FY16 Site Sustainability Plan

Brookhaven National Laboratory

U.S. DEPARTMENT OF ENERGY | Office of Science

BROOKHAVEN NATIONAL LABORATORY

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I. Executive Summary

Brookhaven National Laboratory (BNL) is operated and managed for the Department of Energy Office of Science (DOE-SC) by Brookhaven Science Associates (BSA), a partnership formed by Stony Brook University (SBU) and Battelle Memorial Institute. For more than 65 years, the Laboratory has played a lead role in the DOE Science and Technology mission and continues to contribute to the DOE missions in physical, energy, and life sciences, with additional expertise in environmental sciences, energy technologies, and national security. BNL is staffed by over 3,000 research and support employees and hosts an even greater number of facility users, guest researchers, and scientists annually.

To date, seven Nobel Prizes have been awarded for discoveries made at the Laboratory throughout its history. 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.

With a long-standing expertise in accelerator science and technology, 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 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 research and education programs. The efforts in sustainability are communicated widely across the Laboratory and the Senior Leadership team remains engaged.

In FY15, the Laboratory established a Sustainability Awareness and Engagement team with members from Operations and Science organizations across the Laboratory. The focus was to identify human behavior elements to enhance the BNL Site Sustainability Program and foster a culture of sustainability across the Laboratory. Using smaller working groups, materials and tools were developed to further educate employees and guests on how to reduce their environmental impact at the Laboratory. Most

notably, a new BNL sustainability website was published in early October 2015. We are committed to maintaining this site as a resource for our Laboratory community.

BNL continues to capitalize on efforts from a strong energy management program that has existed for decades at BNL to achieve substantial reductions in our greenhouse gas (GHG) footprint. Strong relationships with local utility providers has been a business strength of the Laboratory for many years to ensure cost effective power rates for operating the energy intensive user facilities and general infrastructure. BNL continues to collaborate 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.

The Long Island Solar Farm (LISF), a solar photovoltaic (PV) power plant, was 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, making it the largest solar PV power plant in the eastern United States. In FY15, the LISF provided 51.4 million kilowatt hours per year (kWh/yr) of clean renewable energy to Long Island.

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. The NSERC became operational in May 2014 and produced approximately 720,000 kWh of solar PV generation in FY15. The Laboratory was also awarded a grant from the Sustainability Project Office in FY15 to further build out this array, and this work will be initiated in FY16.

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. External collaborators include BP Solar, LIPA, SBU, and others.

BNL remains committed to complying with GHG-specific targets as well as the other objectives and goals of the DOE SSPP. BHSO, with support from BNL staff, awarded a Utility Energy Service Contract (UESC) on October 22, 2013. Energy conservation measures associated with this project include improved efficiency in supplying chilled water, upgraded lighting throughout the Laboratory, and the installation of building controls with enhanced temperature setback. Phase I implementation of the UESC was completed in May 2015. The improvements are expected to reduce the Laboratory's annual energy intensity by approximately 11% compared to baseline measurements, and reduce GHG emissions by over 7,000 $MtCO_2e$ per year.

BNL's Modernization Project Office (MPO) continues to ensure that at least 15% of existing buildings greater than 5,000 gsf are compliant with the Guiding Principles (GPs) of High Performance Sustainable Buildings (HPSB) by 2015. In FY15, DOE revised the goal to allow evaluation based on square footage. As a result of this change, the total square footage of HPSB at BNL is 22%.

Water reduction has been a major focus of the BNL sustainability effort. In FY14, BNL completed a project to re-route the treated effluent from the Sewage Treatment Plant (STP) to a groundwater recharge system. Currently, over 80% of BNL's water consumption is returned and recharged to groundwater at potable water quality. As a result of longstanding water reduction and conservation program, BNL has already achieved substantial reductions in water usage through the years (about 55% since 1999). When normalized by site growth (building area in gsf), BNL's annual water use intensity has decreased from 101 gallons per square foot to 86 gallons per square foot, a 14.9% water usage reduction since base-year 2007. In the future, however, Laboratory growth will tend to increase water use. Implementing further water conservation measures will be a significant economic challenge for BNL, as water is plentiful and inexpensive and further water reduction is capital and labor intensive.

BNL's construction and demolition recycling rate for concrete remains strong. The Laboratory recycles 95% of construction, demolition, and wood debris. Concrete and stone/brick demolition debris are stored on-site and then converted to Recycled Concrete Aggregate (RCA) using a concrete crusher. The generated RCA is then used as road base on the Lab's firebreak roads or as underlay in parking areas.

BNL has also had considerable success in reusing and recycling assets from the National Synchrotron Light Source I (NSLS I), which was permanently removed from service on September 30, 2014. Over $74 million of equipment was removed for reuse at NSLS-II and across the BNL campus, in addition to over $2 million of equipment and material that will be reused at Argonne National Laboratory (ANL) and Yale University. Additionally, more than 1.4 million pounds of material has been recycled, while returning $600,000 to the project and avoiding more than $200,000 in waste disposal costs.

The Laboratory continues to be committed to sustainable purchasing, and actively reviews and incorporates Environmental Protection Agency (EPA) recommendations for specifications that designate environmentally preferred products and services on a case-by-case basis. Currently, most of BNL's custodial products are Safer Choice or Green Seal products. All new or replacement water fixtures are evaluated for WaterSense-certified products, if applicable. Most computer products have been certified as EPEAT and both EnergyStar and/or FEMP products have been prioritized within the Laboratory's contracts.

Brookhaven remains strongly committed to supporting and achieving the targets in the DOE SSPP, and continues to seek out additional ways to reduce our environmental impact.

Table 1: Summary Table of Strategic Sustainability Performance Plan Goals, BNL's Performance Status, Planned Actions, and Risks

SSPP Goal #	DOE Goal	Performance Status through FY 2015	Planned Actions and Contribution	Risk of Non-attainment
Goal 1: Greenhouse Gas Reduction				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 19%)	The FY08 baseline was 205,628 $MtCO_2e$. In FY15, BNL's Scope 1 and 2 GHG emissions totaled 120,583.7 $MtCO_2e$—a decrease of 41.4% against the FY08 baseline. ***Note:*** *The total above is in accordance with the CEDR. However, this value does not reflect adjustments by the Sustainability Performance Office (SPO) for the Long Island Solar Farm (LISF). BNL estimates the total FY15 GHG value to be approximately 99,000* $MtCO_2e$.	Continuing efforts for FY16 include 15 MW of hydropower, the LISF, the 500 kW on-site photovoltaic (PV) research array, Renewable Energy Credit (REC) purchases, and energy intensity reduction through the Utility Energy Service Contract (UESC) Phase I, which was completed in May 2015. The UESC Phase I was a great success. As savings and performance are verified, BNL will likely initiate a Phase II effort in FY16. Given the encouraging results of a "right-sized" Combined Heat and Power (CHP) study in 2015, a follow-on study will be pursued in 2016.	Low
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 6%)	Scope 3 GHG emissions are up 0.4% from the 2008 baseline of 20,136 $MtCO_2e$ to 20,207 $MtCO_2e$ in FY15.	Planned efforts include continued promotion of the Two for Tuesdays rideshare initiative; encouraging greater use of BlueJean teleconferencing services; improving metrics for telework and compressed work	Medium

			scheduled using PeopleSoft HR time reporting records; completing the Commuter Choice website; and changing the standard allowable rental in domestic and foreign travel standard procedures from a mid-size to a compact vehicle.	
Goal 2: Sustainable Buildings				
2.1	25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY 2025 from an FY 2015 baseline	BNL's FY15 energy intensity was 243,130 Btu/gsf. This level represents a cumulative reduction of 24.9% from the FY03 baseline of 323,780 Btu/gsf. The UESC Phase I was completed in May 2015. Some of the energy savings are reflected in the FY15 energy intensity value. The Temperature Setback Policy was 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.	As savings and performance for UESC Phase I are verified, BNL will likely initiate a Phase II effort in FY16 to address the latest Energy Intensity reduction goal of 25%. Continued emphasis will be placed on the importance of building temperature setback in FY16.	High
2.2	EISA Section 432 energy and water evaluations	100% completed within the last four years. 25% of our buildings were surveyed by VFA in FY15. The reporting format has been revised to better emphasize potential energy projects.	Green Energy Surveys are in process and on schedule. BNL will continue with the cost-effective Energy Survey/ Facility Condition Assessment (FCA) approach in FY16 and beyond.	Low

2.3	Meter all individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate.	The status of individual building metering is as follows: • Electric: +100% (of appropriate meters) • Natural Gas: 100% • Steam: 93.3% • Chilled Water: 100%.	Additional meter installations are ongoing. BNL is investigating the need for additional sub-meters for any IT loads that are not on the uninterruptible power circuits. A potential project to relocate and consolidate BNL data centers provides an opportunity to improve data center performance and metering.	Low
2.4	At least 15% (by building count or gross square feet) of existing buildings greater than 5,000 gsf to be compliant with the revised Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter.	BNL achieved the goal in FY15 and currently has 22% of square footage classified as HPSB.	BSA will continue to design new construction renovations greater than 5,000 gsf to meet the HPSB requirements.	Low
2.5	Efforts to increase regional and local planning coordination and involvement	The Discovery Park project continued to receive high visibility among state and local agencies and was a key element in several regional economic development initiatives in FY15. A Sustainability Awareness and Engagement team was established to enhance the BNL Site Sustainability Program and foster a culture of sustainability across the Laboratory. Using smaller working groups, materials and tools were developed, including videos, posters, and a new BNL Sustainability website.	Efforts to continue the realization of Discovery Park will continue to move forward with support from local, regional and federal stakeholders. In FY16, the BNL Sustainability website will be reviewed and updated as necessary. The deer management strategy will need to be revisited due to financial risks of performing a maintenance cull in FY16. The Laboratory will	Low

		Deer management successfully reduced the deer population by approximately 300. The Laboratory made a commitment to implement best management practices established by the Pollinator Task Force and has begun to review implementation strategies for the Lab site. The Laboratory continued to support local and federal efforts to reduce reliance on petroleum by supporting programs and events to reduce the use of single occupancy vehicles.	continue to work to implement best management practices established by the Pollinator Task Force. The Laboratory will continue to support local and federal efforts to reduce reliance on petroleum.	
2.6a	Net Zero Buildings: Percentage of the site's existing buildings above 5,000 gsf intended to be energy, waste, or water net-zero buildings by FY 2025.	n/a	BSA will start evaluating existing net-zero buildings to see what technologies exist to help achieve this goal.	High
2.6b	Net Zero Buildings: Percentage of new buildings (>5,000 gsf) entering the planning process designed to achieve energy net-zero beginning in FY 2020.	n/a	BSA will start evaluating existing net-zero buildings to see what technologies exist to help achieve this goal.	High
2.7	Data Center Efficiency: Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.	An initial power utilization effectiveness (PUE) study indicated current PUE to be above 1.6. Additional electric meters and one new chilled water meter were installed in FY14. Efforts to identify and install additional metering continued so that a more	BNL is investigating the need for additional sub-meters for any IT loads that are not on the uninterruptible power circuits. There is a potential project under development that will	Medium

		accurate PUE for each data center may be measured and monitored. A comprehensive evaluation of the metering for the main data center in Building 515 was completed. The PUE for FY14 was determined to be 1.41. This was based on actual metered energy for over 94% of the total energy use. Approximately 6% was estimated based on empirical data.	relocate the existing data center to a new building. The new facility will be designed to achieve the lowest PUE that is cost-effective.	
Goal 3: Clean & Renewable Energy				
3.1	"Clean Energy" requires that the percentage of an agency's total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-2017, working towards 25% by FY 2025.	n/a	Planned actions include continued operation and expansion of the Northeast Solar Energy Research Center (NSERC) facility; REC purchases as necessary to meet both the Renewable and new Clean Energy Goals; and continued investigation and analysis of a CHP.	Low
3.2	"Renewable Electric Energy" requires that renewable electric energy account for not less than 10% of a total agency electric consumption in FY16-17, working towards 30% of total agency electric consumption by FY 2025.	BNL purchased 43 million kWh of RECs, which equals 8.94% of BNL's total usage of electric and thermal energy. When the NSERC output is added, the total is 9.1%. ***Note:*** *FY15 goal from last year's SSP was 7.5%* The LISF began operations in November 2011 and in FY15, provided 51.43 million kWh/yr of clean renewable energy to Long Island. The on-site NSERC solar	A CHP using biomass fuel is not practical at BNL. However, new requirements as part of E.O. 13693 will count the thermal energy from a CHP as "clean" energy. BNL recently learned of approval for SPOFOA funding to install an additional 200 kW of solar PV at the NSERC facility in FY16. RECs will be purchased	Low

