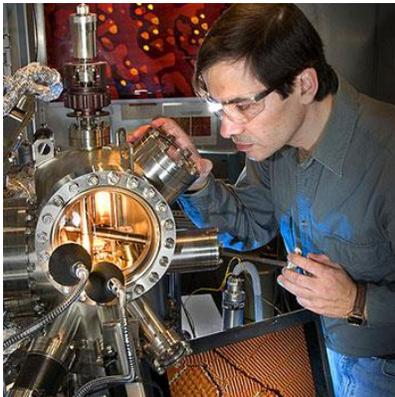


Brookhaven National Laboratory FY 2018 Site Sustainability Plan



U.S. DEPARTMENT OF
ENERGY

Office of
Science

BROOKHAVEN
NATIONAL LABORATORY

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I. Executive Summary

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

BNL is operated and managed for the Department of Energy Office of Science (DOE-SC) by BSA, a partnership formed by Stony Brook University (SBU) and Battelle Memorial Institute. BNL is staffed by over 2,600 research and support employees and hosts an even greater number of facility users, guest researchers, and scientists annually. The Laboratory operates from an extensive campus located in Upton, New York, on 5,320 acres with approximately 4.9 million gross square feet (gsf) of space in over 300 buildings.

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

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

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

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

The Laboratory remains strongly committed to supporting and achieving the targets in the DOE Strategic Sustainability Performance Plan (SSPP). Leadership in sustainability is demonstrated through the Laboratory's management practices, stewardship of the BNL campus, as well as our research and education programs. The efforts in sustainability are communicated widely across the Laboratory, and the Senior Leadership team remains actively engaged.

BNL's energy management program continues to be the centerpiece of our Sustainability program. We continue to maintain solid relationships with local utility providers ensuring cost effective power rates for operating the energy intensive user facilities and general infrastructure. BNL collaborates with the local utilities to leverage purchasing power and assist in renewable energy production to jointly support the goals of BNL and the New York region.

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

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

These projects demonstrate how BNL is continuing to collaborate with many organizations both internally and externally to enhance research at the Laboratory with the sustainability goals in mind. Staff members from the BNL Environment, Biology, Nuclear Science, and Nonproliferation (EBNN) Directorate, Facilities & Operations (F&O) Directorate, Information Technology Division (ITD), and the DOE Brookhaven Site Office (BHSO) have been instrumental in preparing our research agenda and developing a plan to bring it to fruition.

The Comprehensive Scorecard illustrates the areas we've been extremely successful and they include compliance with the Guiding Principles (GPs) of High Performance Sustainable Buildings (HPSB), construction and demolition recycling, fleet management, and sustainable purchasing.

The Laboratory has made significant progress this year in meeting the goals of the SSPP. We have challenges that we are working on creative solutions to overcome. This coming year we will be maintaining focus on those areas that are performing well and will be concentrating on making improvements in those areas that are not on track to meeting the requirements, including evaluating zero emission buildings, GHG emissions, as well as data center efficiencies.

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 Comprehensive Scorecard for BNL is provided in Appendix B.

II. Performance Review and Plan Narrative

Energy Management

This category focuses on all energy-related topics such as greenhouse gas (GHG) emissions, energy intensity, metering & benchmarking, Energy Independence & Security Act (EISA) §432, and non-fleet fuel use.

Performance Status

Greenhouse Gas Emissions

BNL's major initiatives continue to include 15 MW of hydropower, Renewable Energy Credit (REC) purchases, and energy intensity reductions. BNL's on-site solar photovoltaic (PV) array—the Northeast Solar Energy Research Center (NSERC) facility—was expanded from 492 kW to 816 kW in 2016 using Sustainability Performance Office (SPO) funding assistance and completed its first full year of expanded operation in 2017. These actions have resulted in an impressive 50% reduction (~118,000 MtCO₂e) in Scope 1 and 2 greenhouse gas (GHG) emissions for FY17. Further, even though BNL does not receive credit, the 32-MW Long Island Solar Farm (LISF) reduced GHGs on Long Island by 32,109 MtCO₂e.

Details on Scope 3 GHG emissions are provided in the section *Travel and Commute*.

One of the Laboratory's recent success stories was the completion of our first Utility Energy Service Contract (UESC) in May 2015. Annual savings are consistently verified with an annual reduction of approximately 90,000 mmBtu of energy and 7,000 MtCO₂e of GHGs, which were essentially the same as original projections. See the section *Measures, Funding and Training* for additional details.

BNL continually strives to increase the efficiency of the High Energy Mission Specific Facilities (HEMSF), particularly with the cryogenic cooling systems at the RHIC facility. Over the years, the electric energy required to provide cooling has been reduced by several MWs. Furthermore, BNL continues to ensure the Core Facility Revitalization (CFR) project is designed to be as efficient as possible. The CFR project includes consolidation of BNL's data centers.

Other important initiatives include the continued utilization of a number of best management practices, particularly building temperature setbacks during unoccupied periods.

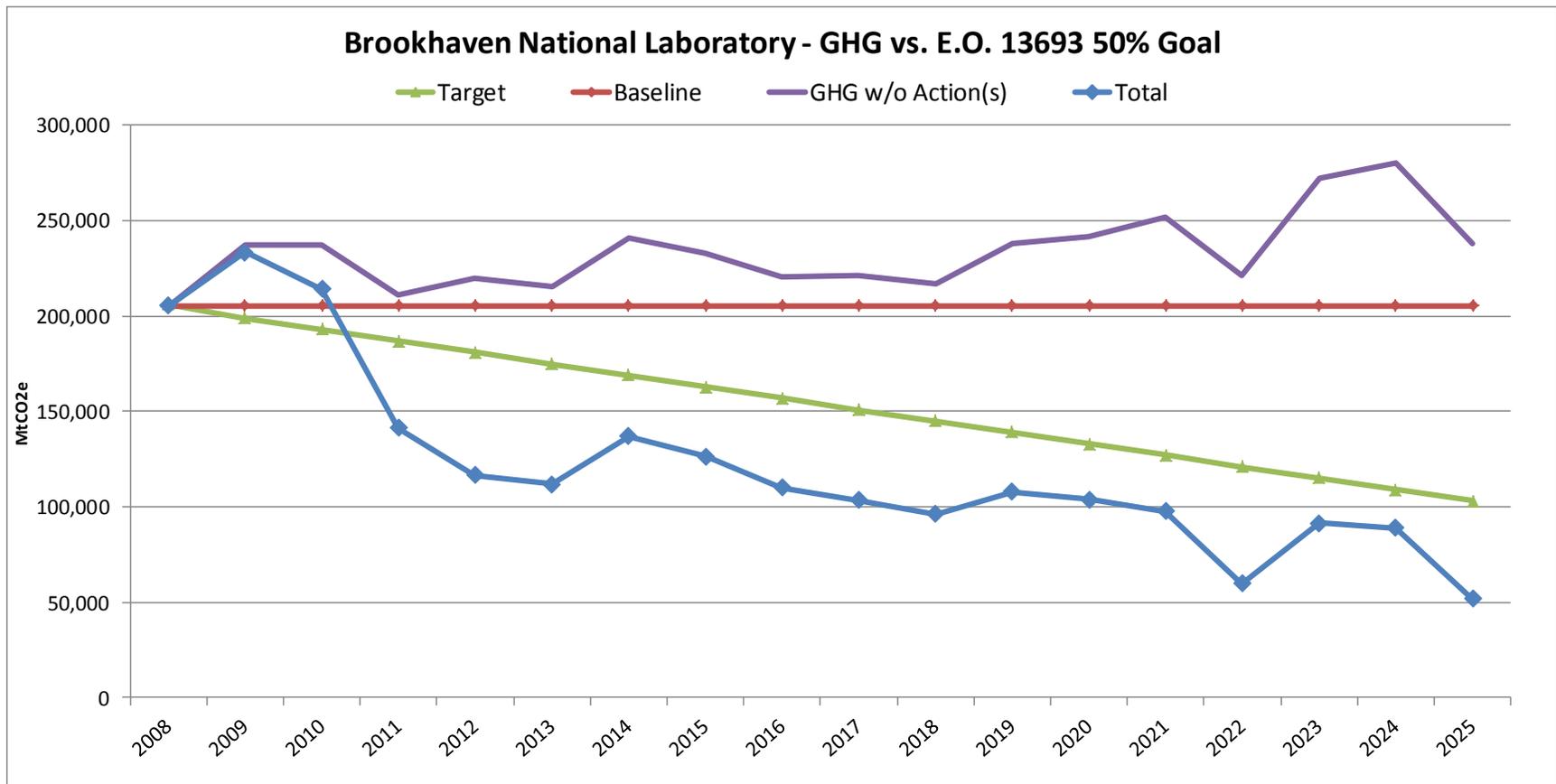


Figure 1: BNL GHG vs. EO 13693 50% Goal

Energy Intensity

BNL's energy intensity for FY17 was 226,029 Btu/gsf and was 7% lower than the new base year of 2015. Given the fact that BNL was able to meet the previous three (3) energy intensity reduction goals of 30% each, we are very pleased with the results. The FY17 reduction surpassed the current target of 5%.

Energy intensity can easily be affected by many factors, including several beyond our ability to control, the most significant of which is weather. Being located in the Northeast results in the fuel for heating being the most dominate energy source for our buildings. Other factors include changing outdoor air code requirements, increased density of new facilities, and constantly changing technologies including computers and related IT systems, lighting, and others.

The following depicts the energy use intensity (EUI) for non-excluded buildings (i.e., goal subject ones) at BNL greater than 5,000 gsf with an EUI of 150 BTU/GSF or above:

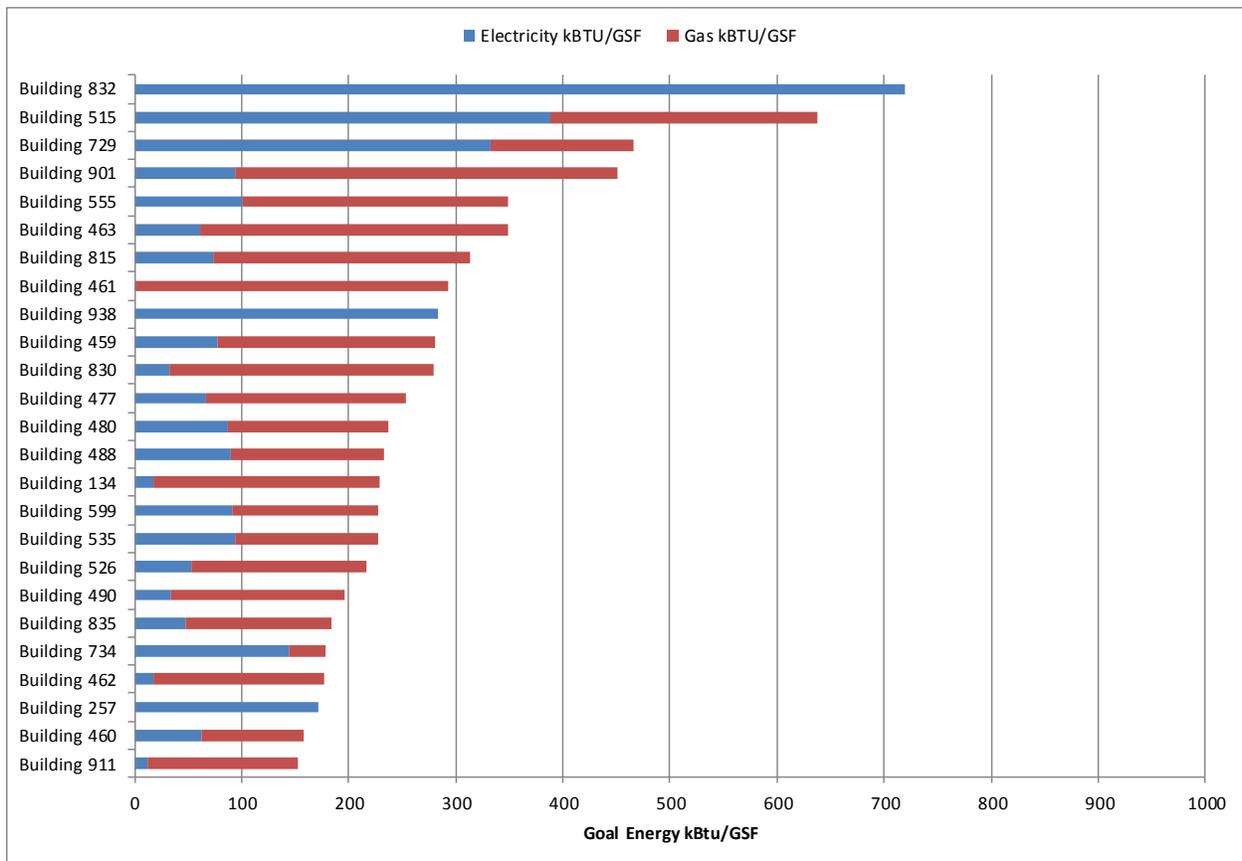


Figure 2: EUI for Non-Excluded Buildings

FY17 was the second full year with the results of the UESC Phase I project. The energy savings were again verified and contributed to the lower energy intensity value. Additionally, the Temperature Setback Policy is continually communicated to the Laboratory via several methods, including Earth Day events and presentations to Facility Project Managers (FPMs), Facility Complex Managers (FCMs), and Laboratory management.

