for implementation.

**Table 10: 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
Water System Connection	High	Planned start in FY24	Direct - SLI	Funded

Five of the projects were successfully implemented in FY23 and continued in FY24. The Water System Connection project was added in FY24 and will continue in FY25. Below is a summary of each project, current status, anticipated effectiveness, and cost information.

#### Critical Response Facilities – Emergency Power

*Summary of Project* – 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 (3PBP) for funding consideration by the Lab's Policy Council. At the end of FY23, the final Consolidated Unfunded Requirements List (CURL) was approved and included the installation of an emergency generator at the Lab's main gate security station (Building 680) 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.

*Current Status* – Construction for the Building 680 emergency generator and transfer switch started in September 2024 and will be completed during the first quarter of FY25.

*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 3PBP approved projects. \$480K in FY24 for the installation of Building 680 emergency generator.

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

*Summary of Project* – 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.

*Current Status* – The design is complete, and the two new chillers are scheduled to arrive mid-winter 2025.

*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

*Summary of Project* – 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 CCWF (B600).

*Current Status* – The design has been completed and concrete duct bank has been installed in FY24. Currently waiting on the delivery of the cable and the associated switchgear that will be installed in FY25.

*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

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

*Current Status* – In FY24 the site began revamping of its condensate/steam metering plan. During the fiscal year, metering was purchased for the following facilities: B452, B463, B490, B535, B555, B510, B725, B734, and B832.

In addition, a calibration of all site-level chilled water meters occurred in the spring of FY24. 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 FY24 purchasing and installing new and maintaining existing meters at BNL.

#### Wildfire Management Program

*Summary of Project* – This project includes continued fuels management and prescribed fire management to support site ecology, land preservation, and reduce risks to sitewide critical assets.

*Current Status* – Fire management activities continued in FY24. 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 was finalized. Using CURL funds, 23 acres in the northern portion of the Lab were mechanically treated to reduce hazards. A single prescribed fire was initiated but was quickly halted when test fire indicated that fire behavior would not meet prescriptions.

*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.

#### Water System Connection

*Summary of Project* – Install emergency water system connection to the local utility provider.



*Anticipated Effectiveness* – This project will add redundancy and resiliency to the entire BNL potable water system if an emergency arises.

*Current Status* – Service line from Suffolk County Water Authority has been installed on-site and currently capped near the new SUSC. Design for cross-connection building and hookup to BNL supply currently under review. Anticipate construction in FY25.

*Cost* – Total cost is anticipated to be approximately \$1.2M.

In FY24, BNL’s Office of Emergency Management (OEM) continued to integrate climate resilience into its day-to-day risk management processes. Some examples include:

- OEM monitors the National Weather Service (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 on-site.

#### Resilience Research

BNL continues to advance climate resiliency through its research and partnerships. For example, in August 2024 the DOE announced \$10 million in funding to support the development of Climate Resilience Centers across the nation. DOE then selected ten university-led research teams to leverage modeling, data and research from the DOE Laboratories to focus on climate prediction of weather hazard risks to better prepare communities. For the New York metropolitan region, the Climate Lighthouse project, led by City College of New York City, will partner with BNL to help residents better cope with extreme heat. The focus will be on using climate data to improve NYC residents’ resilience and to build actionable knowledge among the public.

In addition, BNL co-hosted the Climate READi Northeast Regional Workshop with the Electric Power Research Institute (EPRI) at the end of August 2024. The workshop was the final of four hosted around the country as part of the Climate READi program. The workshop specifically focused on the future of the power system in a world affected by climate change, and planning for impacts of floods and clouds on the power system. BNL’s research in atmospheric and climate science is critical to understanding the climate system and helping utilities in predicting and optimizing restoration after outages from storms.

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

## Plans and Projected Performance

The plan for FY25 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 FY25 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 FY25 (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 – Begin the initiation of construction activities.
- New 13.8kV Feeder – Continue with the construction after the arrival of the long-lead items such as the 15kV cable and switchgear.
- Additional Utility Metering – In FY25 \$75K in funding has been allocated to bolster the site’s metering infrastructure. There is a plan to install the above listed condensate and steam metering infrastructure and tie the data into the site’s EMCS. Additionally, 13 of the new meters are being installed at the cubicle level of substation 631. The cubicle level metering will also be tied into the EMCS system enhancing visibility into distributed electricity usage.
- Fire Management Program – Planning for additional prescribed fires will continue, including thinning/mechanical treatments with approved FY25 CURL funds (\$100K).
- Water System Connection – 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. The final design is in progress and a Utility Procurement Plan needs to be developed to purchase the water.

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

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3PBP	Project, Planning, Programming and Budgeting Process
AC	Air Conditioning
ADA	Americans with Disabilities Act
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
EAC	Environmental Attribute Certificate
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
EPRI	Electric Power Research Institute
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
PTFE	polytetrafluoroethylene
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
RSES	Refrigeration Service Engineers Society
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

## Appendix B: Comprehensive Scorecard



### Scope 1 & 2 Greenhouse Gas Emissions

Goal: Reduce direct GHG emissions by 50 percent by FY 2025 relative to FY 2008 baseline.  
Interim Target (FY 2024): -46.0%

Baseline: 205,628.2 MtCO<sub>2</sub>e

**Current Performance: -32.6%**  
**(138,605.9 MtCO<sub>2</sub>e)**



### Scope 3 Greenhouse Gas Emissions

Goal: Reduce indirect GHG emissions by 25 percent by FY 2025 relative to FY 2008 baseline.  
Interim Target (FY 2024): -23.0%

Baseline: 19,713.6 MtCO<sub>2</sub>e

**Current Performance: -37.0%**  
**(12,415.9 MtCO<sub>2</sub>e)**



### Energy Intensity

Goal: Reduce facility energy in goal subject facilities by 30 percent relative to FY 2015 baseline.  
Interim Target (FY 2024): -30.0%

Baseline: 242,880.5 Btu/GSF

**Current Performance: -7.7%**  
**(224,263.5 Btu/GSF)**



### Renewable Energy

Goal: Use 30 percent renewable energy as a percentage of overall facility electricity use by FY 2025.  
Interim Target (FY 2024): 27.5%

Baseline: 291,655.0 MWh

**Current Performance: 7.4%**  
**(21,628.9 MWh)**



### Potable Water Intensity

Goal: Reduce potable water intensity by 36 percent by FY 2025 relative to FY 2007 baseline.  
Interim Target (FY 2024): -31.0%

Baseline: 22.3 gal/GSF

**Current Performance: -196.4%**  
**(-21.5 gal/GSF)**



### Fleet Petroleum

Goal: Reduce fleet petroleum use by 20 percent by FY 2015 and thereafter relative to FY 2005 baseline.  
Interim Target (FY 2024): -20.0%

Baseline: 115,684.0 GGEs

**Current Performance: -100.0%**  
**(0.0 GGEs)**



### High Performance Sustainable Buildings

Goal: Ensure 15 percent (18 percent by GSF) of buildings meet the Guiding Principles for sustainable buildings by FY 2025.

Interim Target (FY 2024): 16.8%

Baseline: 40.0 Buildings

**Current Performance: 27.5%**  
**(11.0 Buildings)**



### Fleet Greenhouse Gas Emissions/Mile

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

Interim Target (FY 2024): -28.0%

Baseline: 0.0 GHG/Mile

**Current Performance: 0.0%**  
**(0.0 GHG/Mile)**