		array became operational in May 2014. In FY15, NSERC produced ~720,000 kWh.	as necessary to fully meet the goal.	
Goal 4: Water Use Efficiency and Management				
4.1	36% potable water intensity (Gal per gross square foot) reduction by FY 2025 from a FY 2007 baseline. (2015 target: 16%)	Annual water use intensity has decreased from 101.2 gallons per square foot to 86.1 gallons per square foot, a 14.9% water usage reduction since base-year 2007. The Sewage Treatment Plant (STP) modification to recharge treated effluent to groundwater became operational in October 2014. About 80% of BNL's total water "usage" is recharged/ recycled to the source groundwater beneath the Laboratory.	BNL's Water Management Plan will continue to be implemented, and BNL will continue to utilize water-efficient processes and plumbing fixtures to conserve water. Reconstruction of Well House No. 12 (in design) and reduction of Water Treatment Plant (WTP) filter back-wash cycles could reduce BNL's water usage by 3% to 5%. It is expected that increased science activities, with their need for accelerator cooling, will increase water consumption due to cooling tower evaporation.	Medium
4.2	30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target: 10%)	No permanent landscaping or agricultural water use.	n/a	n/a
Goal 5: Fleet Management				
5.1	20% reduction in annual petroleum consumption by FY	This goal was surpassed with a 53% reduction in petroleum consumption.	This goal should be considered part of 5.3, which measures	Low

	2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2015 target: 20%)		greenhouse gas emissions.	
5.2	10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter. (2015 target: 10%)	This goal was not met. The FY05 baseline was very high, and the Laboratory's ability to purchase alternative fuel vehicles was not sufficient to increase the already high baseline.	This goal should be considered part of 5.3, which measures greenhouse gas emissions.	High
5.3	30% reduction in fleet-wide per- mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline. (2015 target: N/A; 2017 target: 4%)	FY14 Baseline: 706.87 gCO_2e/mile FY15 actual: 671.25 gCO_2e/mile Decrease: 5%	All new orders of leased vehicles are alternative fuel vehicles when available. The overall gCO_2e/mile of the fleet will also decrease as older vehicles are replaced with newer, more fuel-efficient models.	Low
5.4	75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2015 target: 75%)	95% of light duty vehicles ordered through the U.S. General Services Administration (GSA) in FY15 were alternative fuel vehicles.	All new orders of leased vehicles are alternative fuel vehicles when available.	Low
5.5	50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2015 target: N/A)	N/A	No actions planned for FY16.	Medium
Goal 6: Sustainable Acquisition				
6.1	Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions	BNL has met the intent of this goal and has incorporated the required provisions and clauses within its contracts.	BNL will be converting its online purchasing to Vinimaya. A minimum of 24 vendor catalogues are expected to be up and operational by the end of the fiscal year. In	Low

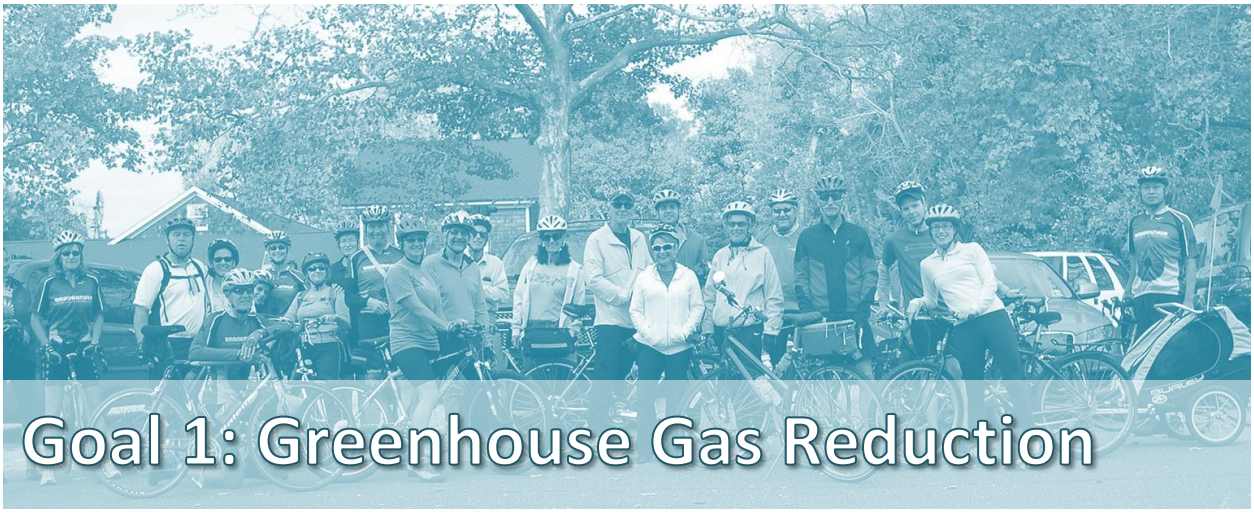
	and clauses are included in 95% of applicable contracts.		addition, “kits” will be created that will direct purchasers toward Environmentally Preferable Purchasing (EPP) products so they can make the appropriate choices for certain products.	
Goal 7: Pollution Prevention and Waste Reduction				
7.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris.	During FY15, BNL's annual diversion rate of non-hazardous solid waste was approximately 74%, aided tremendously by the amount of recycling during the decommissioning of the National Synchrotron Light Source I (NSLS-I).	BNL will evaluate the economic feasibility of food waste composting as a method of further reducing waste sent to the Town’s transfer station.	Low
7.2	Divert at least 50% of construction and demolition materials and debris.	The Laboratory recycles over 95% it’s of construction, demolition, and woody debris.	During FY16, BNL plans to mine concrete debris from the Borrow Pit (the on-site concrete debris storage area) and generate Recycled Concrete Aggregate (RCA).	Low
Goal 8: Energy Performance Contracts				
8.1	Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693.	A UESC (Phase I) was awarded on October 22, 2013 and completed in May 2015. It is estimated to result in a nearly 11% reduction in energy intensity. Estimated annual energy savings are ~$1.2 million. Savings to-date are currently being verified but are on track to match or exceed the estimate. Energy conservation measures include improved	Preliminary audits for additional scope (a potential Phase II) were completed by two independent ESCOs during FY15. BSA management feels it is prudent to further evaluate/verify the savings from the Phase I effort before making recommendations on Phase II.	

		efficiency of supplying chilled water; lighting upgrades throughout the Laboratory; and installation of building controls with enhanced temperature setback.		
Goal 9: Electronic Stewardship				
9.1	Purchases – 95% of eligible acquisitions each year are EPEAT-registered products.	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.	The Laboratory will continue to require that all printers, laptops, and desktop computers ordered through the E-Pro System have an EPEAT "Gold" certification.	Low
9.2	Power management – 100% of eligible PCs, laptops, and monitors have power management enabled.	All systems in the BNL domain that are capable of power management have the setting enabled.	BNL will continue to evaluate the feasibility of extending the desktop computer power management policy to other operating systems.	Low
9.3	Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled.	In FY15, the BNL Office of Institutional Improvement published Managed Printing guidelines, which recommend the use of network/department-wide printers configured for black ink only and duplex printing.	The majority of printers and copiers are not centrally managed at BNL. The Information Technology Division (ITD) does not monitor or configure duplex printer settings. Resources permitting in FY16, ITD will investigate centralized printer management and make recommendations for future upgrades.	Low
9.4	End of Life – 100% of used electronics are reused or recycled using environmentally sound disposition options each year.	BNL computers available for reuse are entered into a Property Management pool. During FY15, over 24 tons of BNL computers and peripherals were reused internally. Once a computer researches	BNL will continue to reuse or recycle electronics in an environmentally sound manner.	Low

		the end of its useful life, it is either put aside for the Computers for Learning Program or is recycled through the Laboratory's computer recycling vendor. The vendor is Responsible Recycling (R2) certified. During FY15, 45 tons of electronics were recycled.		
Goal 10: Climate Change Resilience				
10.1	Update policies to incentivize planning for, and addressing the impacts of climate change.	Aspects of climate change related to extreme weather events are considered in long-range planning at BNL.	The Laboratory will continue to update policies related to planning for and addressing the impacts of climate change, particularly in regards to extreme weather events.	Low
10.2	Update emergency response procedures and protocols to account for projected climate change, including extreme weather events.	The BNL Office of Emergency Management (OEM) maintains the Site Emergency Plan, Severe Weather Planning Guide, Hurricane Plan, and Site Loss of Power Plan. All BNL OEM plans and procedures are reviewed or updated on an annual basis, as required by DOE O151.1C.	All OEM plans and procedures will be reviewed or updated on an annual basis, as required by DOE O151.1C.	Low
10.3	Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.	The Laboratory has a number of workforce policies and programs in place that reflect our understanding of climate change and its projected impact on human health and safety, in particular severe weather events.	The Laboratory will continue to evaluate its workforce policies and programs in light of our understanding of climate changes and its projected impact on human health and safety.	Low
10.4	Ensure site/lab management demonstrates commitment to adaptation efforts through internal	In FY15, the Internal Communications group promoted sustainability messages by way of articles, posters, videos, web features, and more. Some	In FY16, increased communication will occur regarding green purchasing, networked printing, and the Laboratory's use of	Low

	communications and policies.	topics included promotion of Earth Day, recycling days, green purchasing, energy use reduction, UESC news, and the sustainability website.	leased alternative fuel vehicles.	
10.5	Ensure that site/lab climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary.	BNL's strengthened their collaboration with the National Weather Service on-site; initiated a project funded by NYSERDA to determine how fusion of real-time weather data can shorten recovery time for utility system impacted by severe weather; developed a team to improve our capabilities to model regional climate; and engaged with the New York City Mayor's office to discuss collaborations on solar forecasting and a city-wide meteorological sensor network.	In FY16, BNL plans to collect, share, and report meteorological data for the site; publish a full-length article on regional climate modeling relevant to NYC; finalize the upgrade of meteorological measurement equipment; and further develop regional climate modeling strength.	Low

II. Performance Review and Plan Narrative



1.1 Greenhouse Gas Reduction, Scope 1 and 2

50% Scope 1 & 2 GHG reduction by FY 2025 from an FY 2008 baseline (2015 target: 19%)

Performance Status

BNL's major initiatives include 15 MW of hydropower, the Long Island Solar Farm (LISF), the 500 kW on-site photovoltaic (PV) research array, Renewable Energy Credit (REC) purchases, and BNL's approximately 25% energy intensity reduction, resulting in an impressive 41.4% reduction (83,045 $MtCO_2e$) in Scope 1 and 2 greenhouse gas (GHG) emissions for FY15.

Other important initiatives include the continued utilization of a number of best management practices, particularly building temperature setbacks during unoccupied periods. See Section 2.1 for details.

One of BNL's recent success stories is the completion of our first Utility Energy Service Contract (UESC) in May 2015. This important project will provide an estimated annual reduction of nearly 90,000 mmBtu of energy and 7,000 $MtCO_2e$. See Sections 2.1 and 8.1 for additional details.

A major change from previous BNL SSP submissions is a greatly reduced electricity load profile. This change is mainly attributed to a slight delay in the implementation of some of the High Energy Mission Specific Facilities (HEMSF) projects.