BNL has a long-standing, well developed energy conservation program that utilizes a number of the tools recommended in E.O. 13693, including:

- Utilizing the latest Building Automation System (BAS) software to identify inefficiencies (remote auditing);
- Participating in Demand Management programs;
- Entering performance data in EPA Energy Star Portfolio Manager;
- Utilizing the latest BAS software to communicate building energy usage (effectively “Green Button”);
- Space management and optimization practices;
- Comprehensive Data Center metering and monitoring; and
- Targeting Data Center PUE of less than 1.5 for existing facilities and 1.2 to 1.4 for new facilities.

Deferred Maintenance Reduction

BNL’s recently completed UESC project specifically targeted buildings that had systems in need of maintenance and replacement of obsolete controls and lighting. Not only was our deferred maintenance reduced by approximately \$8.9 million but energy efficiency was also improved. BNL is in the process of developing a second UESC project—UESC Phase II—that in addition to energy and GHG deductions, will also target deferred maintenance.

Fossil Fuel Reduction (EISA Section 433) in New Buildings

BNL strives to reduce fossil fuel use in new buildings by having them designed and constructed to the most efficient, cost effective levels possible. By meeting the High-Performance and Sustainable Buildings (HPSB) criteria, energy use is minimized. Further, alternatives to fossil energy sources are thoroughly evaluated (renewable energy, daylighting, ground source heat pumps, etc.) during the design.

Energy and Facility Manager Training

The manager of Energy Management at BNL is a Certified Energy Manager (CEM). In addition, all of the FCMs throughout the BNL campus have the Certified Facility Manager (CFM) recognition from the International Facilities Management Association (IFMA). All of the FCMs and Facility Complex Engineers (FCEs) participate in various training programs throughout the year to ensure core competencies.

New Construction Design for 30% Improvement over ASHRAE 90.1 2010

All new construction designs at BNL are required to design for a 30% improvement in energy efficiency, as compared to ANSI/ASHRAE/IESNA Standard 90.1, whenever cost effective.

EISA Section 432 Evaluations and Benchmarking

Energy audits of HVAC systems, lighting, and office equipment will continue to be used to identify opportunities for energy conservation. The findings will help to develop policies on operation and equipment needs. These audits are being performed in conjunction with ongoing condition assessment surveys in order to reduce additional costs and administrative oversight needs.

All information has been placed in EPA’s Portfolio Manager Program for benchmarking.

Metering

BNL continued its long tradition of advanced metering efforts in FY17 and is meeting the metering goals for electricity, natural gas, and chilled water. During FY17, twelve (12) advanced electric meters were installed; three (3) advanced chilled water meters were replaced; and two (2) advanced steam meters were installed and two (2) existing advanced meters were connected to the building automation system.

Overall, 304 advanced electric meters are installed and they capture over 98% of consumed electricity. Of the 159 buildings greater than 4,000 square feet, 151 (95%) advanced meters are installed.

Thirty-four (34) advanced chilled water meters are installed in 34 buildings or loads with chilled water, and all three (3) of BNL's natural gas-supplied facilities have advanced meters installed.

Advanced steam/condensate metering is installed in 44 buildings. However, 24 buildings still have conventional steam meters that will be upgraded as appropriate. BNL will install new steam metering in larger use buildings where steam metering is insufficient with a goal of upgrading three or more meters per year. This will assist in our planned steam charge-back effort.

Due to the low cost of water, the installation of water meters is not economically justifiable. However, BNL's major facilities with cooling towers, as well as new buildings and major renovations include water metering. For instance, in FY13, the new LEED Gold Interdisciplinary Science Building I (ISB-I) was commissioned and included advanced potable water metering.

A substantial amount of the water used at BNL is utilized by cooling towers, most of which are metered.

Electric Usage Projections

The following chart summarizes BNL’s historical and projected electricity usage for HEMSF and the Site Base.

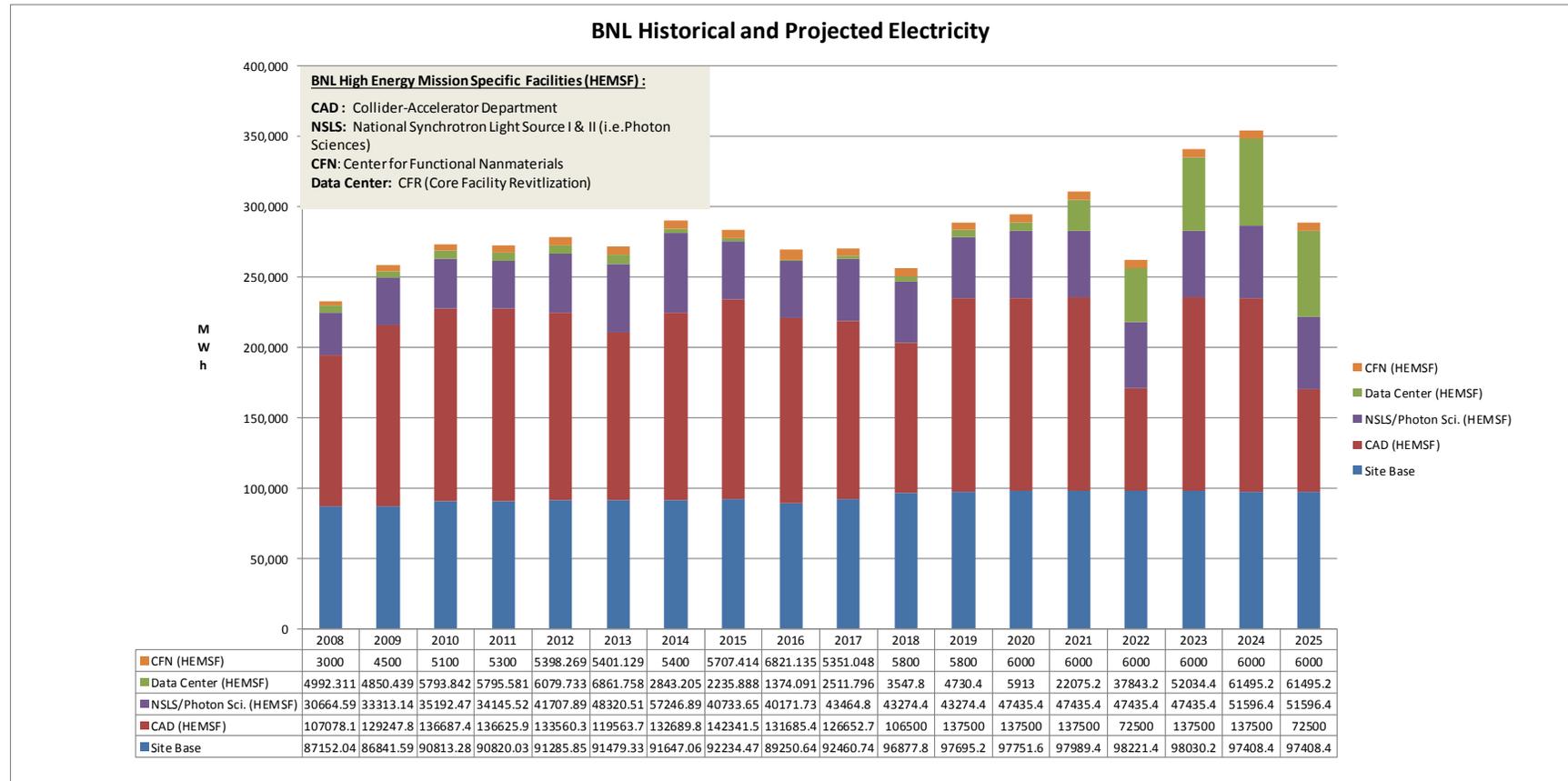


Figure 3: BNL Historical and Projected Electricity

The electric projections take into account current plans, HEMSF operation schedules, and anticipated future projects, including the Core Facility Revitalization Project (CFR) that will consolidate and expand BNL’s data center operations.

Electricity and REC Cost Projections

The chart below shows electricity and REC cost history and projections. REC pricing rates through FY18 are actual. BNL made advanced purchases due to the attractive pricing available of \$0.0007/kWh.

However, given the increasing renewable and clean energy requirements from not only the federal government, but many other entities, including New York State’s 50% renewable by the year 2030 goal, rates are expected to increase substantially. The table assumes that rates will increase to ~\$2/MWh by 2019 and to ~\$5/MWh by 2025. These assumptions are based on discussions with a few REC providers. These assumptions will be updated in future SSPs.

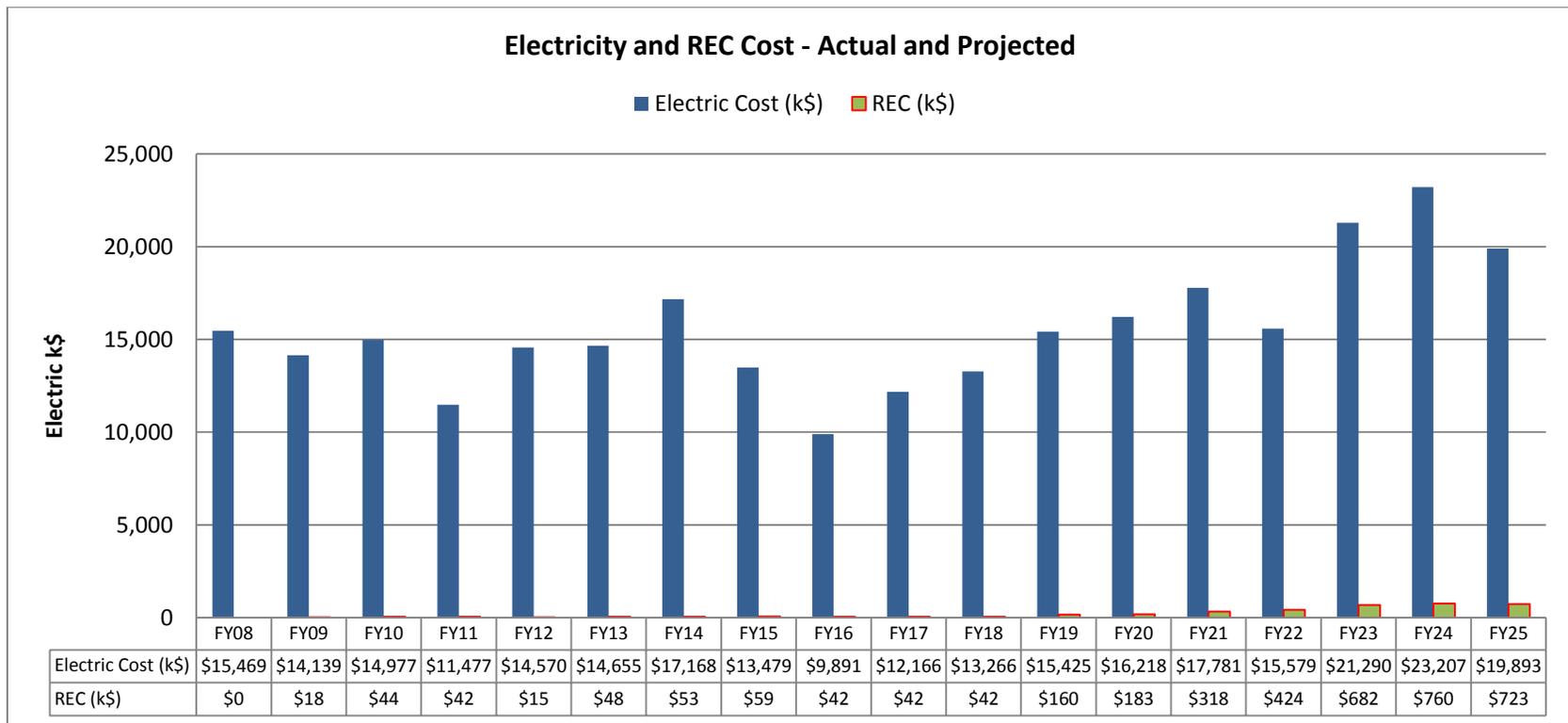


Figure 4: Electricity and REC Cost – Actual and Projected

Plans and Projected Performance

Energy Intensity

One of the biggest challenges for BNL will be to meet the new 25% energy intensity reduction goal by FY25. Since the late 1970's, BNL has implemented numerous energy conservation projects, meeting all three previous energy intensity reduction goals of 30% (1985 vs. 1973), 30% (2003 vs. 1985), and 30% (2015 vs. 2003). As a result of these past efforts, BNL has reduced our energy intensity by approximately 440,000 Btu/sq. ft. (66%). Unfortunately, the previous reductions make it very difficult to identify new cost-effective projects.

As previously stated, BNL has begun a UESC Phase II effort. If enough cost-effective projects can be identified for Phase II, BNL may be able to meet the new 25% reduction goal, or at least make progress toward it. All energy-related projects will be analyzed using Life-Cycle Analyses.

BNL will continue to pursue an aggressive Temperature Setback Policy in FY18 and communicate its importance to the Laboratory population. Further, BNL will continue all of the best practices currently in place, including HVAC setback, steam charge-back, and lighting upgrades as described below.

Heating, Ventilation, and Air Conditioning (HVAC) Setback

A setback capability for HVAC systems continues to be implemented throughout the BNL campus. The FCMs and their staff regularly evaluate systems to ensure that this function is operating as intended. Setback will be captured by using the new Building Automation Program. FCMs will communicate with building occupants about energy usage and the benefits of HVAC setback and energy conservation. Any future lease agreements will be modified to incorporate setback clauses. Further, the existing preventative maintenance (PM) program was recently enhanced for all HVAC systems. The HVAC setback initiative will continue to be emphasized in FY18 as part of BNL's educational effort for the facility managers. This is part of a larger site-wide effort to encourage active employee participation in various conservation efforts.

Steam Charge-back

A steam cost charge-back program was developed for implementation in the near future to encourage energy conservation. BNL uses direct charges to bill occupants for electricity and chilled water, and finds it to be one of the most effective methods to increase energy conservation. One option under consideration is to have the steam charges be phased into a full cost recovery program over several years to accommodate the varying financial impacts to each building's occupants. It is estimated that this should provide energy savings of approximately 62,000 mmBtu/year.

Lighting Upgrades

Planning will continue for BNL's ongoing program of upgrading lighting through the Laboratory with high efficiency replacements. Automated controls will be installed where appropriate.

Metering

Additional meters will be installed as opportunities become available. Electric and steam meter installations often require extensive coordination and shutdown of operations. BNL strives to install at least five (5) electric meters and three (3) steam/condensate meters annually but a number of factors affect our ability to complete the work. The biggest issue is limited funds and coordination of building operations if shutdowns are required.

Water Management

This category focuses on all water-related topics such as potable water intensity and industrial, landscaping, and agricultural (ILA) water consumption.

Performance Status

BNL obtains its potable, process cooling, and fire protection water from Long Island’s underground aquifer. BNL runs its own NYS-regulated “community water system,” which consists of five (5) water wells, a Water Treatment (Iron Removal / Filter) Plant, two (2) elevated water storage tanks with a capacity of 1.3 million gallons, and an underground distribution system with about 45 miles of piping, valves, and hydrants.

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

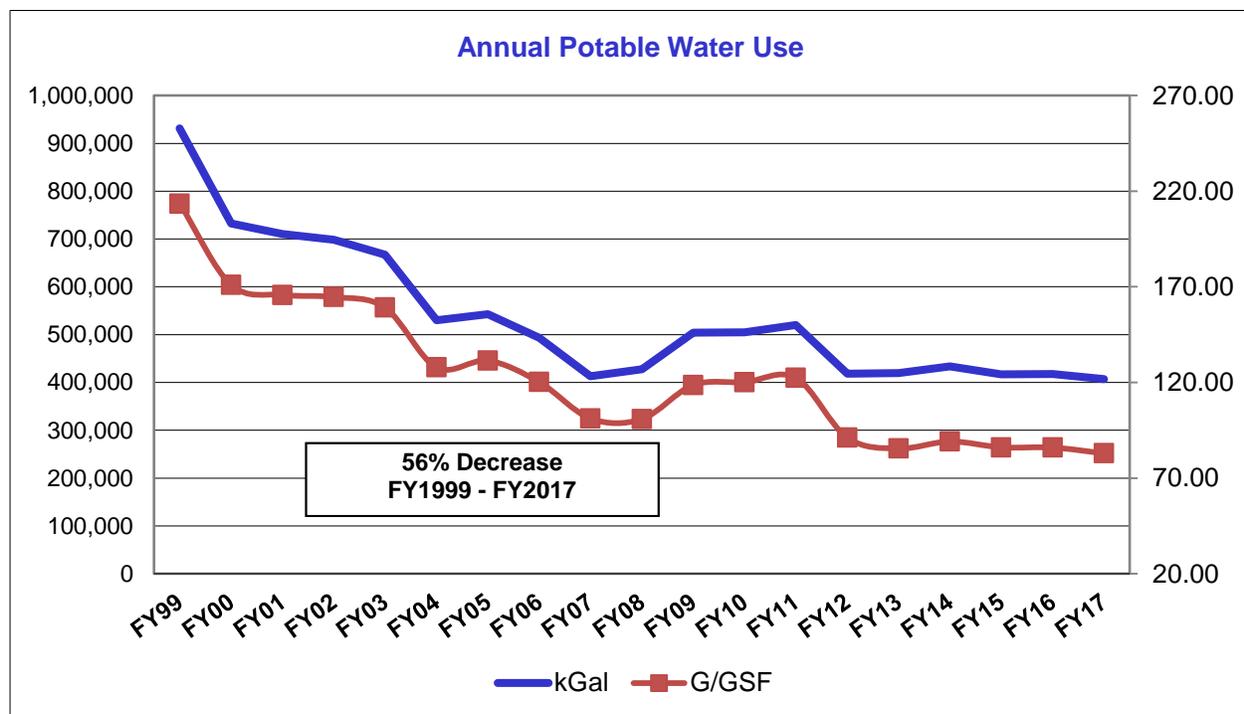


Figure 5: Annual Potable Water Use (1999-2017)

Potable-water usage fell from 931 million gallons/year in FY 1999 (average of 2.55 million gallons per day) to about 407 million gallons/year in FY 2017 (average of 1.12 million gallons per day), a reduction of 56.3%. When normalized by site growth (building area in gross square feet), BNL’s annual water use intensity has decreased from 101 gallons per square foot to 83 gallons per square foot, an 18.0% water usage reduction since base-year 2007.

Figure 6 depicts how BNL uses its potable water, and where it goes thereafter. Note that less than 10% is used for human consumption and sanitation. The majority of BNL's water production is spent for process cooling. This non-contact cooling water is used (once-through) to cool heat exchangers and returned to the groundwater. Water is also used to make up for evaporative, drift, and blowdown losses from re-circulating cooling towers. Tower blow-down is typically discharged into sanitary or storm sewers, treated, and ultimately, returns to the groundwater.

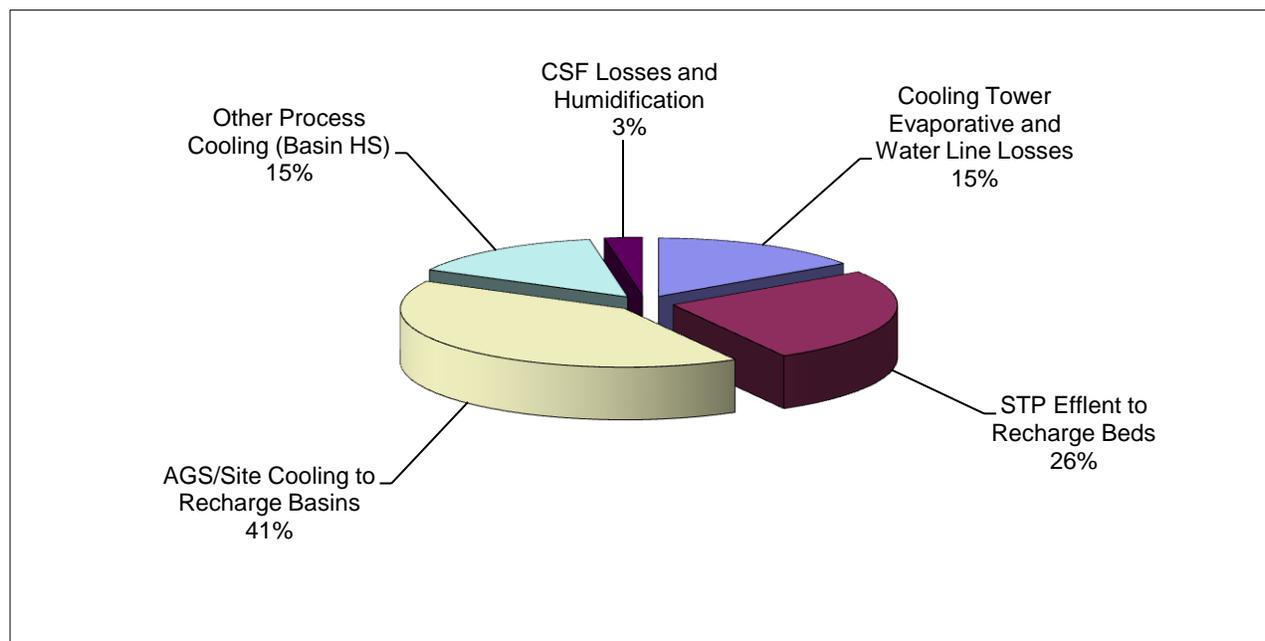


Figure 6: 2015 Potable Water Utilization

In October 2014, BNL implemented groundwater recharge of treated wastewater at its Sewage Treatment Plant. Currently, about 82% of water used at BNL is recharged (recycled) to groundwater via groundwater recharge basins. The water recharged is near potable water quality.

It is estimated that over two-thirds of BNL's water production is attributable to High Energy Mission Specific Facilities.

Plans and Projected Performance

Water Management Plan

BNL's Water Management Plan describes how BNL designs and operates the Laboratory's buildings and facilities to be sustainable and water efficient. It outlines our efforts to continue to reduce water usage by implementing best-management practices. The E.O. 13693 goals require that BNL reduce water consumption by 2% per year toward the goal of 36% reduction by FY 2025 compared to the FY 2007 baseline.

Presently, we are implementing best-management practices (BMPs) as detailed in Section 2.2 of our Water Management Plan. Implementing water conservation is a significant economic challenge. Water is plentiful and inexpensive at BNL. The variable cost of producing water currently is about \$0.50 per

thousand gallons. Most water conservation measures are capital- and labor-intensive. We are always evaluating the return on investment of implementing additional BMPs. These BMPs have the potential to lower water consumption by more than 40 million gal/yr. Our ability to implement these capital-intensive measures depends upon obtaining additional benefits (such as replacing obsolete equipment, extending equipment's end-of-life, reduced maintenance costs, reducing waste water discharges to the Sewage Treatment Plant, and increasing energy savings) and upon obtaining capital funding to install them (aligned with other priorities).

Finally, we emphasize that over 80% of BNL's water consumption is returned and recharged to groundwater at potable water quality. We believe that BNL's groundwater recharge fully meets the DOE's water management "recycling" or "non-consumptive" criteria (except for insignificant temperature changes). In an effort to increase the rate of on-site recharge, BNL completed a project in 2014 to re-route the treated effluent from the Sewage



Treatment Plant from a surface water discharge to a groundwater recharge system. This project eliminates a potential source of trace metals contamination to the Peconic River and improves the quality of the river downstream of BNL. A review of analytical data on Sewage Treatment Plant effluent has shown that the water quality meets all federal and state groundwater quality standards. This change resulted in an increase of over 100 million gallons per year recharged locally versus off-site flow via the Peconic River.

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

- Public Information and Education Programs. BNL's water-related public information and education programs emphasize the excellent quality of BNL's potable water supply and seek to minimize employee's use of expensive, environmentally unfriendly bottled water.
- Distribution System Audits/Metering. BNL periodically audits its water distribution system as part of infrastructure planning and utility reviews (e.g., 10-year Master Plans). BNL's utility engineers understand BNL's water system to be "tight" and relatively leak-free. Because of the plentiful supply and low cost of water at BNL, water meters are not available at most buildings or major process users. We bill one major process user for water.
- Water-efficient Landscaping. BNL's minimal formal landscaping is compatible with the local climate and rainfall. BNL does not routinely irrigate lawns and landscape.

- Toilets and Urinals. BNL currently specifies low consumption toilets and flushometers (1.6 gallons per flush [gpf] for toilets and 1.0 gpf for urinals) for new construction, renovations, and maintenance.
- Faucets and Showerheads. BNL specifies low-flow, WaterSense faucets and showerheads for new construction, renovations, and maintenance.
- Boiler/Steam Systems. BNL has a district steam-system and Central Steam Facility. Depending on the season, 75-85% of the steam exported from the facility returns as condensate. (This is excellent return for a large district steam-system and the condensate return conserves water and energy).
- Single-Pass Cooling Systems. BNL has reduced water flow through single-pass cooling systems that discharge to the sanitary sewer system. The marked success of these efforts is reflected in the 56% water use intensity reduction.
- Cooling-tower Systems. To reduce water use in once-through cooling systems, BNL has 16 cooling towers with a flow rate of over 300 gpm. Many other smaller towers are located around the site. To maximize cooling efficiency and minimize water use, BNL controls the blowdown rates on the large towers to maintain the “cycles of concentration” between 4 and 5.
- Water Reuse and Recycling. Over 80% of BNL’s water consumption (except evaporation and drift at cooling towers) is recharged back to the ground (where the well water came from). All of BNL’s process water (e.g., make-up and cooling) is obtained from the Laboratory’s potable-water system and is accounted for in accordance with Executive Order 13693, “Planning for Federal Sustainability in the Next Decade.”
- Sewage Treatment Plant Effluent Recharge. A modification to convert the Sewage Treatment Plant from surface water discharge (Peconic River) to groundwater recharge / recycling was completed in September 2014. Purified wastewater (effluent) from BNL operations is currently being recharged and recycled to groundwater.