Space Management and Alternative Workplace Arrangements

BNL has a robust space management program. All occupants/users pay a "space charge" for areas occupied. This is a very effective tool to ensure space is effectively utilized and unnecessary space is reallocated, mothballed, or demolished. BNL strives to meet all recommended standards for each type of activity.

BNL provides the opportunity for both flexible work schedules and the ability to work from other locations, including the employee's home when it is practical. This opportunity will be continued for the foreseeable future.

Process & Fugitive GHG Emissions

Periodic purging of carrier gases, which are used during experimental runs at the Relativistic Heavy Ion Collider (RHIC) is responsible for the bulk of BNL's process and fugitive GHGs. In FY15, carrier gases were purged from various subsystems within the PHENIX and STAR detectors as summarized below. The table indicates the percentage of BNL's FY15 fugitive GHGs that can be attributed to the purging of carrier gases from these subsystems.

Table 2: Fugitive GHG Emissions

Gas	Subsystem	Detector	Percentage of Total Fugitive GHG Emissions
1,1,1,2-tetrafluoroethane (HFC-134a)	Time of flight counter west & resistive plate chamber subsystems	PHENIX	5.8 % (759 $MtCO_2e$)
Sulfur hexafluoride (SF_6)	Time of flight counter west & resistive plate chamber subsystems	PHENIX	4.3 % (569 $MtCO_2e$)
perfluoromethane (PFC-14)	Muon tracking chamber north and south subsystems	PHENIX	72.7 % (9,570 $MtCO_2e$)
Methane (CH_4)	Time projection chamber	STAR	0.05 % (6.4 $MtCO_2e$)
Sulfur hexafluoride (SF_6)	Muon telescope detector	STAR	1.0 % (129 $MtCO_2e$)
1,1,1,2-tetratfluourethane (HFC-134a)	Time of flight (TOF) subsystem	STAR	2.1 % (273 $MtCO_2e$)
1,1,1,2-tetratfluourethane (HFC-134a)	Muon telescope detector	STAR	6.5 % (854 $MtCO_2e$)

Emissions of SF_6 from insulating gas leaks and the transfer of insulating gases during periodic maintenance of the BNL's Tandem accelerators accounted for 7.5% (991 MtCO2e) of FY15 process and fugitive GHGs.

In 2012, BNL's PHENIX Group began acquiring funds to upgrade the resistive plate chamber (RPC) detector single pass circulation system to a recirculation system that will reduce purged HFC-134a and SF_6 emissions by 50% to 75%. Most of the materials to upgrade the system have been purchased and the recirculation system installation is about 90% complete. Plans to complete the recirculation system were suspended because the RPC detector was not used in the FY15 PHENIX experimental run. Meanwhile, the new gas recirculation system on the multi-gap resistive plate TOF subsystem that BNL's STAR Group completed prior to the FY14 experiment reduced TOF HFC-134a gas purge rates by 87.5% from 120 to 15 liters per hour.

Sulfur Hexafluoride Emissions

In FY14, BNL finalized a High Energy Equipment Management Plan that the Energy & Utilities (EU) Division Electric Distributions Group will follow to accurately account for and effectively manage leaks of SF_6 associated with gaseous dielectric used in high voltage electric equipment. The plan establishes a proactive process to identify and repair leaks by setting up a periodic inspection and maintenance schedule for each piece of equipment. None of the ten switches inspected during the year were found to be leaking after technicians compared SF_6 gas pressure readings with baseline readings recorded when the switches were last inspected.

Plans and Projected Performance

GHG Reduction Strategy

BNL remains committed to meeting this important goal and is currently at or below the FY25 target of 103,000 $MtCO_2e$. (The CEDR calculates it at 120,583.7 but BNL calculates it at ~99,000). This impressive reduction is due to a combination of hydropower (obtained in March 2011) and hosting and support for innovative projects, such as the LISF, NSERC, and REC purchases. However, in order to ensure achievement of the 50% reduction goal by FY25, BNL must be diligent in maintaining these valuable assets and be aggressive with energy conservation, renewable energy purchases and projects, operational improvements, and infrastructure modernization. This will involve seeking and obtaining funding from every possible source, along with cultural changes and increased emphasis on management practices.

With a combination of maintaining existing initiatives as well as planned ones, BNL is on target to reduce Scope 1 and 2 GHG emissions by significantly more than 50% by FY25 when compared to the FY08 baseline. According to the CEDR calculation for FY15, we are already at -41.4% (120,584 $MtCO_2e$). This value does not reflect adjustments by the SPO for the LISF. As indicated above, BNL estimates the total FY15 GHG value to be approximately 99,000 $MtCO_2e$. Further, with additional initiatives such as Phase II of the UESC and additional REC purchases to meet the renewable and new clean energy goals, we estimate the FY25 value to be only 6,800 $MtCO_2e$, a reduction of nearly 105%.

The Combined Heat and Power (CHP) study that was completed in 2015 suggests that a CHP can have financial value, in addition to providing a significant GHG reduction (~50,000 $MtCO_2e$) and clean energy. While we currently do not believe that additional reduction will be necessary to achieve the GHG goal, there are still other potential advantages, including the ability to power the base site if the electric grid is down and meeting the “clean energy” goals. BNL will continue to evaluate GHG in FY16.

Initiatives to reduce fugitive emissions will be continued and enhanced. Wherever possible, BNL will eliminate/reduce the use of systems that require SF_6 when viable alternatives are available.

High Energy Mission Specific Facilities (HEMSF) - Challenges

As other sites have experienced, HEMSF pose significant challenges to reducing GHGs. As previously noted, BNL’s latest electric load projections are significantly lower that previous estimates. The main reason for this is a delay in the estimated implementation dates of HEMSF projects and initiatives. One major new project, called eRHIC, is estimated to begin after 2025, the latest GHG reduction target date.

The eRHIC project is estimated to increase our GHG emissions substantially (~70,000 $MtCO_2e$). Once eRHIC begins, additional initiatives to reduce GHG may be required.

Summary

The table below summarizes the Laboratory's current and projected GHG status in light of existing and planned initiatives.

Table 3: Current and Projected GHG Status

	$MtCO_2e$	Change Compared to	
		2008	Target
2008 GHG Emissions	205,628		
50% GHG Reduction Target	103,000	-50%	
2025 Projected GHG Emissions with Initiatives	6,800		-105%

It is important to note there is a significant change in GHG estimates from previous years due to significantly lower electric power estimates.

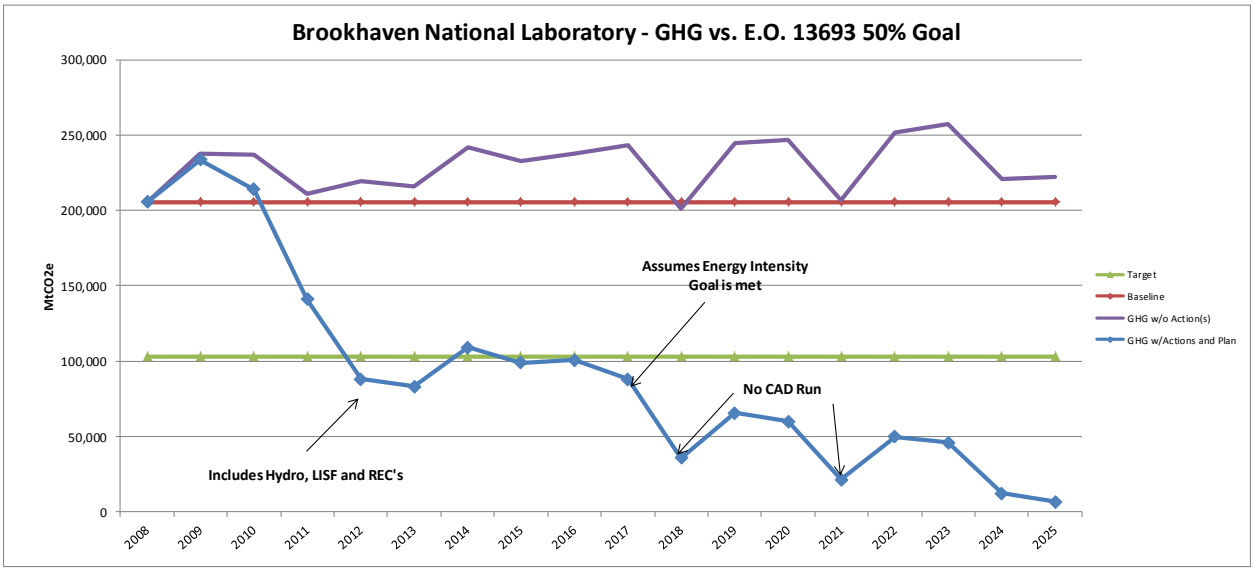


Figure 1: Scope 1 and 2 Greenhouse Gas Emissions vs. EO 13693 Goal

1.2 Greenhouse Gas Reduction, Scope 3

25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 6%)

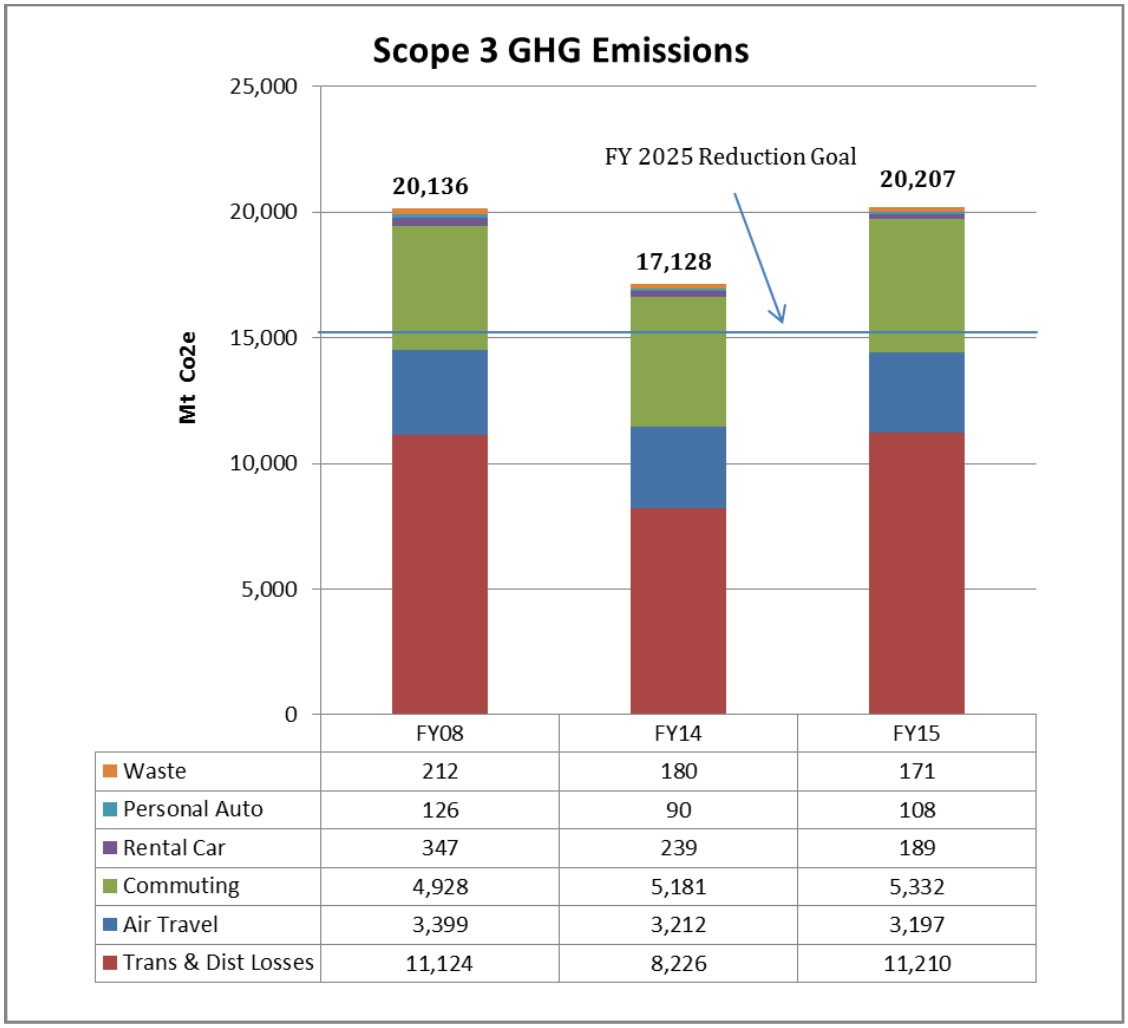
Scope 3 GHG Reduction Strategy

BNL's Scope 3 GHG reduction strategy focuses on the following:

- Rideshare: Encouraging employees to rideshare through effective communications and programs to help individuals identify potential participants.
- Telecommuting: Provide flexible work schedules and the ability to work from home to reduce personal employee travel.
- Business Travel: Increase opportunities for teleconferencing by taking advantage of commercially available systems and services and providing dedicated teleconferencing areas. Encourage employees to utilize more efficient vehicles when on business travel.
- Employee Personal Choices: Increase employee awareness of more efficient vehicles, including electrics and hybrids through various methods, including annual Earth Day events.