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

In FY16, the Laboratory funded the engineering and design of a new Well House No. 12. Start of construction of the new well house is now planned for FY20. Total estimated cost (TEC) for the project will be about \$1,000K. The new well house will replace the well house structure destroyed in a propane explosion in October 2008. Well No. 12 is located in an area of the BNL site with low-iron groundwater. Return of Well No. 12 to operation will reduce the need to operate BNL’s high-iron wells – Well Nos. 4, 6, and 7. This in turn will reduce the duty on BNL’s Water Treatment (i.e., Iron Removal / Filter) Plant, and reduce the number of backwash cycles and backwash wastewater. This could reduce BNL’s water usage by 3% to 5%.

We continue to expect that increased, “main-mission” science program activities and their need for accelerator cooling will tend to increase water consumption, due to cooling tower evaporation. “Fully built-out” operation of BNL’s National Synchrotron Light Source II (NSLS-II) accelerator is projected to

increase BNL's water consumption by about 12% over the next few years due to process cooling requirements. This is not as significant an issue at BNL as it is at DOE facilities in arid locales. Groundwater recharge from annual precipitation (almost all storm water is recharged on-site) is orders of magnitude greater than BNL's water usage that is "lost" due to evaporation (in evaporative cooling towers).

Reducing BNL's water consumption by 2% per year through 2025 against planned (and hoped-for) science program growth and on top of past reductions will continue to be a challenge.

Waste Management

This category focuses on all waste-related topics such as municipal solid waste, waste diversion, wastewater treatment, and associated GHG emissions.

Performance Status

BNL has a mature established waste reduction and diversion program that recycles the following components:

- mixed paper;
- cardboard;
- bottles and cans;
- tires;
- construction debris;
- used motor oil;
- metals;
- concrete/asphalt;
- automotive batteries;
- printer/toner cartridges;
- fluorescent bulbs;
- Blasocut (cutting oil coolant);
- scrap electronics; and
- animal bedding (composted).

As evidenced by the graph below, BNL's annual diversion rate on non-hazardous solid waste has been above the Department's 50% goal for the past 18 years. During FY17, the recycling rate was approximately 73%.

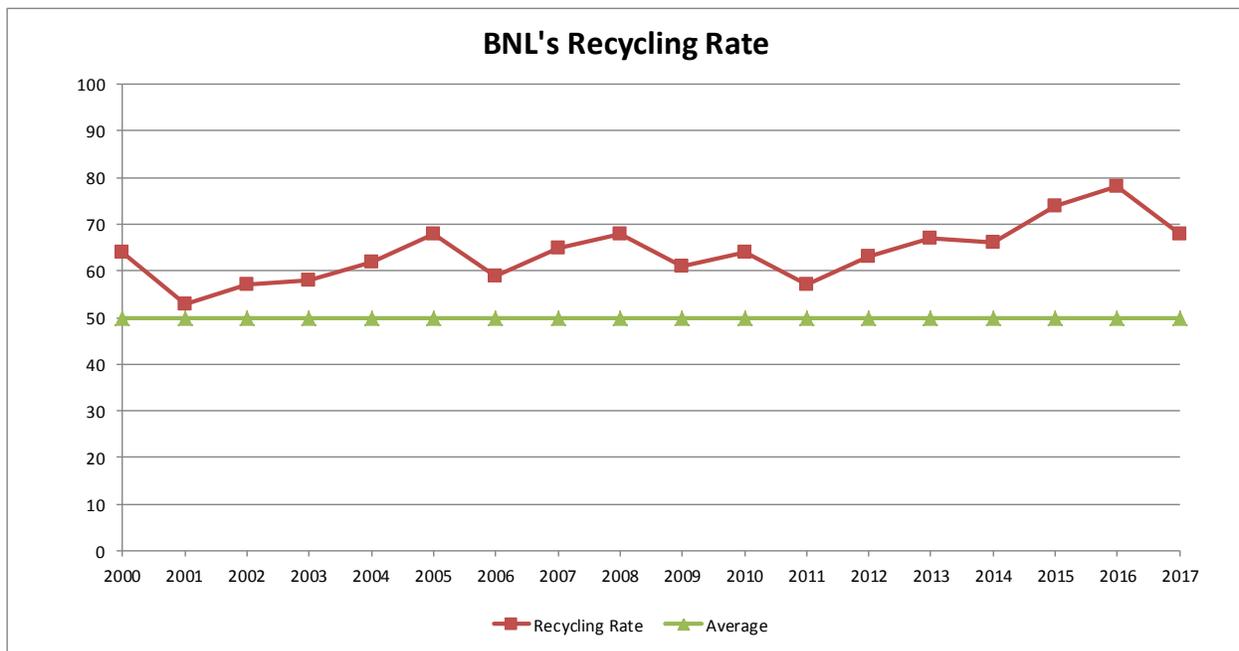


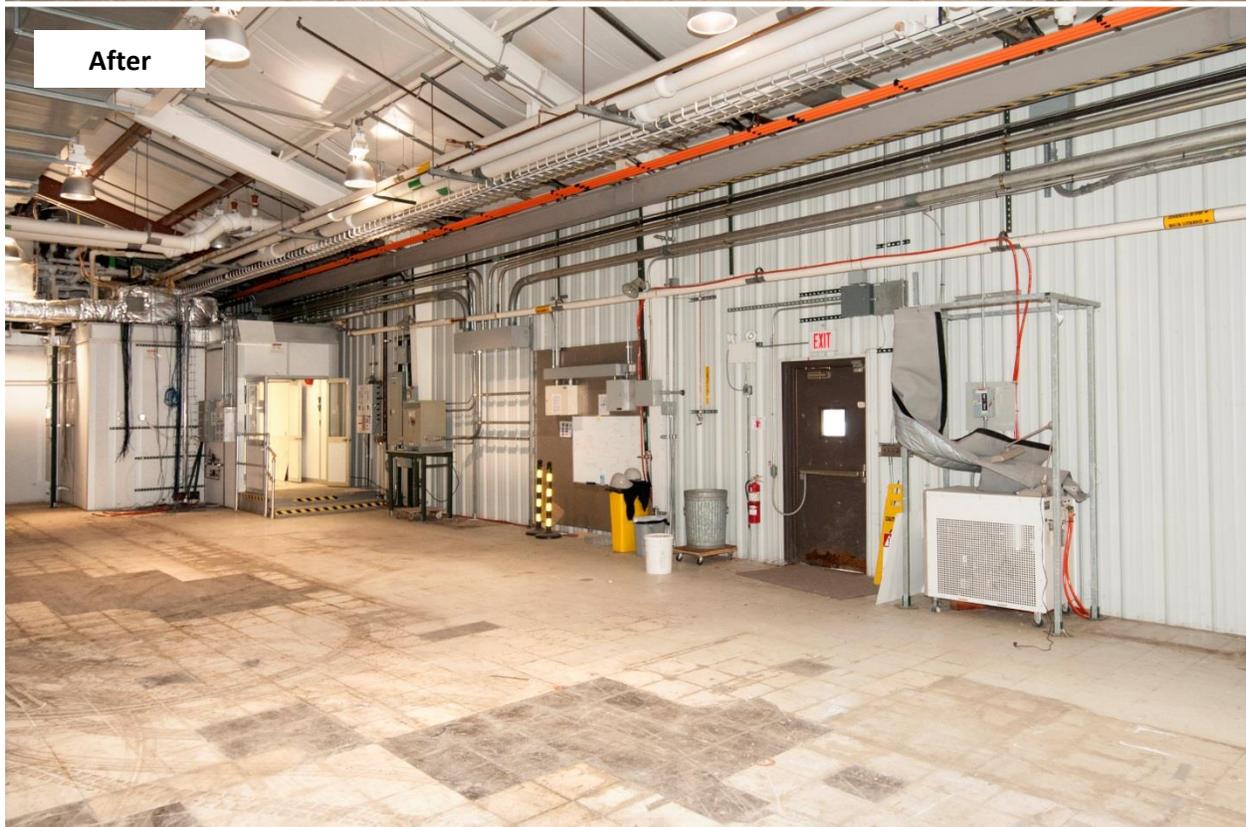
Figure 7: BNL's Recycling Rate

BNL diverts 95%+ of its construction debris to an on-site borrow pit for future conversion to recycled concrete aggregate (RCA). During this past year, BNL brought a concrete crusher on-site and generated approximately 3,500 tons of RCA.



RCA Generation

Site population changes, construction, and demolition activities do not heavily influence the Laboratory's diversion percentage since recycling and diversion rates are measured against municipal solid waste rates, which are a function of work and population. Employee reassignments (or departures), programmatic changes, and project completions allow opportunities for area housekeeping, reassignment of useful process components, and proper recycling of materials. During 2017, BNL cleaned out the basement of Building 535 and Building 729 of NSLS-I spare parts and components. Cost savings attributed to component repurposing and metals recycling were \$195,771 and \$79,930, respectively.



Before/After of Building 729 Clean-up

Construction and demolition projects affect construction debris generation, which is not included in the Laboratory's recycling rate.

The Laboratory's putrescible waste (municipal solid waste) is sent to the Town of Brookhaven, which is subsequently sent to a local waste-to-energy facility. Hence, no Laboratory municipal solid waste is sent to a landfill.

BNL continues to evaluate new processes and products to minimize the Laboratory's environmental footprint. During this upcoming year, BNL will look into the operational and economic feasibility of diverting its food waste to a commercial food waste composter, which is currently scheduled for start-up in September 2018.

BNL's Chemical Management System (CMS) allows the Laboratory to control chemical inventory and to minimize the acquisition and use of hazardous chemicals and materials. Prior to allowing a new chemical or product on-site, the Safety Data Sheet is evaluated for the product's hazardous properties. If an acceptable non-toxic or less toxic alternative is not available, then limited amounts of the product may be purchased and used.

BNL has an Integrated Pest Management Program that is audited by a third party on a periodic basis. BNL does not use sprinkler systems to water any areas on-site and has planted native plants and grasses to help reinvigorate pollinators in post-demolition areas.

Plans and Projected Performance

BNL's waste diversion program is expected to remain intact in the future years and may grow with the addition of food waste composting pending the start-up of a commercial food waste composter in relatively close proximity to the Lab.

Fleet Management

This category focuses on all fleet-related topics such as GHG emissions and fleet inventory, mileage and fuels, including petroleum reduction and alternative fuel use.

Performance Status

For FY17, we achieved total GHG emissions of 422.37 gCO₂e/mile. This represents a 47% reduction from our FY14 baseline. The target for FY17 was 4%. We achieved this by replacing older, less fuel efficient gasoline vehicles with newer alternative fuel vehicles, most with E-85 capabilities.



Plans and Projected Performance

We will continue to work with GSA to obtain the newest vehicles with alternative fuel capabilities wherever possible. We will continue to utilize our own alternative fuel dispensing station, as well as look for new opportunities for other alternative fuel use.

Fleet management will work with GSA to ensure that plug-in hybrids and zero emissions vehicles replace at least 20 percent of new passenger vehicle acquisitions by FY 2020 and 50 percent by FY 2025.

We also intend to implement Telematics in Light Duty Vehicles on or before 2/1/18. Upon installing the devices in all light duty vehicles, we will begin to evaluate the data received to determine which factors will best lead to an increase in sustainability. These factors may include engine idling, speeding, and real-time maintenance information.

Clean and Renewable Energy

This category focuses on clean and renewable energy use as a percentage of overall energy use.

Performance Status

Clean Energy

BNL's "Clean Energy" requirement for 2017 was 53,990,000 kWh. BNL purchased 60,800,000 kWh of RECs for 2017 to meet the "Clean Energy" requirement.

All of BNL's RECs have been and will continue to be purchased through a competitive solicitation process. Each solicitation includes the latest DOE requirements, including the required in-service dates.

BNL completed an updated economic evaluation of a CHP in 2016. The report highlighted the potential to reduce GHGs by approximately 50,000 MTCO_{2e} per year and be an on-site source of "clean energy." There are a number of other benefits associated with CHP including providing increased resilience in the event of impacts from weather or other events that could affect the electric grid. However, current and estimated low energy costs in the future prevent CHP from being economically viable at this time.

Renewable Energy

BNL's "Renewable Energy" requirement for 2017 was 38,358,000 kWh. BNL purchased 60,800,000 kWh of RECs for 2017 to meet the "Clean Energy" requirement, thereby exceeding the "Renewable Energy" requirement.

In 2017 the NSERC facility produced 968,485 kWh on site. No RECs from NSERC were sold in 2017. The NSERC facility was expanded by 324 kW to 816 kW in 2016 with the help of SPO funding.

All of BNL's RECs have been and will continue to be purchased through a competitive solicitation process. Each solicitation includes the latest DOE requirements, including the required in-service dates.

Plans and Projected Performance

BNL will continue to operate the NSERC facility and provide for expansion to a full MW when sufficient funds are identified. REC purchases will continue to meet the renewable energy and clean energy goals.