Performance Status

The figure below illustrates that, overall, Scope 3 GHG emissions are up 18.0% from FY14 (3,079 $MtCO_2e$), and 0.4% higher than the FY08 baseline value.



	FY08	FY14	FY15
Waste	212	180	171
Personal Auto	126	90	108
Rental Car	347	239	189
Commuting	4,928	5,181	5,332
Air Travel	3,399	3,212	3,197
Trans & Dist Losses	11,124	8,226	11,210

Figure 2: Scope 3 Greenhouse Gas Emissions

Waste

Since 2008, GHGs from contracted waste are down 19.3% 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 has also helped to reduce waste levels. These food preparation wastes are used at the Sewage Treatment Plant (STP) to raise plant biochemical oxygen levels, which, in turn, aids in the de-nitrification process and supplements the biomass at the STP.

Personal Auto (Business)

GHGs from employees using their personal vehicles for business use have decreased 14.3% since FY08.

Rental Cars

GHG emissions from rental vehicles used for employee business travel dropped by 50 $MtCO_2e$ or 21% from FY14.

Commuting

Commuting GHGs rose 2.9%, or 151 $MtCO_2e$, from FY14. In September 2011, a survey was performed using traffic counters to aggregate and distinguish the types of vehicles entering the site from 7 am to 9 am over a five-day period. The survey results were combined with tallies of the number and types of multi-occupant vehicles each day to estimate the commuting GHGs. A modest increase in the average employee round trip commute from 27.70 miles in FY14 to 28.92 miles in FY15 is the primary reason for the rise in commuting GHGs. The average commuting distance increase accounts for the corresponding increase in the commuting distance traveled by single occupancy passenger cars/light duty trucks and carpools noted in Section 8.3 of BNL's CEDR.

At the end of March, BNL's Badging Office sent a mass e-mail to 1,288 active employees, guests, and contractors requesting that they update their current stickered vehicle database records. By mid-May, all but 15 individuals had responded and provided their missing model information and/or removed older vehicles they no longer owned or had in service. As a result, stickered vehicle database records for more than 3,500 individuals covering just over 5,000 vehicles from model year 1984 to 2016 are recorded in the database. Records include the vehicle make, model, and model year, which can been combined with the EPA's combined mileage ratings from the US DOE fuel economy website to estimate the average fuel economy of employee vehicles and annual commuter GHG emissions.

Based on current database records, the average fuel economy of employee vehicles used for commuting in FY15 was estimated at 23.8 miles per gallon compared to an average fuel economy estimate of 23.2 miles per gallon for FY14. As employees gradually replace older vehicles with newer vehicles that reflect higher Corporate Average Fuel Economy (CAFE) Standards established for vehicle manufacturers by the National Highway Traffic Safety Administration (NHTSA) shown in the table below, the average fuel economy of vehicles used for commuting will continue to rise. As the average fuel economy of employee vehicles rises, then employee commuting GHG emissions should fall.

Table 4: Projected Fuel Economy Standards

	2012	2013	2014	2015	2016	2017	2018
Passenger Cars	33.6	34.4	35.2	36.4	38.2	39.6	41.1
Light Trucks	25	25.6	26.2	27.1	28.9	29.1	29.6
Combined Cars & Tucks	29.8	30.6	31.4	32.6	34.3	35.1	36.1
Table is based on CAFE certification data from model year 2010, a car-truck sales split from the Energy Information Administration's Annual Energy Outlook for 2012, and future sales forecasts by JD Powers.							

To make the Laboratory campus more accessible to bicyclists, BNL's Laboratory Protection Division (LPD) announced a new pilot program to expand the number of site access points to BNL bicycle commuters from two to three in April 2014. The program was developed to provide bicycle commuters residing south and east of the Laboratory with more direct access via a gate at the southeast corner of the site. The program also allowed registered bicyclists entering the site via the Main Gate from the west and the North Gate without having to slow down and present their badge every time they enter the site. On May 11, 2015, after completing its evaluation of the program, Laboratory management announced that it would be extended for a year. As of September 30, 2015, 92 bicyclists had signed up for the program.

To increase employee awareness and appreciation of the environmental, health, and economic benefits of sustainable means of transportation, BNL participated in the 3rd Annual Car Free Day Long Island (LI) celebration on September 22, 2015. To participate, employees completed an online pledge on the Car Free Day LI website to be car-free or car-lite on September 22, 2014 and commit to drive less by carpooling, biking, walking, or telecommuting.

In an effort to encourage more employees to carpool on Car Free Day, the Environmental Protection Division (EPD) introduced a new carpooling initiative called Two for Tuesdays. The initiative emphasizes that ridesharing can be as simple two people carpooling once a week. Promotion of the initiative included a feature article on BNL's homepage, e-mail messages, and posters focused on the 89 percent of BNL employees who reside in "carpool clusters" (areas where 10 or more fellow employees live). Employees residing in each of the 39 carpool clusters were directed to use the 511NYRideshare Ride-match tool to reach out to employees residing nearby who were also interested in carpooling. To further encourage participation, all individuals that made pledges were automatically entered in a random drawing for multiple donated prizes.

In June, EPD staff met with Fiscal Services staff to discuss how the Laboratory's current time-keeping system in PeopleSoft can be used to accurately record the number of days and hours of employees teleworking under BNL's Flexible Work Arrangement procedures.

Airline Travel

Airline travel GHGs dropped by 15 $MtCO_2e$, a decrease of 0.5% from the FY14 total. With this decline, FY15 airline travel GHGs are 5.9% less than the FY08 baseline.

Transmission and Distribution Losses

From FY08 to FY15, GHGs from electrical transmission and distribution losses rose 0.8%, or 86 $MtCO_2e$, despite a 22.2% increase in purchased electricity. Hydropower purchases of 121,682 MWh in 2015 from New York Power Authority (NYPA) accounted for 42.9% of all electrical power purchases. Lower e-Grid

GHG emission factors for the Long Island sub-region in FY15 versus those of FY08 helped to moderate the increase in transmission and distribution loss GHGs. The 36.3% increase in electrical transmission and distribution losses from FY14 to FY15 is primarily due to an increase in the transmission and distribution loss factor from 6.18% in FY14 to 10.10% in FY15.

Plans and Projected Performance

To achieve the 25% Scope 3 GHG emission reduction goal for FY25 and the FY20 12% employee business travel GHG emission reduction goal, BNL must lower overall Scope 3 GHGs and employee travel GHGs by 5,034 $MtCO_2e$ and 1,056 $MtCO_2e$, respectively. Meeting the 25% Scope 3 GHG emission reduction goal will be especially challenging in light of requirements to include purchased electricity, steam, hot water, and chilled water GHG emissions associated with leased building spaces greater than 10,000 square feet into Scope 3 GHG totals. Current Phase I plans for BNL's proposed Discovery Park project call for the construction of a 130,000 square foot Central Office Building in 2020. As planned, the building will be leased from an outside landlord.

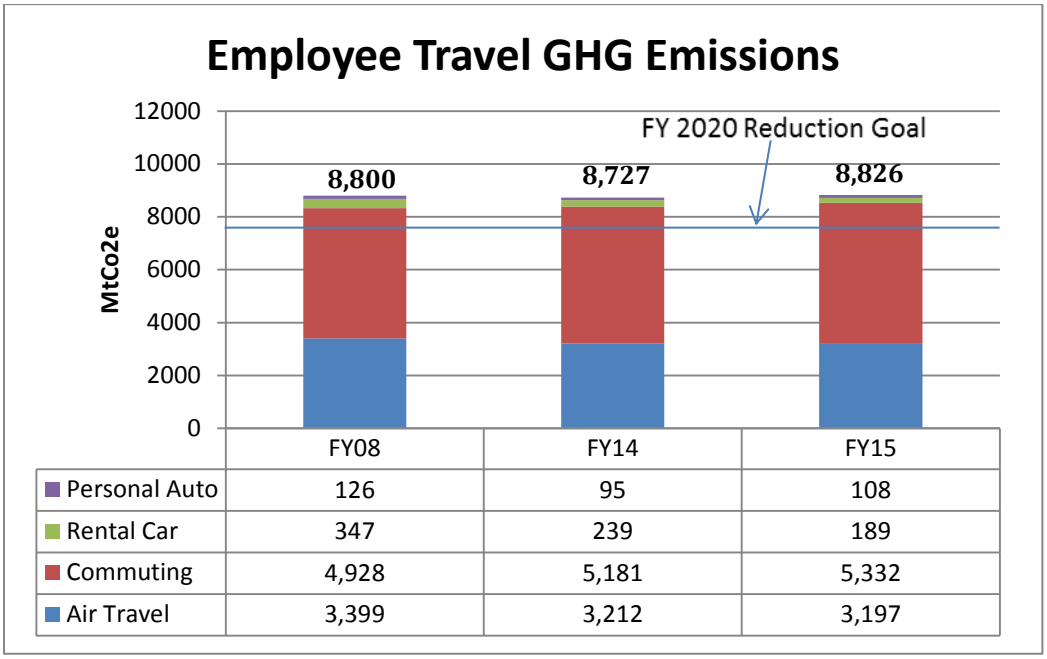


Figure 3: Employee Travel Greenhouse Gas Emissions

To encourage more employees, managers, and organizations to use BlueJean teleconferencing tools, BNL will work with the ITD Conferencing Services Office to communicate the merits of the new BlueJean tools, emphasizing the return on Investment gained through avoided airline and travel costs.

During the second quarter of FY16, Human Resources (HR) staff will make necessary changes to the Standards-Based Management System (SBMS) Flexible Work Arrangements Subject Area to direct employees how to record telework days in PeopleSoft. Following this, HR will roll-out plans to communicate the subject area changes to affected workers and their supervisors. EPD staff will meet with HR staff and Fiscal Services to determine if additional changes need to be made to the subject area to ensure that compressed work hours are being accurately captured in PeopleSoft time reporting.

BNL will continue efforts to convert the current EPD Rideshare website to a Commuter Choice website. Several new intranet links to other BNL web locations (i.e., Staff Services Transportation, HR Careers, BNL Users Group, and others) will be added to make the Commuter Choice website visible and accessible to more individuals. BNL will also establish links to the new Commuter Choice website on the BNL Site Sustainability webpage.

To affect reductions in rental car GHGs, efforts will be made to amend the standard allowable rental in BNL's Domestic Travel and Foreign Travel standard procedures from a mid-size to a compact vehicle.

2.1 Energy Intensity Reduction

25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY 2025 from an FY 2015 baseline.

Performance Status

BNL's energy intensity for FY15 was 24.9% lower than the previous base year of 2003. The established goal was 30%. While BNL missed the goal by ~5%, we are still pleased with the results, as this reduction is on top of two previous 30% reduction goals, which were met. Furthermore, it is anticipated that FY16 will be even lower due to the full effect of the UESC, which was completed in May of 2015.

During FY15, the Temperature Setback Policy was 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.

Executive Order 13693, Section 3(a)(i) Recommended Tools

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
- Targeting Data Center PUE of less than 1.5 for existing 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 but energy efficiency was also improved.

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 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 facility managers throughout the BNL campus either have, or in the process of obtaining the Certified Facility Manager (CFM) recognition. All of the facility managers and engineers 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.

Plans and Projected Performance

It will be a challenge for BNL to meet the new 25% reduction goal by FY25. Since the late 1970's, BNL has implemented numerous energy conservation projects and reduced energy intensity by 427,000 Btu/sq. ft. As a result, it is becoming very difficult to identify cost effective projects.

As previously stated, BNL will pursue a Phase II of the UESC effort once actual savings from Phase I are verified. If enough cost effective projects can be identified for Phase II, BNL may be able to meet the new 25% reduction goal. Preliminary audits for Phase II have been completed, and it is anticipated that a formal UESC Phase II effort will begin by the end of FY16.

BNL will continue to pursue an aggressive temperature setback policy in FY16 and communicate its importance to the Laboratory population. Further, BNL will continue all of the practices currently in place, as identified in the Performance Status section.

Best Practices Implemented at BNL

<u>HVAC Setback</u>

A setback capability for heating, ventilation, and air conditioning systems (HVAC) continues to be installed 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. Lease agreements will be modified to incorporate setback clauses. In addition, the existing preventative maintenance (PM) program will be enhanced for all HVAC systems.

The HVAC setback initiative will be emphasized extensively during FY16 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 is planned 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. A steam charge-back program was recently piloted and is planned to 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. Where applicable, automated controls will be installed. It is estimated that this will provide an annual savings of approximately 4,000 mmBtu/year.

Energy Audits

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.

2.2 Energy and Water Evaluations

EISA Section 432 energy and water evaluations, benchmarking, project implementation, and measures follow up

Performance Status

Overall Strategy

BNL completed their annual energy and water evaluations. They were combined with Facility Condition Assessments (FCAs) a few years ago to save cost and complete the effort more efficiently. Annual cost savings are approximately $50,000.

In 2014, BNL modified the Green Energy Assessments (Energy and Water Audits) to make it easier to display conservation projects. However, to-date no significant cost-effective projects have been identified. Any projects that are identified will be included in a future UESC/ESPC initiative.

BNL's current budgets do not allow for substantial retro commissioning. However, as part of our UESC Phase I project, 9 buildings were effectively "retro commissioned."

Strategy for Prioritizing and Implementing Projects

Projects are prioritized based on cost-effectiveness, maintenance backlog reduction, energy savings, and overall need for the particular facility.

Benchmarking Facilities with EPA Portfolio Manager

All of BNL's covered facilities have been entered into the EPA Portfolio Manager system. Further, all annual Green Energy Assessments are entered. Benchmarking is available and done on an as-needed basis.

Covered Facilities

All of BNL's buildings and facilities are considered covered, representing 100% of the energy consumption.

Plans and Projected Performance

BNL will continue with the cost-effective Energy Survey/FCA approach in FY16 and beyond.

The energy survey information includes rough energy project cost estimates, along with simple payback calculations. This information is maintained in the database and used to identify viable energy projects. All building survey information is entered in the EPA Energy Star Portfolio Manager database, making benchmarking of the facilities easier and more robust.

All identified cost-effective projects will be considered when BNL initiates our planned future UESC/ESPC initiative.

2.3 Individual Buildings Metering

Meter all individual buildings for electricity, natural gas, steam and water, where cost-effective and appropriate.

Performance Status

BNL's annual metering plan is included as Appendix C.

BNL continued its successful history of advanced metering in FY15 and currently meets the metering goals for electricity, natural gas, and chilled water. Advanced electric meters are installed in 298 buildings, advanced chilled water meters are installed in 34 buildings or loads with chilled water, and all four (4) of BNL's natural gas-supplied facilities have advanced meters installed.

Advanced steam/condensate metering is installed in 41 buildings. However, 29 buildings still have conventional steam meters that will be upgraded as appropriate. BNL will install new steam metering in

large use buildings where steam metering is insufficient with a goal of upgrading three or more meters per year. This will assist in our 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. In FY13, the new LEED Gold Interdisciplinary Science Building I (ISB-I) was commissioned and included advanced potable water metering.

Electric

Seventeen (17) Ethernet-based Power Quality meters were installed throughout the Laboratory.

Steam

Four (4) steam meters were upgraded to the advanced metering platform, and two (2) malfunctioning advanced steam meters were replaced.

Chilled Water

One (1) additional advanced chilled water meter was installed. Additionally, chilled water metering in the new National Synchrotron Light Source II (NSLS-II) includes segregated metering for the ring/process loads and the Laboratory-Office Building (LOB) cooling loads.

Plans and Projected Performance

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.

Utilization of "Green Button" is not necessary at BNL due to the capabilities provided with our state-of-the-art BAS, which provides all relevant energy information to the facility managers.

Implementation Barriers

There are currently no barriers. Annual audit costs range from $30k to $80k, depending on the buildings being audited. At the present time, the cost is covered through a surcharge on the internal energy bills.

2.4 High Performance Sustainable Buildings (HPSB) – Existing Buildings

At least 15% (by building count or gross square feet) of existing buildings greater than 5,000 gsf to be compliant with the revised Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter.

Performance Status

BNL has surpassed the 15% milestone and is currently at 22%. BNL has enough LEED-certified buildings,

as well as a buildings classified as High Performance Sustainable Buildings (HPSB) in EPA's Portfolio Manager, to meet the requirement by 2025.

Plans and Projected Performance

Approach to Make Progress Towards 100% Conformance

BSA will continue to design new construction and renovations greater than 5,000 square feet to meet the HPSB requirements, thereby, moving towards 100% conformance. For the immediate future, the Building 924 renovation and the Core Facility Revitalization (CFR) Project will incorporate HPSB requirements into the design and construction. In addition, future UESC/ESPC initiatives will target opportunities to help meet HPSB criteria.

Incorporation of Federal Guiding Principles and Sustainable Practices

The HPSB requirements are included as part of BNL's Standards and Procedures. These requirements are part of all new designs for new and retrofit projects, whether designed internally or with external resources.

Climate-Resilient Design

Climate-resilient design is considered with all new projects. BNL is required to follow all federal and state building codes. As these codes are updated it is expected that climate-resilient criteria will be included.

2.5 Regional and Local Planning

Efforts to increase regional and local planning coordination and involvement

Performance Status

Regional Transportation Planning

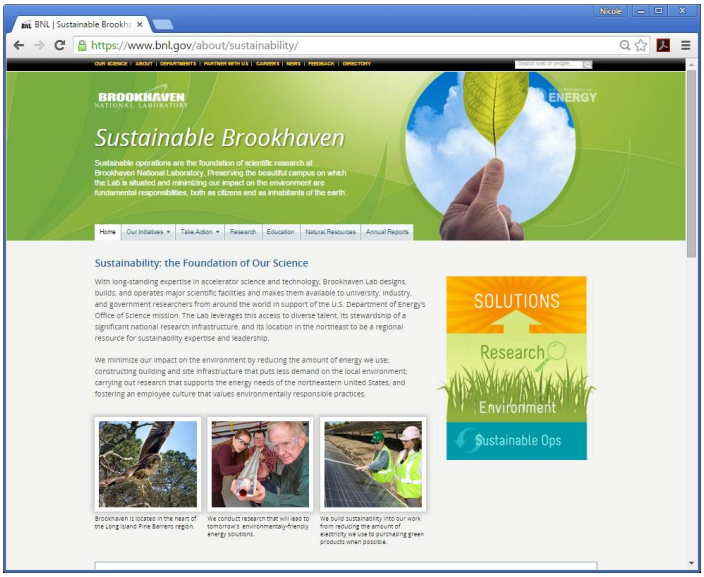
<u>Discovery Park</u>

In FY15, the vision for Discovery Park received strong support from BSA, DOE and regional stakeholders. The Discovery Park project made a great deal of progress in obtaining support to move forward and is currently viewed as a project of regional significance. The project was recently incorporated into Suffolk County's Innovation Zone (iZone), with the County seeking to relocate the Yaphank Train Station to the Laboratory site to enhance utilization of public transit.

A grant proposal for the utility infrastructure of Discovery Park from the Empire State Development Corporation (ESDC) has received positive response through the State regional competition. The grant application received 21 letters of support from businesses, civics, academia, not-for-profits, government, user advocacy groups, and labor.

Sustainability Awareness and Engagement

The Laboratory established a Sustainability Awareness and Engagement team in January 2015 with members from operations and science organizations across the Laboratory. The focus was to identify human behavior elements to enhance the BNL Site Sustainability Program and foster a culture of sustainability across the Laboratory. Using smaller working groups, materials and tools were developed to further educate employees and guests with suggestions for reducing their environmental impact at the Laboratory, including videos, posters, and a website.



Throughout FY15, a sub-team worked extensively to design, develop, and publish a new BNL Sustainability website. The site was published in early October 2015 and covers a wide variety of sustainability topics. This includes promoting the Laboratory's sustainability initiatives; describing actions that employees can take to reduce their environmental impact; and showcasing the research that BNL performs in sustainability areas, such as energy and climatology.

Additionally, two posters and two videos were released on Earth Day. A trifold that provides guidelines on recycling programs at BNL, printed on 100% recycled paper, was produced and also issued on Earth Day. A large ongoing campaign using posters and written material to increase awareness of proper recycling at BNL began in June for our staff, as well as our many summer students, users, and visitors.

Coordination with Federal, State, Tribal and Local Organizations

Deer Management

Deer management was successfully implemented at the Laboratory by the Natural Resources Manager in partnership with the New York State Department of Environmental Conservation (NYSDEC) and U.S. Department of Agriculture (USDA) Wildlife Services, reducing the site's deer herd by 300 animals. Following the reduction, a June 2015 survey estimated that 400 deer are currently on-site due to the population reduction and winter mortality. The program was well communicated and socialized to the Laboratory community and regulators. Additionally, in conjunction with the deer reduction, the four-poster tick devices were effective in reducing ticks by approximately 50% in FY15.

Pollinator Health Task Force

The Pollinator Health Task Force established goals and best management practices (BMPs) to protect and enhance pollinators and their habitat. DOE is part of the task force and has made a commitment to participate. The Laboratory made a commitment to implement best management practices established by the Pollinator Task Force and has begun review implementation strategies for the Lab site. The Sewage Treatment Plan (STP) has been determined to be the area of focus in the upcoming year.

Reducing Reliance on Petroleum

In FY15, the Laboratory continued to support local and federal efforts to reduce reliance on petroleum by supporting programs and events to reduce the use of single occupancy vehicles. Activities included the examination of alternate work schedules; planning, promotion, and coordination of a National Drive Electric Week event; promotion of and participation in Car Free Day Long Island; and promotion of the NY Ride-match Tool, in partnership with 511RideShare Transit and Transit Solutions.

Siting of Renewable Energy Infrastructure

BNL responded to a Request for Proposal (RFP) from the local electric utility in 2008. The RFP was requesting host sites to locate up to 50 MW of solar PV. A 31.5 utility scale solar PV generating station was subsequently located on BNL property and has been operating since November 2011. See Section 3 for details.

Planning for New Federal Facilities and Leases

As previously indicated, BNL is in the process of developing Discovery Park. This initiative will carefully evaluate and implement to the extent practical a pedestrian friendly development, near existing public transportation (local train stop will be moved to BNL) and an existing employment center (BNL).

Plans and Projected Performance

As the concept of Discovery Park moves forward, BSA is committed to engage stakeholders and partners to bring a concept and proposal to the Office of Science within a year. The National Environmental Protection Act (NEPA)/State Environmental Quality Review Act (SEQRA) process will need to be initiated.