A renewable energy assessment that included the BNL site was completed by National Renewable Energy Laboratory (NREL) in 2016. The report concluded that even though the site is over 5,000 acres, given the existence of the 31-MW Long Island Solar Farm (LISF) on the BNL site and that much of the land is forested and in environmentally sensitive areas, BNL is concerned about clearing additional land for another renewable energy (RE) project.

The NREL report also states: "PV, biomass, LFG, and SHW do not appear economically viable at this time. Should the cost of electricity increase or escalate at a rate higher than what is assumed in the model, or

should the price of RE decrease or new incentives become available, then it is possible additional RE projects could become cost effective.” NREL did suggest consideration of small wind turbines given the Federal Aviation Administration’s (FAA’s) determination that large (300 ft. high) ones would pose an aviation problem in the area.

As indicated above, BNL completed an updated economic evaluation of a CHP in 2016 and it again highlighted the fact that it could reduce GHG’s by approximately ~50,000 MTCO₂e annually. However, at the present time BNL’s low energy rates keep a CHP from being economically viable. We will continue to revisit the CHP concept when the economic or other conditions change that could make it a viable undertaking.

Renewable energy systems, especially solar hot water, are considered in all new construction and major building renovations. To date, it has been difficult to find cost effective projects. However, a new office building is being considered (the Science and User Support Center [SUSC]) and will potentially incorporate a number of concepts including solar hot water heating and potentially a solar wall for pre-heating.

Green Buildings

This category focuses on green building related topics such as HPSB, Net-Zero and building inventory changes and design.

Performance Status

New Building Design

All buildings designed from 2007 were designed to meet the NYS Energy Code. In addition, BNL incorporated these principles into major renovations, such as the Building 924 renovation. As such, these buildings, some of which also obtained LEED certification, meet or exceed the Guiding Principles. BNL does not have any leased facilities. BNL's Design Standards (MPO Procedure 100E) for new buildings includes requirements to ensure that all new construction is at least 30% more efficient than ASHRAE 90.1 2016. Current EISA Section 433 is not applicable, as BNL does not have any planned commercial or multi-family high-rise residential buildings.

Guiding Principles

Currently 24% of non-excluded buildings have achieved 100% of the Guiding Principles and an additional 11% are at 90% or higher. As BNL constructs new buildings and demolishes old non-compliant buildings, this percentage will increase. The very recently completed major renovation of Building 924 increased compliance with the Guiding Principles but has not yet been fully evaluated to identify if there are any remaining issues for full compliance.

Net Zero Buildings

With respect to net-zero energy buildings, BNL has the option of applying the output of the NSERC to make it net-zero. The determination will be made in concert with the Brookhaven Site Office (BHSO).

The Modernization Project Office (MPO) hosted net-zero energy training, which was attended by 28 Facilities and Operations (F&O) staff members from MPO, Utilities, and Integrated Facility Management (IFM). Based on the training, three future buildings will be evaluated for net-zero designation.

Regional and Local Planning, Coordination and Involvement

Discovery Park

Discussions were held with staff of the Long Island Railroad (LIRR) where the vision for Discovery Park was shared with the group and plans for the proposed railroad station were discussed. The effort is expected to accelerate now with funding approved in the State budget. The LIRR views the initial \$20M as opportunity to complete a "Phase I," including closing the Yaphank station, selecting and developing a site for the new "Brookhaven National Laboratory" station, and construction on some type of station to initiate service with diesel trains, with electrification to follow at a later date.

Deer Management

The FY17 Deer Management Plan was implemented, removing 202 deer. The remaining population on-site is currently estimated at 200 to 300 deer, with 5,732 lbs. of meat donated to the hungry.

Pollinator Task Force

The pollinator support plants at the Long Island Solar Farm included 21 total species of wildflowers, mostly non-native, and hosted 19 butterfly species and 9 bee species.

The no mow areas were variably successful. Most of the wildflowers planted did not germinate due to drought conditions. However, the no mow area at NSLS-II supported native bees.

Plans and Projected Performance

New Building Design

Projects currently in various stages of planning such as the SUSC building and the CFR major renovation of Building 725 will be designed to meet the Guiding Principles.

Guiding Principles

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

Net Zero Buildings

Although not an issue at this point, BNL has not yet made specific progress on the net-zero energy building goals, but there is continued discussion with BHSO and DOE-HQ. BNL will continue to engage the national laboratory community on techniques to economically meet net-zero these requirements.

For designs starting in 2020, where economically viable, BNL will ensure net-zero requirements are included in future designs. BNL will consider net-zero concepts in the preliminary design of the SUSC but discussions with staff in the SLI program indicate the current funding constraints will make it difficult to justify additional costs associated with achieving net-zero.

Regional and Local Planning, Coordination and Involvement

Discovery Park

Efforts toward the realization of Discovery Park will continue to move forward with support from local, regional, and federal stakeholders.

The Laboratory will continue to work closely with the Long Island Railroad, Suffolk County, and the Town of Brookhaven to determine the best possible site for the relocation of the Yaphank Train Station, which will enable employees, users, students and visitors with a more sustainable way of accessing the Laboratory from NYC and elsewhere.

Deer Management

The deer management strategy will be reassessed working with the New York State Department of Environmental Conservation (NYSDEC) and Laboratory management to find a cost alternative to the current culling program and determine the feasibility of an on-site hunt being implemented in FY18 with a goal minimizing the deer herd to ~250 animals on-site.

Pollinator Task Force

The Laboratory will continue to work to implement best management practices established by the Pollinator Task Force and continue pollinator-related research.

The no mow areas will be revisited for modifications to management and replanting depending on funding.

Reduce Reliance on Petroleum

The Laboratory will support local and federal efforts to reduce reliance on petroleum.

Acquisitions and Procurement

This category focuses on non-electronic acquisitions, procurement, and GHG supply chain topics.

Performance Status

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

- energy efficient (ENERGY STAR or FEMP-designated);
- water efficient (WaterSense);
- bio-based (USDA BioPreferred);
- environmentally preferable (including EPEAT-registered products);
- non-ozone depleting (Significant New Alternative Policy [SNAP]) chemicals or other alternatives to ozone-depleting substances and high global warming potential hydrofluorocarbons;
- recycled content, including paper containing 30% post-consumer fiber; and
- non-toxic or less toxic alternatives products (Safer Choice labeled).

This past year, BNL completed its online purchasing system implementation to the Vinimaya system (“E-Buy”). Twenty catalogs are now online and being actively used. The tabular matrix of commonly purchased items (based on the manufacturer’s part number) that are EPP compliant has been updated with additional products. The Vinimaya system can use the manufacturer’s part number and scan all of the catalogs to come up with the most efficient pricing from each vendor.

Challenges remain as vendor information regarding recycled content for all categories is lacking, making conformance time-intensive and difficult for purchasers. BNL offers assistance to E-Buy requisitioners on request to help find conforming items and continues to develop the “Commonly Purchased Items” guide of EPP-compliant office products. The guide was originally developed during FY16 to help requisitioners easily select compliant E-Buy items. However, better product information from manufacturers would go much further toward improving purchasing performance and BNL does not have the purchasing power to influence the vendors to provide the needed information.

In 2017, BNL also established EMS objectives to improve EPP purchasing performance for EPEAT electronics and office products. The efforts focused on promoting the requirements with requisitioners. Members of the environmental compliance organization along with purchasing staff met with the senior administrative group in order to emphasize the EPP purchasing requirements. The requirements were incorporated into an E-Buy training program for all E-Buy users. In addition, the Procurement Division began auditing E-Buy purchases for EPP conformance, an effort directed mostly at office products. Decreasing numbers of nonconforming product purchases identified throughout the year indicate performance is improving. Procurement and Property Management (PPM) contracts include EPP purchasing performance reports from vendors, but the information received is not detailed enough to allow BNL to measure actual performance.

Other product/equipment categories are evaluated during various project/research design phases. For example, pre-planning for construction or major maintenance work by the F&O Directorate is initially screened via an Environmental, Security, Safety & Health (ESSH) Evaluation form (i.e., 500A Form), to

which EPP considerations have been added. This screening step allows an opportunity to ensure that EPP contract provisions are met for all product categories, from bio-based items, low-solvent paints, energy efficiency, SNAP chemicals, recycled content building materials, office furniture, water efficient products, etc. During this past year, BNL received the Green Electronics Council's 2017 EPEAT Purchaser Award, as well as the DOE EHSS Greenbuy Program Gold Winner Status for sustainable acquisition of 14 products in 7 different categories, indicating that BNL processes in place to maximize or drive acquisition of sustainable products have been effective.



BNL also promoted the EPP program during this past year's Earth Day activities. A scavenger hunt was designed around major categories of BNL's SSP, namely energy research, efficient buildings, reducing energy and water usage, greenhouse gas reduction, fleet management, green purchasing, and waste

minimization. Site Services promoted their use of environmentally friendly cleaning products as part of the event.



Plans and Projected Performance

During 2018, BNL will continue to work on the Commonly Ordered Items page, provide E-Buy training specific to EPP purchasing requirements, and provide feedback to the user community on EPP products. BNL will also write new EMS objectives to promote that program and drive improvement.

Measures, Funding, and Training

This category focuses on topics relating to efficiency and conservation measure, performance contracts and other funding mechanisms, and training and education.

Performance Status

Efficiency & Conservation Measures

Internally funded energy conservation and sustainability related initiatives include a continuation of various best practices, including temperature setback, small lighting and water conservation projects, and other miscellaneous efforts.

Funding

Funding is very difficult for energy conservation and sustainability related projects in the current budget constrained environment. As a result, BNL, like other DOE sites, has been increasingly using third party financing options that utilize cost savings to pay for the projects.

Table 1: Sustainability Funding

Category	FY17 Actual	FY18 Planned/ Request	FY19 Projected
Sustainability Projects	0	0	0
Sustainability Activities other than projects	272	550	585
SPO Funded Projects (SPO funding portion only)	0	0	0
Site Contribution to SPO Funded Project	0	0	0
ESPC/UESC Contract Payments (if applicable)	1,462	1,506	1,551
Renewable Energy Credits (REC) Purchase Costs (if applicable)	0	0	160
Total	1,734	2,056	2,296

Energy Performance Contracts

BNL completed its first UESC in 2015, which has been performing well and is meeting the original energy savings estimates. Given the success of this project, we are now in the process of developing a second UESC project. A number of lessons learned from the first project, UESC Phase I, will be used to inform the next project, UESC Phase II. Some of these lessons are outlined below.

What Worked in UESC Phase I:

- Separating PA/IGA from overall contract; retained ownership of documents

- Providing a fully vetted design for the chiller installation project, which provided much better results than design/build
- Incorporating the full team (including engineers, procurement, BSA/BHSO, project support, safety, etc.) from the beginning
- Stressing and clearly communicating our expectations with regard to safety prior to issuing the Request for Proposals (RFP)
- Website for RFP documents
- SharePoint site for project management
- Weekly meetings with core team
- Monthly meetings with the full team.

Recommendations for UESC Phase II:

- Insist on full design and approval prior to awarding construction contract(s), or have full engineering done ahead of time using Laboratory funds and then provide to the Energy Service Company (ESCO) (no sample or “typical” designs)
- Require detailed, on-site inspections of equipment and existing conditions as part of Investment Grade Audit (IGA); identify actual, as-built status vs. getting information from drawings; and identify all inoperative systems and components
- Address deficiencies (inoperative devices, systems, etc.) first, or allow for contingency funds to address during the project; can have funds included with the project or have a separate fund
- Provide for financial ramifications for poorly performing contractors and sub-contractors; and define and streamline capability to terminate poor performing contractors/sub-contractors
- Give full consideration to self-funded efforts (e.g., Institutional General Plant Projects [IGPP]) instead of complicated UESC/Energy Savings Performance Contract (ESPC) methods (saves considerable money from financing, Overhead & Profit [OH&P] from ESCO)
- Insist ESCO uses reasonable/realistic estimates of BNL/DOE approval and review period requirements
- Insist on a schedule that incorporates BNL/DOE’s review and approval requirements; do not allow ESCO to develop unrealistic schedules
- Allow schedule to be properly loaded, including float to deal with unforeseen conditions, poor performance, etc. If the financing terms limit the duration of the schedule, then structure the project to fit those limits, i.e., break it up into smaller segments
- Ensure ESCO has appropriate staff and resources, particularly if work is taking place in multiple locations simultaneously
- Require submission and approval of defined measurement and verification (M&V) data collection and processing method(s) before contract award
- Require submission and approval of defined system commissioning and approval processes before contract award
- Ensure ESCO commits to appropriately experienced staff for the type of work taking place, i.e., if it is a building controls project, then the ESCO must have demonstrated real-life controls experience and have on-site representation
- Provide ESCO with detailed Safe Work Plan (SWP) examples and a full explanation of requirements as part of the RFP
- Provide clear personnel requirements for safety and job oversight in the RFP and early communications; this is particularly true when work is taking place in multiple buildings and areas simultaneously (i.e., safety watch per site/building)

- Consider allowing Government-Owned, Contractor-Operated (GOCO) sites to take full responsibility for project management to minimize communication problems; DOE retains all approval authorization
- Ensure consistency among various complexes/building managers in terms of expectations, limits of the UESC, responsibilities, and oversight, i.e., differing opinions on asbestos sampling rates
- Senior Management must allocate sufficient resources for project implementation; allocated amounts must be based on estimates and actual experience, as opposed to what is available
- Insist all sub-contractors attend pre-contract and pre-construction meetings to ensure they are fully aware of BNL/DOE requirements
- Insist that no renegotiation of subcontractor prices and/or conditions takes place after award to ESCO by DOE, as this could cause significant delays to a previously agreed upon schedule
- Ensure project team reads and understands all aspects of the Contractor's approved Health and Safety Plan (HASP).