In FY16, Sustainability Awareness and Engagement efforts will be ongoing, and the BNL Sustainability website will be reviewed and updated to reflect current information.

The Laboratory will participate in the Community Wildfire Protection program in partnership with the Central Pine Barrens Commission and other municipal, state, and federal land management agencies. Through this program, the Laboratory will work with the Ridge and Manorville Fire Departments and other community stakeholders to create a Community Wildfire Protection Plan. The plan will identify areas at risk in those communities; make recommendations for hazardous fuel treatments (vegetation thinning); prioritize areas for wildfire mitigation funding; and make recommendations for actions that homeowners can take to reduce fire.

While deer management was extremely successful in FY15, it will require a change in implementation in FY16 due to Laboratory budgetary constraints. Laboratory management has made a commitment for continued funding of deer management in FY17. Although deer management will not occur in FY16, the commitment for FY17 ensures continued support of the permit to feed deer with no impact to the Laboratory's four-poster program and tick reduction efforts.

In FY16, Pollinator Best Practices for 3,000 acres will be incorporated into the Laboratory's Natural Resources Management Plan. Native grasses and wildflowers will be planted in the area of the STP.

Finally, the Laboratory will continue to support local and federal efforts to reduce reliance on petroleum by supporting programs and events to reduce the use of single occupancy vehicles.

2.6a Net Zero Buildings: Existing Buildings

Percentage of the site's existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY 2025.

Performance Status

BNL has carefully evaluated opportunities for net-zero facilities. We are currently considering utilizing the NSERC solar PV array to power a local building to achieve net-zero status.

Plans and Projected Performance

Beyond utilizing the NSERC solar array, this will be a difficult goal to achieve. BSA staff will commence benchmarking how other laboratories plan to meet this requirement and identify if there is appropriate technical training for staff.

2.6b Net Zero Buildings: New Buildings

Percentage of new buildings (>5,000 gsf) entering the planning process designed to achieve energy net- zero beginning in FY 2020.

Performance Status

There was no FY15 performance, as this is a new goal.

Plans and Projected Performance

BNL will try to meet this goal and will design future facilities with the net-zero goal in mind. However, this will be a difficult goal to achieve given most facilities at BNL include laboratories and or are HEMSF's. Based on the most recent facilities, the ISB-I building and NSLS-II, it would be impractical to meet the net-zero requirements. However, BSA staff will commence benchmarking how other laboratories plan to meet this requirement.

2.7 Data Center Efficiency

Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.

Performance Status

BNL operates a 22,000-gsf data center for scientific computing and network operations, and a 2,000-gsf administrative data center for site-wide information technology functions. The Laboratory has

undertaken a variety of practices to minimize energy consumption by servers and operate the data centers efficiently. Approximately 70% of applications now run on virtual servers. Energy efficient blade servers have replaced old servers as they are retired. Both data centers use efficient Uninterruptible Power Supply (UPS) systems, either battery-supplied UPS systems with 90% to 97% efficiency under operating loads or by flywheel UPS systems with 98% efficiency. Spot cooling is used in older parts of the data center to bring cold air to the high-density equipment. Air conditioning systems in the data centers are fairly new. Cloud computing has recently been approved through Amazon.

BNL recycles used and obsolete electronic equipment, including desktop and laptop computers, cameras, printers, scanners, and network servers to reduce pollution and prevent toxic materials from entering the environment. Electronic equipment at the end of its lifecycle is sent to a local recycling facility, which has a zero-landfill policy.

BNL has had a policy to procure EPEAT-certified systems for a number of years. When the systems arrive from the vendor, the Energy Star settings are already in place.

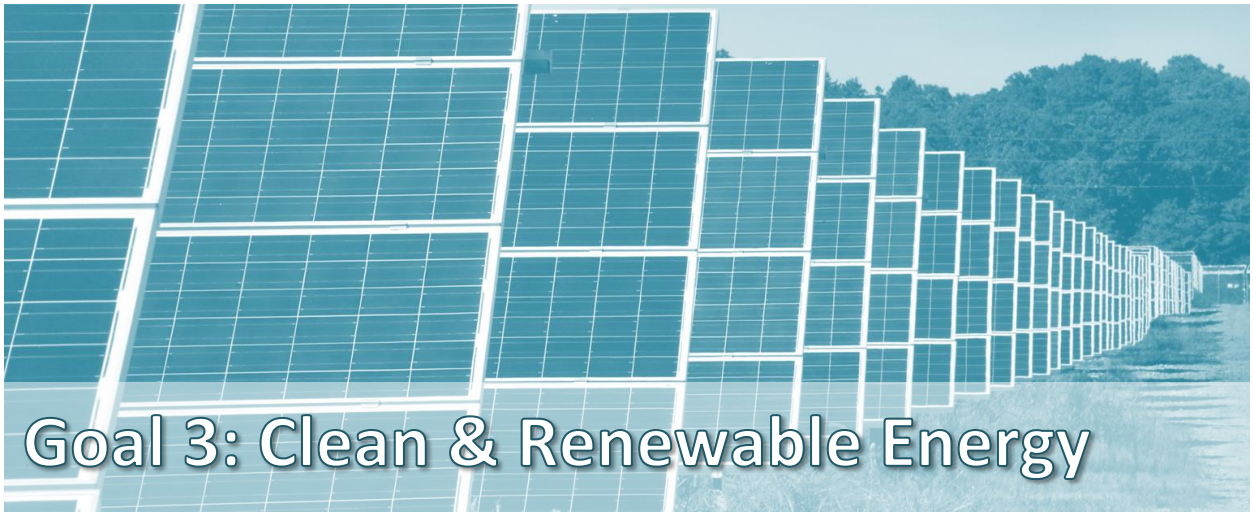
Additional electric meters and a new chilled water meter were installed in FY14 to better assess data center energy usage. During FY15, a detailed evaluation of the energy use associated with the data centered was performed and it was determined that for FY14 the PUE was 1.41. A final evaluation of FY15 data is still underway, but the preliminary results suggest a very similar number to the last year, about 1.4.

Site Data Center Sustainability Performance Metrics

All necessary site data center sustainability performance metrics will be reported to the DOE CIO as required.

Plans and Projected Performance

BNL is currently in the process of developing a project to relocate the data center to a new location. Several concepts are being evaluated to achieve the most cost-effective and efficient facility.



3.1 and 3.2 Clean & Renewable Energy

"Clean Energy" requires that the percentage of an agency's total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-2017, working towards 25% by FY 2025.

"Renewable Electric Energy" requires that renewable electric energy account for not less than 10% of a total agency electric consumption in FY16-17, working towards 30% of total agency electric consumption by FY 2025.

Performance Status

BNL purchased 43 million kWh of RECs for FY15, which equals about 8.94% of BNL's total usage of electric and thermal energy. When the 720,000 kWh output for the NSERC facility is included, the total is 9.1%. The FY15 goal in the SSP was 7.5%. It should also be noted that all of the power from the NSERC facility is consumed by BNL. There are no REC transactions for this power.

BNL has purchased RECs using a few different methods:

- Direct from a supplier
- From the Defense Logistics Agency (DLA)
- Through a broker that competitively solicited RECs from various suppliers.

BNL's has achieved the best results thus far from the broker with savings of approximately 10% compared to the DLA.

REC pricing through FY15 are actual. Rates going forward are currently estimated to be ~$2/MWh in FY16 and increase gradually to $5/MWh by 2025. These assumptions are based on discussions with a few REC providers.

As stated previously, BNL was an instrumental partner in the development of the LISF, currently the largest solar PV facility in the northeast. The LISF is located on 195 acres of land at BNL and became operational in November 2011. In FY15, it provided 51.4 million kWh/yr of clean renewable energy to Long Island.

BNL completed a detailed CHP study in August 2013, a comprehensive Wind Study in June 2013, and initiated a follow-up CHP study in FY14-FY15 to better evaluate the financial viability of CHP at the Laboratory. The study concluded that a CHP of approximately 20 MW could potentially provide a financial benefit to BNL but only with natural gas as a fuel. Renewable biomass is not financially viable.

The following renewable energy projects have also been implemented on-site:

- A solar thermal hot water heating system in Building 461 (gymnasium)
- Solar-powered traffic signals in various locations
- Solar-powered lights in remote parking lots
- A solar hot-water demonstration project integrating flat-panel solar hot water collectors and a high-efficiency condensing oil-fired boiler in Building 30 (Brookhaven Center), which is a partnering project with funding from the New York State Energy Research and Development Authority (NYSERDA), the Federal Energy Management Program (FEMP), and BNL
- The NSERC, which became operational in May 2014, produced approximately 720,000 kWh of solar PV generation in FY15.

Although BNL has championed several renewable energy projects, they have yet to be economically favorable.

Plans and Projected Performance

Clean Energy

BNL will continue to operate the 500 kW NSERC facility. Further, as discussed in the Renewable Energy section below, the system will be expanded by an additional 230 kW as a result of an award from the Sustainability Performance Office Funding Opportunity Announcement (SPOFOA) process. Additionally, BNL recently received funds from New York State that will provide a total capacity of nearly 1 MW.

CHP is continually being evaluated at BNL. While current conditions indicate a CHP could provide a small economic advantage, the new Clean Energy requirements will necessitate a fresh look. Beyond economics, a CHP can provide other benefits, including:

- Significant reduction in GHGs
- Clean energy from the thermal output
- Ability to maintain main base site operations in the event of a loss of the electric grid
- Further the establishment of Micro Grids in the local area
- Provide a partial hedge against potential electric supply contract problems.

REC purchases will also be a major tool in meeting the clean energy goals. Based on the 25% requirement of both electric and thermal loads, it will be necessary to increase REC purchases beyond that needed to meet the Renewable Energy goals unless other measures are implemented, such as CHP and additional on-site renewable energy.

Renewable Energy

The new Executive Order requirement to increase renewable energy to 30% will require further evaluation to determine the best course of action. For now, BNL will continue to purchase RECs as appropriate.

As indicated above, the NSERC facility became operational in May 2014. It is currently providing approximately 500 kW of peak generation and generated ~720,000 kWh in FY15.

In early FY16, BNL received notice that we were approved to receive $469,000 in funding from the 2015 SPOFOA process. This award, along with $201,000 of BNL funds, will be used to increase the NSERC output to 720 kW in FY16. Further plans will increase the capacity to 1 MW, which will result in over 1 million kWh/year of renewable energy. The base NSERC research array is a result of BNL's partnership with the LISF project.

BNL will continue to evaluate and assess renewable energy opportunities. However, it is extremely difficult to identify cost-effective projects either through direct funding or third-party contracts, such as a UESC or Energy Savings Performance Contract (ESPC).

BNL continues to expand the use of bio-based fuels for on-site vehicles and will continue to use bio-based fuel for satellite boilers and diesel-fueled utility vehicles.

<u>Renewable Energy Systems in New Buildings and Major Renovations (ref. EISA Section 523)</u>

All new buildings and major renovation projects will evaluate incorporation of renewable energy systems. This is currently included as part of BNL's design Standards and Procedures for HPSB.

4.1 Potable Water Intensity

36% potable water intensity (Gal per gross square foot) reduction by FY 2025 from a FY 2007 baseline (2015 target: 16%)

Performance Status

BNL has a long history of reducing water consumption even though water on Long Island is plentiful and inexpensive. The Laboratory's potable, process cooling, and fire protection water is obtained 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's minimal formal landscaping is compatible with the local climate and natural rainfall amounts are sufficient to support local flora.

In October 2014, BNL implemented groundwater recharge of treated wastewater at its Sewage Treatment Plant (STP). Currently, about 80% of water used is recharged to groundwater via groundwater recharge basins. The water recharged is near potable water quality.

In simplified numbers, about 85% of BNL's water production is used in various ways for process cooling and building air conditioning systems. About 5% is required as make-up water for BNL's steam plant and district heating system. Only about 10% of BNL's water production is used for human consumption and sanitation. For a more detailed water balance, see Figure 5.