Training

The manager of Energy Management at BNL is a Certified Energy Manager (CEM). In addition, all of the Facility Complex Managers throughout the BNL campus have the Certified Facility Manager (CFM) recognition from the International Facilities Management Association. All of the Facility Complex Managers and Facility Complex Engineers participate in various training programs throughout the year to ensure core competencies.

Further, numerous employees attend training programs to maintain their professional certifications including PE, CEM, Green Professional, LEED, and many others.

Plans and Projected Performance

BNL is in the process of developing a UESC Phase II project that will likely including various energy conservation measures, such as lighting, HVAC, controls, solar preheating, energy (chilled water) storage, efficient boilers, and others. While it is not possible to estimate energy savings at this early stage, we anticipate savings to be equal to or greater than the recent UESC Phase I project.

Travel and Commute

This category focuses on all travel-related topics such as Scope 3 GHG emissions, air travel, ground travel, and commuting.

Performance Status

The figure below illustrates that, overall Scope 3 GHG emissions are down 26.1% from FY 2016 (6,023 MtCO_{2e}), and 14.5% lower than the FY 2008 baseline value.

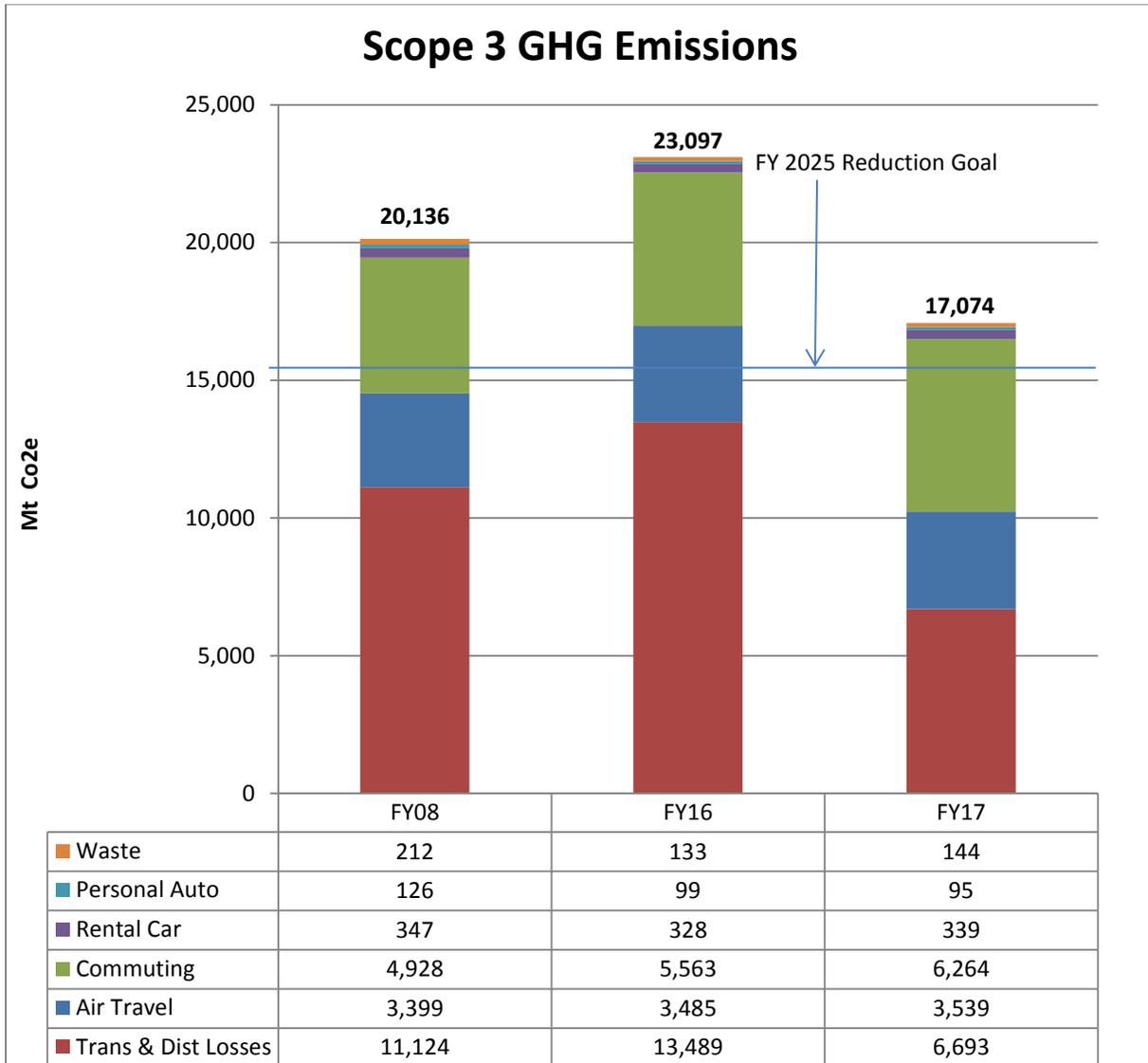


Figure 8: Scope 3 GHG Emissions

The decrease from FY 2016 is largely due to a 50.4% drop in GHG emissions from transmission and distribution (T&D) losses despite a modest 0.7% increase in combined purchases of electricity from the Long Island grid and hydropower from New York Power Authority's (NYPA's) upstate facilities. The reduction in GHG emissions from T&D losses was primarily due to a 42.7% drop in the e-Grid Distribution Loss Adjustment Factor, which declined from 9.09% in FY 2016 to 5.21% in FY 2017.

In September, BNL introduced an alternative methodology with improved metrics to calculate GHG emissions from commuting to the DOE Sustainability Performance Office. The key to our proposed alternative methodology is the use of a combination of passenger car and light-duty truck (LDT) emission factors, which are:

1. Equivalent to those found in Table 8 of the EPA Center for Corporate Climate Leadership Emission Factors for Greenhouse Gas Inventories for Model Year 2008 and earlier passenger cars and light duty trucks;
2. The CO₂ emission factors that EPA established as fleet-wide emission targets for Model Years 2012-2016 and for Model Years 2017-2025 cars and light duty trucks in the joint Corporate Average Fuel Economy (CAFE) rules passed by EPA and the National Highway Traffic Safety Administration on May 7, 2010 and October 15, 2012; and
3. CH₄ and N₂O emission factors established by ICF International based on vehicle emissions test procedures for certifying gasoline passenger car and light-duty trucks to comply with EPA Tier 2 vehicle emission standards.

After reviewing our proposal, the Sustainability Performance Office (SPO) noted that programming changes would have to be made to DOE's Sustainability Dashboard to accommodate our use of the alternative methodology for estimating commuting GHG emissions. Unfortunately, we were advised that due to limited funds, the programming changes could not be made this year. Instead, we used the existing 2016 Federal Greenhouse Gas Accounting and Reporting Guidance to calculate FY 2017 commuting GHG emissions.

Utilizing 2016 gate survey data on the aggregate number and types of vehicles entering the site, while making adjustments for a reduction in the number of full-time employees, commuting GHG emissions rose 12.6%, or 701 MtCO_{2e}, from FY 2016. A sharp increase in the average employee round trip commute from 29.46 miles in FY 2016 to 35.60 miles in FY 2017 is the primary factor for the increase. Had the alternative methodology been approved by the SPO, estimated commuting GHG emissions would have declined 4.9% from FY 2016 to 5,304 MtCO_{2e}.

Once again, BNL participated in the Annual Car Free Day Long Island (LI) celebration on September 22, 2017 in an effort to increase employee awareness and appreciation of the environmental, health, and economic benefits of sustainable means of transportation. To participate, employees completed a pledge on the Car Free Day LI website to be car-free or car-lite on September 22 and commit to drive less by carpooling, biking, walking, or telecommuting.

Promotion of Car Free Day included a Monday Memo segment that encouraged employees to make a Ride Green pledge for September 22. All employees making a pledge were automatically entered in a random drawing for multiple prizes to enhance participation. A follow-up story on the 62 participants in Car Free Day was posted on BNL's webpage, along with the photo below of Ali Lopez from the Condensed Matter Physics Division receiving her new mountain bike from members of the Environmental Protection Division.



BNL's Information Technology Division continues to emphasize how video conferencing utilizing the Blue Jeans cloud-based tool can be used for internal meetings and to collaborate with external associates. This enables employees to boost their productivity while also helping to reduce their travel time and costs to attend meetings and conferences.

Waste

Since 2008, GHG emissions from contracted waste are down 32% due to a corresponding reduction in the volume of waste transferred to the Hempstead Resource Recovery Facility. Diverting cafeteria food preparation wastes from the waste stream have also helped to reduce waste levels. These food preparation wastes are used at the Sewage Treatment Plant to raise plant biochemical oxygen levels, which, in turn, aid in the de-nitrification process and supplement the biomass at the Sewage Treatment Plant.

Personal Auto (Business)

GHG emissions from employees using their personal vehicles for business use have decreased 25.6% since FY 2008.

Rental Cars

GHG emissions from rental vehicles used for employee business travel rose by 11 MtCO₂e or 3.4% from the FY 2016 total, however, they are 2.3% lower than the FY 2008 total.

Air Travel

Air travel GHG emissions rose by 54 MtCO₂e, a 1.5% increase from the FY 2016 total. With this increase, FY 2017 airline travel GHG emissions are 4.1% higher than the FY 2008 baseline.

Plans and Projected Performance

Combined electricity purchases of conventional power and hydropower are expected to rise 3.5% from 270,619 MWh in FY 2017 to 280,000 MWh in FY 2025. Using eGrid 2014 T&D loss factors and NPCC Long Island and NPCC Upstate non-baseload output emission rates, estimated T&D GHG emission will increase to 6,927 MtCO₂e in FY 2025. Assuming that T&D loss factors and NPCC Long Island total output and NPCC Upstate non-baseload emission rates remain unchanged in future versions of eGRID, reaching the Scope 3 reduction goal of 15,102 MtCO₂e is unlikely. To meet this goal, GHGs from all other Scope 3 categories would have to drop from 10,381 to 8,175 MtCO₂e, a 21.3% reduction.

Nonetheless, BNL will continue to strive to reduce other Scope 3 GHG emissions. Some of the activities planned for FY 2018 are as follows.

The Environmental Protection Division will continue to work with BHSO to advocate for the SPO to make the necessary programming changes to enable BNL to use of the alternative methodology for estimating commuting GHG emissions that were proposed in September.

The Environmental Protection and Information Technology Divisions will conduct a survey of recent Blue Jeans video conference service users to ascertain how often they used the service, whether they used it while working on-site or on business travel, what they liked and didn't like about the service, and to what extent they avoided business travel. After the results from the survey have been compiled, key findings will be disseminated throughout the Laboratory to encourage more widespread use of this valuable communications resource.

The Environmental Protection Division will reach out to Human Resources to jointly explore how the resources and recommendations in the Sustainable Commuting US DOE National Laboratories Report & Toolkit can be used to engage employees and managers on the benefits of ridesharing, telework, and alternative work schedules.

Fugitives and Refrigerants

This category focuses on the emissions of fugitive gases and refrigerants.

Performance Status

Fugitive and Refrigerant GHG Emissions

A variety of activities and operations at BNL use greenhouse gases for different purposes. The largest user of greenhouse gases at BNL is the Tandem Van de Graaff Facility. The two Tandem accelerator vessels with a combined storage volume of 16,050 ft³ are filled with an insulating gas mixture consisting of 46%v SF₆, 44%v N₂, 6%v CO₂, and 4%v O₂. Annually, there are some emissions of SF₆ and CO₂ due to insulating gas leaks and the transfer of insulating gases during periodic maintenance of the Tandem accelerators.

The table below provides a summary of the sources of BNL fugitive greenhouse gas emissions in FY 2017.

Table 2: Fugitive GHG Emissions

Source	Activity	Gas	GHG Emissions (MtCO ₂ e)
Tandem Van de Graff	Insulating gas leaks	SF ₆	1,974.48
		CO ₂	0.003
	Accelerator gas transfers	SF ₆	8.07
STAR Experiment	Detector gas purging	CH ₄	5.91
		CO ₂	0.04
		SF ₆	121.00
Fleet Vehicle Repair	Fleet Motor Vehicle A/C Leaks	HFC-134a	24.43
Whole Site		HFC-134a	4.77
		PFC-14	234.64
		CO ₂	0.04
Refrigeration/AC Equipment	Gas leaks	HFC-134a	19.46
		R-401A	0.02
		R-410A	90.90

The bulk of BNL's process and fugitive GHG emissions were due to periodic purging of carrier gases used in STAR detector subsystems during the FY 2017 Relativistic Heavy Ion Collider (RHIC) experimental run. The recirculation system on the multi-gap resistive plate TOF subsystem reduced purged gas releases of HFC-134a by 87.5% throughout the experimental run.

Under EPA's Significant Alternatives Policy (SNAP) Program, several hydrofluorocarbon (HFC), perfluorocarbon (PFC), and HFC/PFC blend refrigerants have been approved for use and have been used in BNL refrigeration equipment for several years. In November 2016, final revisions to EPA's Refrigerant

Management Requirements (40 CFR 82 Subpart F) were published in the federal register. The primary objectives of the revisions were to:

1. Reduce class 1 and 2 ozone depleting substance (ODS) emissions associated with refrigeration equipment leaks through more stringent leak repair provisions;
2. Extend the ODS leak repair provisions to refrigeration equipment using EPA SNAP-approved HFC, PFC, and HFC/PFC blend refrigerants; and
3. Maximize the recovery and reuse of substitute refrigerants with high global warming potentials (i.e., HFCs, PFCs, and blends).

Recognizing the economic, environmental, and customer service benefits of implementing the Subpart F provisions all at once rather than over a 3-year staggered approach per the Subpart F revisions, BNL took a proactive approach and revised its Refrigerant Management Plan in May, fully incorporating all of the modified and new Subpart F provisions. In July, three training sessions were held with refrigeration and air conditioning technicians and their supervisors to acquaint them with the revisions to 40 CFR 82 Subpart F and the corresponding changes to BNL’s Refrigerant Management Plan.

Sulfur Hexafluoride Emissions

The Energy & Utilities (EU) Division’s Electric Distributions Group follows provisions within the High Energy Equipment Management Plan to account for and effectively manage leaks of SF₆ associated with gaseous dielectric used in high voltage electric equipment.

As requested in the SC Supplemental Guidance, below is an updated table of BNL facilities and devices that utilize sulfur hexafluoride:

Table 3: BNL Facilities and Devices that Utilize Sulfur Hexafluoride

Brookhaven National Lab				Emissions (lbs)												
				FY10				FY11				FY12				Projected
Applications, Processes, Facilities & Systems Using SF ₆	Identify Key Facilities by FIMS Asset #	SF ₆ Device Inventory (lbs)	Current SF ₆ Storage Inventory (lbs)	FY10	FY11	FY12	FY13	FY14	FY15	Total FY10 to FY15	FY16 Actual	FY17	FY18	FY19	FY20	Total FY16 to FY20
Tandem Accelerators ^{1,2}	Accelerator_TV	43,305	2,460	77	96	96	192	96	96	652	191.7	191.7				383.4
Gas Insulated Switches & Breakers ^{3,4}		714	558	0	0	0	0	0	0	0						0.0
PHENIX Experiment	1008	na	70	55	155	169	170	70	55	674	38	0	0	0	0	38.0
CFN Electron Beam Microscopes (dielectric)	735	325	na	0	0	0	0	0	0	0						0.0
Accelerator Test Facility Insulating Dielectric in Pulse Forming Network Laser System	Accelerator_ATF	185	na	0	0	0	0	0	0	0						0.0
Insulating Dielectric used in LINAC Facility RF Coaxial Circulator Devices	Accel_AGS LINAC	105	na	0	0	0	0	0	0	0						0.0

Brookhaven National Lab				Emissions (lbs)												
Applications, Processes, Facilities & Systems Using SF ₆	Identify Key Facilities by FIMS Asset #	SF ₆ Device Inventory (lbs)	Current SF ₆ Storage Inventory (lbs)	FY10	FY11	FY12	FY13	FY14	FY15	Total FY10 to FY15	FY16 Actual	Projected				Total FY16 to FY20
												FY17	FY18	FY19	FY20	
STAR Experiment	1006	na	23	0	0	0	0	6	13	19	13	11.7				24.7
Evaporative Losses Based Query of Chemical Management System			na	108.3	264.6	0.5	21	-110	0	394	0	0				0.0
Balance of Site		370	na	0	0	0	0	0	0	0	0	0				0.0
Total		45,004	3,111	240	516	265	383	172	163	1,739	242.7	203.4				

¹ The device inventory was calculated on the assumption that each of the tandem accelerators contained 22,170 lbs. of SF₆ in May 2004.
² SF₆ is stored in five 222.9 ft³ cylinders at a pressure of 85 psig.
³ The device inventory represents the cumulative SF₆ dielectric capacity of 8 gas insulated circuit breakers and 28 gas insulated switches.
⁴ The storage inventory includes product stored outside the Bldg. 603 substation, the Bldg. 631 switch yard, and supply cylinders outside Bldg. 835.

Plans and Projected Performance

BNL will conduct self-audits of its Refrigerant Management Plan in December and July to assess the effectiveness of the Refrigerant Management Plan, identify any deficiencies in the plan, and resolve them in a timely manner. Refrigeration service documentation will be carefully reviewed during the self-audit process to ensure that refrigerant leaks are being repaired in the timely manner specified in the 40 CFR 82 Subpart F Refrigerant Management Requirements. In addition, the self-audit will ensure that leaking refrigeration equipment retrofit/replacement plans have been prepared for larger refrigeration equipment with HFC, PFC, and mixed refrigerant charges of 50 pounds or more where leaks could not be adequately repaired within the timeframes permitted by 40 CFR 82 Subpart F. The primary objective of the self-audit process will be to identify gaps in BNL’s Refrigerant Management Plan and to implement corrective actions to mitigate fugitive emissions of HFC and PFC due to refrigerant leaks.

Electronic Stewardship

This category focuses on all electronics-related topics such as acquisitions, operations, end-of-life disposal strategies, and data centers.

Performance Status

Acquisition

The contract governing the procurement of printers, laptops, and desktop computers ordered through the BNL E-Pro system requires that they have an EPEAT “Gold” certification. BNL has met this goal for FY17.

Operations

All systems in the BNL domain that are capable of power management have the setting enabled. BNL has met this goal for FY17.

BNL has published Managed Printing guidelines, which recommend the use of network/department-wide printers configured for black ink only and duplex printing. BNL has effectively met this goal for FY17.

End of Life

BNL tracks computer components through its PeopleSoft program to ensure full utilization of these products throughout their lifespans. The average age of a BNL computer prior to disposal is approximately six years, which is 50% above the average retirement age of four years.

Usable computers and peripherals are sent to an on-site warehouse where departments can go to acquire computers as needed. Last year, approximately 997 desktop computers, 450 laptops, and 90 tablets were reused internally by BNL personnel. BNL has computers set aside for the Computers for Learning (CFL) program; however, at six-years-old, the operating systems are usually outdated and cannot be updated at a reasonable cost for the schools or not-for-profits.

New York State environmental regulations prohibit household electronic waste (E-Waste) to be disposed of with municipal solid waste (household trash) and requires that home owners dispose of their E-Waste through Town-specified collection points, usually located at solid waste transfer stations. As an incentive for employees to dispose of their E-Waste in an environmentally acceptable manner, while easing the burden of finding and scheduling a time to travel to a transfer station, BNL has established three employee household E-Waste collection days during the year. Information is supplied to employees on how to sanitize and/or remove their computer hard drives to avoid personal information from getting into the open domain.



BNL disposed of approximately 21 tons of electronic equipment through an R2 certified recycler during 2017.



Data Centers

Existing Data Centers

BNL completed an evaluation of our existing data centers in response to the Data Center Optimization Initiative (DCOI) from the summer of 2016. Our internal assessment identified eight (8) data centers that meet the new DCOI criteria. Previously, BNL had two (2) data centers based on the former definition. A comprehensive assessment has yet to be completed but it is clear that additional resources will be needed to meet the goal of a PUE < 1.5. Four of the eight data centers will require the installation of additional metering in order to determine the actual PUE.

New Data Centers

It was determined that a mission need exists to provide mid-range computational and data storage support to current BNL programs and planned particle physics experiments using RHIC and the ATLAS detector at CERN. Significant infrastructure in terms of space, power, and cooling within the existing RACF has degraded over time due to obsolete equipment and increasingly stringent operating standards for data centers. Capable, reliable, and efficient computing facilities are required to support experiments that are expected to generate ever greater amounts of data that must be stored and analyzed. Additionally, the evolution of the technologies employed to deliver computation and data storage capabilities is expected to require higher levels of reliability and demand more robust infrastructure. These factors combine to effectively make almost half of the current computing and data storage facility functionally obsolete. The projected capability gaps in computing infrastructure are due to a combination of decreases from degrading capacities and increases in future requirements of mid-scale computing performed by RACF.

The Core Facility Revitalization (CFR) project is being designed to renovate and revitalize Building 725—the former home to the NSLS-I. This project includes repurposing a significant portion of the building for use as a new computing facility with associated support space and new infrastructure. The proposed project will renovate approximately 50,000 gross square feet of the first floor area. In late FY16, a conceptual design was completed for the CFR project, BNL's new data center initiative. Critical Decision 1 (CD-1) was received in April 2017 and CD-2 is expected in FY18.

Plans and Projected Performance

Acquisition

The Laboratory will continue to require that all printers, laptops, and desktop computers ordered through the E-Pro system have an EPEAT "Gold" certification.

Operations

BNL will continue to evaluate the feasibility of extending the desktop computer power management policy to other operating systems.

The majority of printers and copiers are not centrally managed. BNL will continue to communicate the importance and benefits of duplex printing.

End of Life

BNL will continue to evaluate methods of increasing computer useful life and will continue to dispose of electronic waste in an environmentally sound manner through a certified R2 recycler.

Data Centers

Existing Data Centers

Meeting the PUE of 1.5 for the existing data centers will require a significant investment. Further, four of the eight existing data centers will require the installation of new metering, which is partially in progress.

BNL will work to identify the actions and resources needed to meet the PUE 1.5 requirement for the eight existing data centers and if cost effective, begin the process of obtaining potential funding. The first effort will focus on determining the most cost effective metering on four of the data centers that are currently not metered in order to determine their actual PUE.

New Data Centers

The data center associated with the CFR project is in the design phase and is targeting a PUE of < 1.3 in accordance with the recent DCOI. The CFR project has received CD-1 approval and could start construction in FY19.

Organizational Resilience

This category focuses on resilience strategies and procedures that identify and respond to events with the potential to disrupt, strain, compromise, or eliminate DOE activities or facilities (see E.O.s 13693 and 13806).

Performance Status

Organizational Resilience

Emergency Response and Local/Regional Coordination

During FY17, the BNL Office of Emergency Management (OEM) revised and edited all emergency management plans and procedures to meet the requirements of the new DOE O151.1D, Comprehensive Emergency Management System:

- BNL Site Emergency Plan
- BNL All Hazards Survey
- Updated the Management System
- Developed new Emergency Action Levels
- Updated all plans and procedures.

During major weather events, OEM participates on the National Weather Service regional severe weather calls. These calls begin the coordination efforts for the region in determining the predicted damage for the area. BNL is also part of Suffolk County's Comprehensive Emergency Plan to support Suffolk County in times of catastrophic emergencies. BNL attends periodic meetings with Suffolk County Office of Emergency Management regarding emergency management and response.

Risk/Vulnerability Assessment

BNL OEM has implemented the new DOE O 151.1D. With this implementation, OEM reviewed and rewrote all internal plans, policies and procedures. This includes changing the BNL Hazards Survey to an All-Hazards Survey for effects of severe weather phenomenon on the BNL site. BNL OEM has also developed a Threat and Hazard Identification and Risk Assessment (THIRA) program that meets the DOE requirement for extreme events and includes severe weather phenomenon.

Workforce Protocols

The Laboratory's current Flexible Work Arrangements policy, which went through significant revision in FY 2014, provides many options for employees to manage their work schedules during times of severe weather events and potentially limit the need to commute to work on-site. This provides the Laboratory with significant savings per weather-related site closure day of indirect cost because exempt employees may work with their managers to find a way to complete their target hours for the month through use of the Flexible Work Arrangements policy.

In January 2017, Human Resources (HR) launched its new Recognition and Reward Program, which includes additional non-cash mechanisms for recognizing staff members who exhibit the Lab Values, including the value of Environmental Stewardship. HR is currently manually tracking the usage of this new program, but has initiated a project with ITD to automate the tracking such that it can more easily report out on when recognition has occurred tied to this value.

Climate-Resilient Design of New or Newly Retrofitted Buildings

The Laboratory does not currently have design guidelines specifically for climate-resilient design. However, as a standard practice, new facilities and retrofit projects are designed using higher and lower temperatures than required by ASHRAE as a means of incorporating forward-looking climate data into the design of our capital improvement projects. New York City's Office of Recovery and Resiliency has developed a draft of Climate Resiliency Design Guidelines, which will be evaluated for applicability and are planned to be used on Laboratory projects once finalized.

Plans and Projected Performance

Emergency Response and Local/Regional Coordination

All OEM plans and procedures will continue to be reviewed and updated as required by DOE O151.1D. Additionally, OEM will continue to engage with local and regional partners in information-sharing and coordination activities regarding emergency management and response.

Workforce Protocols

The Laboratory will continue to evaluate its workforce policies and programs in light of our understanding of climate change and its projected impact on human health and safety.