It is estimated that about two-thirds (67%) of BNL's water production is attributable to High Energy Missions Specific Facilities.

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 meet legislative requirements by implementing best management practices (BMPs). BNL's Water Management Plan will be updated in

FY16 to reflect the E.O. 13693 water reduction goals. The new goals require BNL to reduce water consumption by 2% per year toward the goal of 36% reduction by FY25 compared to the FY07 baseline.

Presently, we are implementing BMPs as detailed in Section 2.2 of our Water Management Plan. Implementing water conservation is a significant economic challenge, as water is plentiful and inexpensive at BNL. The variable cost of producing water is less than $0.50 per thousand gallons. Most water conservation measures are capital- and labor-intensive. We are continuing to evaluate the return on investment of implementing additional BMPs, which have the potential to lower water consumption by more than 40 million gal/yr. However, the ability to implement these capital-intensive measures depends upon obtaining additional benefits (e.g., replacing obsolete equipment, extending equipment's end-of-life, reduced maintenance costs, reduced waste water discharges to the STP, or increased 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 STP 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 the analytical data for STP effluent shows that the water quality meets all federal and state groundwater quality standards. This change should result in an increase of 100 million gallons recharged locally versus off-site flow via the Peconic River.

Reducing Water Use

BNL has managed an effective water-reduction and conservation program for more than 20 years, as illustrated in Figure 4 by the trend in annual potable (includes process) water usage.

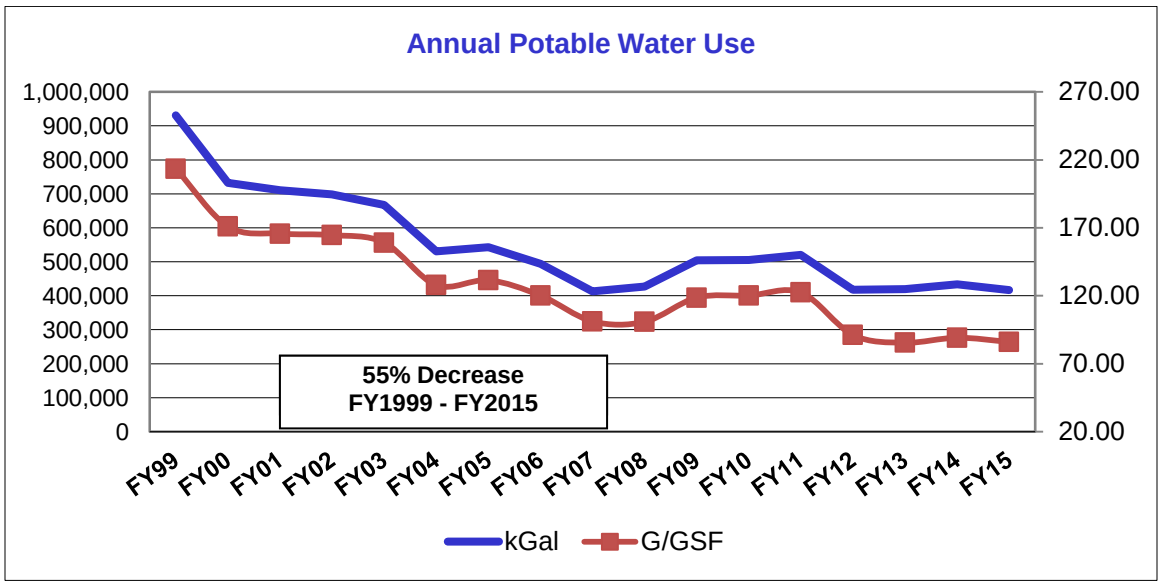


Figure 4: Annual Potable Water Use (1999-2015)

Potable water usage fell from 931 million gallons/year in FY99 (average of 2.55 million gallons per day) to about 417 million gallons/year in FY15 (average of 1.15 million gallons per day), a reduction of 55.2%. 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 86 gallons per square foot, a 14.9% water usage reduction since base-year 2007.

Total water consumption was up about 3% in FY14, driven increased programmatic activities at BNL, especially the beginning of machine operations at NSLS-II. It is estimated that the new NSLS-II, when fully operational, will raise BNL's annual water usage by over 12%.

Water Production and Usage

Figure 5 depicts how BNL uses its potable water, and where it goes thereafter. 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. Less than 10% is used for human consumption and sanitation.

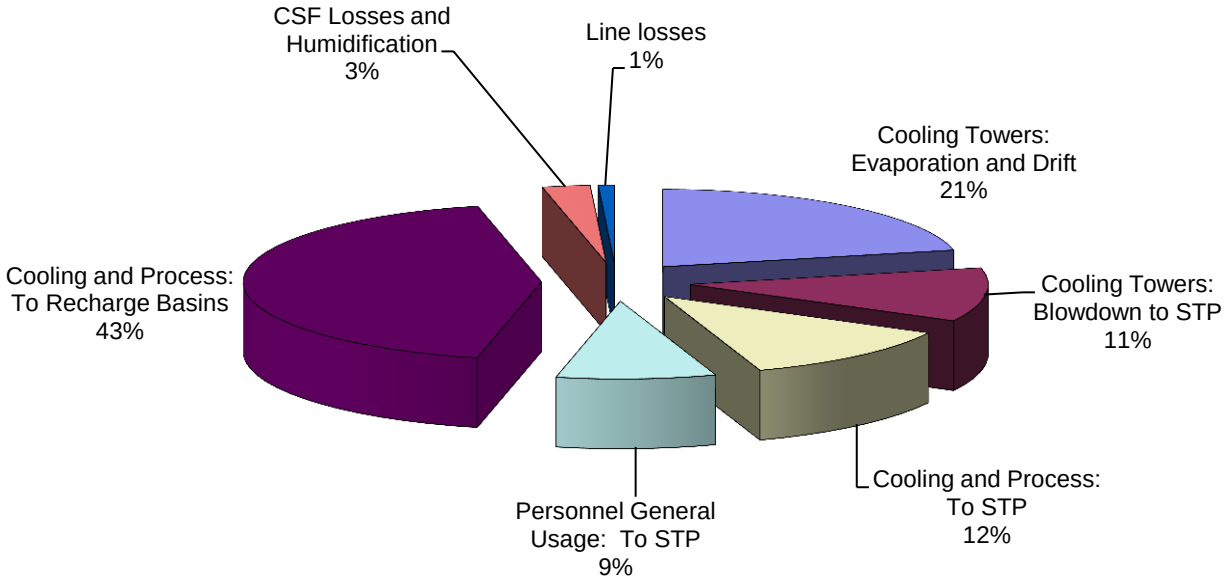


Figure 5: Annual Potable Water Utilization

Water Conservation Methods

The following summarizes BNL's past and present efforts in water conservation (best management practices) with more details available in BNL's Water Management Plan.

- **Public Information and Education Programs.** BNL's water-related public information and education programs emphasize the excellent quality of BNL's potable water supply and seek to minimize employee's use of expensive, environmentally unfriendly bottled water.

- **Distribution System Audits/Metering.** BNL periodically audits its water distribution system as part of infrastructure planning and utility reviews (e.g., 10-year Master Plans). BNL's utility engineers understand BNL's water system to be "tight" and relatively leak-free. Because of the plentiful supply and low cost of water at BNL, water meters are not available at most buildings or major process users. We bill one major process user for water.

- **Water-efficient Landscaping.** BNL's minimal formal landscaping is compatible with the local climate and rainfall. BNL does not routinely irrigate lawns and landscape.

- **Toilets and Urinals.** BNL currently specifies low consumption toilets and flushometers (1.6 gallons per flush [gpf] for toilets, 1.0 gpf for urinals) for new constructions, renovations, and maintenance.

- **Faucets and Showerheads.** BNL specifies low-flow, WaterSense faucets and showerheads for new constructions, renovations, and maintenance.

- **Boiler/Steam Systems.** BNL has a district steam system and Central Steam Facility. Depending on the season, 75-85% of the steam exported from the facility returns as condensate. (This is excellent return for a large district steam system, 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 55% 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 currently obtained from the Laboratory's potable water system and is accounted for in accordance with E.O. 13693.

An STP modification contract was awarded and fieldwork commenced in the fourth quarter of FY13. The purpose of this construction project was to convert the BNL STP from surface water discharge (Peconic River) to groundwater recharge/recycling. This modification was completed in September 2014. Purified wastewater (effluent) from BNL operations is currently being recharged and recycled to groundwater.

Plans and Projected Performance

We will continue to implement BNL's Water Management Plan. We plan to update BNL's Water Management Plan in the near future to reflect the E.O. 13693 longer-term water reduction goals. (The new goals require BNL to reduce water consumption by 2% per year toward the goal of 36% reduction by FY25 compared to the FY07 baseline).

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

In FY16, BNL has funded the engineering and design of a new Well House No. 12. Construction of a new well house is planned for FY17. Total estimated cost (TEC) for the project is about $900K. 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 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%.

BNL continues to expect that increased, "main-mission" science program activities with their need for accelerator cooling will tend to increase water consumption, due to cooling tower evaporation. "Fully built-out" operation of BNL's 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 located 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 2% per year, ad infinitum, in the face of planned (and hoped for) science program growth and on top of past reductions will continue to be a challenge.

4.2 Industrial, Landscaping, and Agricultural (ILA) Water Consumption

30% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target: 10%)

BNL has no permanent landscaping or agricultural water use (i.e., irrigation).

5.1 Petroleum Consumption

20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2015 target: 20%)

Performance Status

This goal was surpassed. A 2% decrease in petroleum consumption from 2005 to 2015 meant a 20% cumulative decrease. The Laboratory obtained a 53% decrease due to the ordering of alternative fuel vehicles and increasing the efficiency of our driving.

Plans and Projected Performance

This goal, as well as goal 5.2, is considered part of goal 5.3, as that calls for a reduction in GHG emissions per mile, which is achieved through less petroleum use via alternative fuel use in new and existing vehicles.

BNL will continue to order alternative fuel vehicles to ensure this goal continues to be met or exceeded.

5.2 Alternative Fuel Consumption

10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter. (2015 target: 10%)

Performance Status

This goal was not met due to the fact that the 2005 baseline for alternative fuels was already very high. The Laboratory's ability to purchase alternative fuel vehicles was not sufficient to increase the already high baseline. The targeted total increase in alternative fuel use was 159% by 2015; the Laboratory achieved 130%.

Plans and Projected Performance

This goal, as well as goal 5.1, is considered part of goal 5.3, as that calls for a reduction in GHG emissions per mile, which is achieved through less petroleum via alternative fuel use in new and existing vehicles.

The majority of new vehicles will be alternative fuel, electrics, or hybrid vehicles. BNL will continue to try to reduce on-site vehicle travel and idling through various methods, including improved work coordination and assignments.

5.3 Per-Mile GHG Reductions

30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline. (2015 target: N/A; 2017 target: 4%)

Performance Status

The 2014 baseline is 799.28 gCO_2e/mile. Even without purchasing new vehicles, the Laboratory was still able to affect a 5% decrease in gCO_2e/mile. This can be attributed to driving more efficiently and removing older vehicles from service.

Plans and Projected Performance

With the recent advent of leasing vehicles from the U.S. General Services Administration (GSA), the expectation is to replace many vehicles with alternative fuel vehicles and decrease the age of our vehicles. This will aid in increasing the fuel efficiency and continuing to reduce our fleet-wide per-mile greenhouse gas emissions.

5.4 Vehicle Acquisitions

75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2015 target: 75%)

Performance Status

In 2015, a contract was signed with GSA to begin leasing vehicles. GSA has ordered 139 replacement vehicles for many of the older vehicles in the BNL fleet. Of those, about 126 were light duty, and 95% of them are E-85 vehicles, substantially exceeding the 75% goal.

Biodiesel fuel is currently used for some of BNL's diesel and off-road vehicles.