Additionally, HR will continue working with ITD on a project to automate tracking of employee recognition tied to the value of Environmental Stewardship. Expected completion of the project will be based on limited ITD programming resources.

Climate-Resilient Design of New or Newly Retrofitted Buildings

The Laboratory will evaluate the applicability of the draft Climate Resiliency Design Guidelines developed by New York City's Office of Recovery and Resiliency, and plans to utilize them on Laboratory projects once finalized.

Appendix A: Dashboard Data Accuracy Self-Certification

Self-Certification of the Dashboard

BNL has utilized the built-in approval process within DOE's Sustainability Dashboard to certify the accuracy and completeness of the data submission.

Appendix B: Comprehensive Scorecard

12/11/2017

Sustainability Dashboard: Comprehensive Scorecard



Comprehensive Scorecard

All Dept / Under Secretaries
All Program Offices
Brookhaven National Laboratory
FY 2017 (tentative)

Greenhouse Gas Inventory



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 2017): -25.0 %

Current Performance: -42%

	FY 2008	FY 2017	% Change
Facility Energy	198,085.9	114,824.8	-42.0%
Non-Fleet V&E Fuel	265.6	385.1	45.0%
Fleet Fuel	942.4	313.8	-66.7%
Fugitive Emissions	6,266.9	3,522.0	-43.8%
On-site Landfills	65.4	39.9	-39.0%
On-site WWT	2.1	1.0	-52.4%
Renewables	0.0	0.00	N/A
RECs	0.0	0.00	N/A
Total (MtCO2e)	205,628.2	119,086.5	-42.1%



Scope 3 Greenhouse Gas Emissions

Goal: Reduce indirect GHG emissions by 25 percent by FY 2025 relative to FY 2008 baseline. Interim Target (FY 2017): -9.0 %

Current Performance: -487%

	FY 2008	FY 2017	% Change
T&D Losses*	10,700.2	-86,523.8	-908.6%
Air Travel	3,398.7	3,538.8	4.1%
Ground Travel	473.0	434.2	-8.2%
Commute	4,929.0	6,264.3	27.1%
Off-site MSW	212.8	0.00	-100.0%
Off-Site WWT	0.0	0.00	N/A
Total (MtCO2e)	19,713.6	-76,286.5	-487.0%

* Includes T&D losses for purchased renewable electricity and T&D credits from RECs

Facilities



Energy Intensity

Goal: The latest energy intensity reduction goal, requires a reduction in energy intensity for goal subject facilities by 25 percent by FY 2025 relative to FY 2015 baseline. The prior goal, required a 30 percent reduction by FY 2015 relative to FY 2003 baseline. Interim Target (FY 2017): -5.0%

Current Performance: -10%

	FY 2015	FY 2017	% Change
Purchased Utilities (MMBtu)	718,305.2	676,000.6	-5.9%
Purchased Renewables (MMBtu)	0.0	0.0	N/A
Goal-subject GSF	2,957,443.0	3,098,007.0	4.8%
Energy Intensity (Btu/GSF)	242,880.5	218,205.0	-10.2%



Renewable Electricity

Goal: By FY 2025, use 30 percent renewable energy as a percentage of overall facility electricity use. Interim Target (FY 2017): 10%

Current Performance: 23%

	FY 2017 Electricity Consumption	FY 2017 Renewable Electricity w/ Bonuses	% of Total
Grid Electricity	270,619	0.00	N/A
On-Site Renewable Energy	529	1,057	0.4%
Purchased Green Electricity	0	0.00	N/A
Renewable Energy Certificates	N/A	60,800	22.4%
Total (MWh)	271,148	61,857	22.8%



Clean Energy

Goal: By FY 2025, use 25 percent renewable energy as a percentage of overall facility electric and thermal energy use. Interim Target (FY 2017): 10.0 %

Current Performance: 14%

	FY 2017 Energy Consumption	FY 2017 Clean Energy w/ Bonuses	% of Total
Grid Electricity	923,353	0.00	N/A
Non-renewable Thermal Energy	586,812	0.00	N/A
On-Site Renewable Energy	2,504	5,008	200.0%
Purchased Green Electricity	0	0.00	N/A
Renewable Energy Certificates	N/A	207,450	N/A
Total (MMBtu)	1,512,669	212,457	14.0%



Potable Water Intensity

Goal: Reduce potable water intensity by 36 percent by FY 2025 relative to FY 2007 baseline. Interim Target (FY 2017): -20.0 %

Current Performance: -43%

	FY 2007	FY 2017	% Change
Water Consumption (million gal)	412.9	406.9	-1.5%
Aquifer Recharge (million gal)	322.1	345.8	7.4%
Total GSF	4,081,900.0	4,831,930.0	18.4%
Water Intensity (Gal/GSF)	22.3	12.6	-43.5%



Industrial, Landscaping, Agricultural Water

Goal: Reduce industrial, landscaping and agricultural water use by 30 percent by FY 2025 relative to FY 2010 baseline. Interim Target (FY 2017): -14.0 %

Current Performance: 0.0%

	FY 2010	FY 2017	% Change
Industrial	0.0	0.0	N/A
Landscaping	0.0	0.0	N/A
Agricultural	0.0	0.0	N/A
Total ILA Water (million gal)	0.0	0.0	N/A



High Performance Sustainable Buildings

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

Current Performance: 13.7%

	Building Count	GSF
Guiding Principles Certified	17	1,214,170
Total Applicable*	124	4,497,074
Performance (%)	13.71%	27.00%

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

Fleet



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 2017): -4.0 %

Current Performance: -47%

	FY 2014	FY 2017	% Change
Fleet Fuel GHG (MtCO ₂ e)	635.6	313.8	-50.6%
Fleet Miles (x1000)	792.0	742.9	-6.2%
Greenhouse Gas Emissions / Mile (gCO₂e/Mile)	803.0	422.0	-47.4%



Fleet Petroleum

Goal: Reduce fleet petroleum use by 20 percent by FY 2015 and thereafter relative to FY 2005 baseline

Interim Target (FY 2017): -20.0 %

Current Performance: -76%

	FY 2005	FY 2017	% Change
Gasoline	91,140	20,878	-77.1%
Diesel	24,544	6,690	-72.7%
Biodiesel*	0	675	N/A
Total Petroleum (GGE)	115,684	28,244	-75.6%

* Includes only the diesel content of B20



Fleet Alternative Fuel

Goal: Increase fleet alternative fuel use by 10 percent by FY 2015 and thereafter relative to FY 2005 baseline

Interim Target (FY 2017): 10.0 %

Current Performance: 80%

	FY 2005	FY 2017	% Change
E-85	0	46,516	N/A
Biodiesel*	0	169	N/A
CNG	26,000	0	-100.0%
Other*	0	0	N/A
Total Alternative (GGE)	26,000	46,684	79.6%

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

Waste



Municipal Solid Waste Diversion

Goal: Divert at least 50 percent of non-hazardous solid waste (excluding construction and demolition debris)

Interim Target (FY 2017): 50.0 %

Current Performance: 75%

	FY 2017	%
Off-Site Landfills	N/A	N/A
On-Site Landfills	0.0	0.0%
Waste to Energy*	351.0	25.0%
Non-diverted Waste	351.0	25.0%
Diverted Waste	1,032.0	73.6%
On-site composted	20.0	1.4%
Off-site composted	0.0	0.0%
Total Diverted Waste	1,052.0	75.0%
Total Waste (metric tons)	1,403.0	100.0%

* For E.O. 13693, waste to energy does not count as diverted waste.



Construction & Demolition Diversion

Goal: Divert at least 50 percent of construction and demolition materials and debris

Interim Target (FY 2017): 50.0 %

Current Performance: 96%

	FY 2017	%
Landfilled C&D Waste	159.3	4.2%
Diverted C&D Waste	3,659.3	95.8%
Total C&D Waste (metric tons)	3,818.5	100.0%

Electronics



Electronics Acquisition

Goal: 100 percent of eligible electronics procurements must be environmentally sustainable (e.g. EPEAT)

Interim Target (FY 2017): 95.0 %

Current Performance: 96%

	EPEAT Acquired	Total Acquired	%
Monitors	157	171	91.8%
Computers	418	431	97.0%
Imaging Equipment	0	0	N/A
Televisions	0	0	N/A
Total Acquired	575	602	95.5%



Electronics Recycling

Goal: Dispose of 100 percent of electronics through government programs and certified recyclers

Interim Target (FY 2017): 100.0 %

Current Performance: 100%

	Amount	%
Transferred or Donated	0.000	0.0%
Recycled by Certified Recycler	19.119	100.0%
Recycled by non-Certified Recycler	0.000	0.0%
Amount disposed (e.g. landfill)	0.000	0.0%
Total Electronics Waste (metric tons)	19.119	100.0%



Power Management

Goal: Implement and actively use power management features on 100 percent of eligible computers (PCs & laptops) and monitors

Interim Target (FY 2017): 100.0 %

Current Performance: 38%

	Total Owned	PM Enabled	Exempt	%
Monitors	0	0	0	N/A
Computers	3,318	1,273	0	38.4%
Total Items	3,318	1,273	0	38.4%



Duplex Printing

Goal: Implement and actively use duplex printing features of 100 percent of eligible printers

Interim Target (FY 2017): 100.0 %

Current Performance: 0%

	Total Owned	Duplex Enabled	Incapable	%
Total Printers	0	0	0	0.0%

Acquisition



Sustainable Acquisition

Goal: Ensure 95 percent of new contract actions for products and services meet sustainable acquisition requirements

Interim Target (FY 2017): 95.0 %

Current Performance: 100%

	Contracts Reviewed	Contracts Without Opportunity	Contracts Meeting All Requirements	%
Number of Contracts	48,341	0	48,341	100.0%

Appendix C: List of Acronyms & Abbreviations

AGS	Alternating Gradient Synchrotron
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ATF	Accelerator Test Facility
BAS	Building Automation System
BHSD	Brookhaven Site Office
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
Btu	British thermal unit
C-AD	Collider-Accelerator Department
CAFE	Corporate Average Fuel Economy
CD	Critical Decision
CEM	Certified Energy Manager
CERN	European Organization for Nuclear Research
CFL	Computers for Learning
CFM	Certified Facility Manager
CFN	Center for Functional Nanomaterials
CFR	Core Facility Revitalization
CHP	Combined Heat and Power
CMS	Chemical Management System
DCOI	Data Center Optimization Initiative
DOE	Department of Energy
EHSS	Office of Environment, Health, Safety & Security
EISA	Energy Independence and Security Act
EMS	Environmental Management System
EO	Executive Order
EPA	Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPP	Environmentally Preferable Purchasing
ESCO	Energy Service Company
ESPC	Energy Savings Performance Contract
ESSH	Environmental, Security, Safety & Health
EU	Energy & Utilities
EUI	Energy Utilization Index
F&O	Facilities and Operations
FCE	Facility Complex Engineer
FCM	Facility Complex Manager
FEMP	Federal Energy Management Program
FIMS	Federal Information Management System
FY	fiscal year
gal	gallons
GHG	Greenhouse Gas
GOCO	Government-Owned, Contractor-Operated
GP	Guiding Principle

gpf	gallons per flush
GSA	U.S. General Services Administration
gsf	gross square feet
HASP	Health and Safety Plan
HEMSF	High-Energy Mission-Specific Facility
HFC	hydrofluorocarbon
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
ILA	industrial, landscaping, and agricultural
ISB-I	Interdisciplinary Science Building I
ITD	Information Technology Division
kW	kilowatt
kWh/yr	kilowatt hour per year
LDT	light-duty truck
LEED	Leadership in Energy & Environmental Design
LI	Long Island
LINAC	linear accelerator
LIRR	Long Island Railroad
LISF	Long Island Solar Farm
M&V	measurement and verification
mmBtu	one million Btu
MPO	Modernization Project Office
MtCO ₂ e	metric tons of carbon dioxide equivalent
MW	megawatts
MWh	megawatt hours
NPCC	Northeast Power Coordinating Council, Inc.
NREL	National Renewable Energy Laboratory
NSERC	Northeast Solar Energy Research Center
NSLS-I	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source II
NYC	New York City
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
ODS	ozone depleting substance
OEM	Office of Emergency Management
OH&P	Overhead and Profit
PE	Professional Engineer
PFC	perfluorocarbon
PHENIX	Pioneering High Energy Nuclear Interaction Experiment
PM	preventative maintenance
PPM	Procurement and Property Management

PUE	power utilization effectiveness
PV	photovoltaic
RACF	RHIC ATLAS Computing Facility
RCA	recycled concrete aggregate
RE	Renewable Energy
REC	Renewable Energy Credit
RFP	Request for Proposals
RHIC	Relativistic Heavy Ion Collider
SC	Office of Science
SLI	Science Laboratories Infrastructure
SNAP	Significant New Alternative Policy
SPO	Sustainability Performance Office
SSP	Site Sustainability Plan
STAR	Solenoidal Tracker at RHIC
SUSC	Science User Support Center
SWP	Safe Work Plan
TEC	total estimated cost
THIRA	Threat and Hazard Identification and Risk Assessment
TOF	time of flight
UESC	Utility Energy Service Contract
USDA	U.S. Department of Agriculture