Plans and Projected Performance

In the future, as new vehicles are selected for replacement, priority will be given to alternative fuel vehicles. To the maximum extent practical, BNL will continue to order a minimum of 75% of the new light duty vehicles with alternative fuel capability. We are confident in our ability to meet this goal in the future. All alternative fuel vehicles will have access to alternative fuel at BNL.

Biodiesel fuel will continue to be utilized for BNL's diesel and off-road vehicles to the maximum extent possible.

5.5 Electric Vehicles

50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2015 target: N/A)

Performance Status

There was no availability in FY15 of zero emission/plug-in hybrids. BNL ordered 5 ordinary hybrids.

There is currently a number of Level 1 charging stations at BNL. They were installed to support electric utility type vehicles.

Plans and Projected Performance

Currently, through GSA, plug-in hybrids and zero emissions vehicles are not available. The Laboratory's ability to acquire new vehicles depends solely on GSA at the present time. In the future, we expect to see more of these vehicles available.

When these vehicles become available, we will continue to develop the infrastructure (additional Level 1 as well as Level 2 charging stations) needed to support these types of vehicles in order to meet the goal.

6.1 Procurement

Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts.

Performance Status

BNL actively reviews and incorporates EPA recommendations for specifications that designate environmentally preferred products and services on a case-by-case basis through internal processes, such as work planning (using the 500A Form for operational safety and environmental concerns, and Experimental Safety Reviews for experiments). Currently, most of BNL's custodial products are Safer Choice or Green Seal products. All new or replacement water fixtures are evaluated for WaterSense certified products, if applicable. Most computer products have been certified as EPEAT and both EnergyStar and/or FEMP products have been prioritized within the Laboratory's contracts. In addition, BNL's Pollution Prevention Coordinator is currently serving on an EPA-directed governmental task force that is evaluating sustainable criteria and designations for paints and coatings.

BNL's procurement documents and guidance require consideration of BioPreferred and Biobased products.

Plans and Projected Performance

BNL is embarking on a one year process (during 2016) to convert its online purchasing system to the Vinimaya system, to which other DOE labs are also converting. Vinimaya is an umbrella program that allows users to gain access to specified vendor catalogues and purchase products. Language is being incorporated into the Vinimaya contracts to maximize the availability of sustainable products. Sustainable acquisition language includes: procurement of energy efficient products (EnergyStar or FEMP-designated); water efficient (WaterSense); biobased (USDA BioPreferred); environmentally preferable; EPEAT-certified electronics; non-ozone depleting substances (Significant New Alternative Policy [SNAP] chemicals); recycled content; non-toxic alternative products (Safer Choice); and fuel efficient products and services (SmartWay Transport partners and SmartWay products). Monthly vendor

reporting and feedback will enable the Procurement and Property Management (PPM) Division to veer BNL employees toward these preferred EPP products.

Upon completion of the conversion to the Vinimaya system, BNL will evaluate supply chain GHG emissions management (projected date of 2017). In addition, BNL will continue to review and implement EPA's recommendations for specifications, labels and standards that designate environmentally preferable products and services.

7.1 and 7.2 Non-Hazardous Solid Waste & Construction and Demolition Debris

Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris.

Divert at least 50% of construction and demolition materials and debris.

Performance Status

BNL's Pollution Prevention (P2) and Waste Minimization programs are fully described in Section 2.3.4.4 of the 2014 Site Environmental Report. The Laboratory continues to focus on its pollution prevention and waste minimization measures by evaluating metrics that are geared toward enhancing environmental stewardship.

Pollution Prevention, Waste Reduction, and Recycling

Over the previous 13 years, BNL's annual diversion rate of non-hazardous solid waste has always been above the 50% baseline level prescribed by the Executive Order, ranging between 54% and 68%. During FY15, the recycling rate was approximately 74%, aided tremendously by the amount of recycling during the decommissioning of the NSLS-I. The Laboratory is very close to achieving 60% recycling as its own baseline standard.

Since BNL's recycling efforts are programmatic, population change, construction, and Decontamination & Decommissioning (D&D) activities may impact waste generation rates and volumes, but should not impact the recycling diversion percentage rate.

The amount of material that does get sent out as waste (predominantly putressibles) is sent to the Town of Brookhaven's transfer station, where it is combined with the Town's waste, and subsequently sent to the Hempstead Resource Recovery Facility (a waste-to-energy facility) for energy recovery. During FY15, approximately 458 tons of waste was sent out as putressible waste. An increased focus on employee awareness of recycling was targeted this past year. Posters of what, and how, to recycle were placed in central locations for employees to see. In addition, bulletin board sized posters were sent to

departments for inclusion on their informational message boards. Informative meetings were held with departments where the custodial staff noted low recycling rates.

Construction and Demolition Debris

The Laboratory recycles over 95% it's of construction, demolition, and woody debris. Construction materials (e.g., wood, shingles, metals, etc.) are transported to a Construction & Demolition (C&D) transfer station, where they are sorted and recycled by the vendor. Concrete and stone/brick demolition debris are stored on-site and then converted to Recycled Concrete Aggregate (RCA) using a concrete crusher. The generated RCA is then used as road base on the Lab's firebreak roads or as underlay in parking areas. Since the crushed demolition debris is used on-site, there are no transportation-related emissions or landfill space required. By not purchasing RCA for these projects, transportation and manufacturing of RCA is also avoided, as well as the associated impact on the environment presented by these operations. Reusing C&D materials helps to save the environment and represents the essence of sustainability. This reuse process aided four Laboratory user buildings (ISB, Center for Functional Nanomaterials [CFN], NSLS-II, and the Research Support Building [RSB]) in achieving LEED certification.

Compostable Waste

BNL currently has two programs for diverting compostable materials. The first program, established in 2005, allows the composting of animal bedding used by the Medical Department that subsequently is mixed in with wood-composted debris to form mulch or soil conditioner. The second program involves the transferring of food prep waste from the on-site cafeteria that is deposited into an inlet of the STP. This serves to supplement the existing food levels to achieve maximum efficiency of the system's biological processes. During 2015, animal bedding composting has scaled back considerably, as NASA research is winding down at BNL and expected to end within the next few years. In addition, the Laboratory operates a "stump-dump," which receives and composts on-site leaves, tree debris, and stumps. The compost that is generated is reused on-site as needed.

Non-toxic or Less Toxic Chemicals

The Laboratory is continually working with its scientists to find ways to minimize the use of toxic materials and substitute less or non-toxic surrogates in their procedures. Protocols and contracts established by the PPM Division have led to a streamlined, just-in-time method for ordering chemicals, which has minimized the Laboratory's footprint of on-site chemicals.

Experimental reviews are conducted for each scientific experiment. During this process, experts such as Environmental Compliance Representatives, ES&H Coordinators and/or Industrial Hygienists review the experimental procedures and may recommend the use of alternative chemicals.

In some instances, such as Custodial Services, the individuals involved with using the chemicals have reviewed them for less toxic substitutes. All of BNL's custodial cleaning chemicals/products are Green Seal certified.

Pest Management

The Laboratory has a fully integrated Pest Management system and uses native plantings with no in-ground sprinkler systems. During 2012, BNL's Integrated Pest Management program was audited by a third-party team (Cornell Cooperative Extension Program, a non-profit community education agency established in 1917) and found to be fully integrated and functioning. During 2014, the Cornell Cooperative Extension Program gave a lunchtime presentation on the "Identification and Concerns of Ticks and Mosquitoes on Long Island." Members of the Facilities and Operations (F&O) Site Resources Division that apply pesticides are licensed through the NYSDEC and except for one herbicide (Round-Up), they purchase regulated materials that do not contain glycophosphates. In fact, a non-restricted pesticide that is less toxic than most materials and contains cedar oil is being applied for tick control in areas allowed by the NYSDEC regulations.

Encumbered Metals

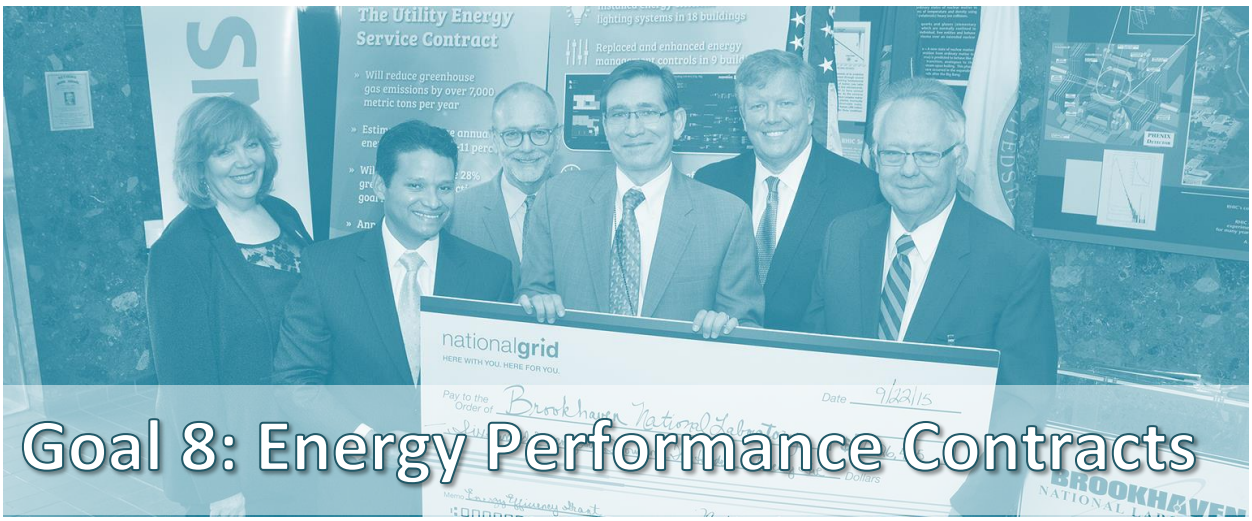
The Radiological Control Division has written procedures to ensure that the release and clearance of property with the potential to contain residual radioactive material is conducted in accordance with DOE O 458.1, Section 4-K (Release and Clearance of Property). In addition, a Laboratory-wide procedure entitled, "Management of Moratorium and Suspension Encumbered Metals," establishes BNL's specific program and survey requirements for managing scrap metal in compliance with DOE directives. This procedure has been reviewed and approved by DOE and has been presented as an example of good practice to other DOE laboratories.

NSLS Recycling and Reuse

The Laboratory has been successful in reusing and recycling assets from the NSLS-I, which was permanently removed from service on September 30, 2014. During the first six months following shut down, equipment with a total value of more than $74 million was removed for reuse at NSLS-II or elsewhere on the BNL campus. Since decommissioning began in June, more than 1.4 million pounds of material has been recycled, while returning $600,000 to the project and avoiding more than $200,000 in waste disposal costs. During decommissioning, more than $2 million of equipment and material were also removed for re-use at ANL and Yale University.

Plans and Projected Performance

During FY16, BNL plans to mine concrete debris from the Borrow Pit (the on-site concrete debris storage area) and generate RCA. BNL will also evaluate the economic feasibility of food waste composting as a method of further reducing waste sent to the Town's transfer station.



Goal 8: Energy Performance Contracts

8.1 Energy Performance Contracts

Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693.

Performance Status

The UESC was awarded on October 22, 2013. Phase I implementation of the UESC was completed in May 2015.

The $12.8 million (only $12.2 financed due to utility rebate) UESC included upgrading lighting systems in 18 buildings, replacing and enhancing energy management controls in nine buildings, and installing a new high-efficiency 1,250-ton water chiller and related components at the Laboratory's Central Chilled Water Facility. The improvements are expected to reduce the Laboratory's annual energy intensity by approximately 11% compared to baseline measurements, and reduce GHG emissions by over 7,000 $MtCO_2e$ per year.

Annual energy savings were estimated to be ~$1.2 million. While actual savings are still being verified, the values appear to be on track to achieve or exceed the estimate.

Plans and Projected Performance

Preliminary audits were completed for potential Phase II projects. Planned initiatives include chilled water storage, lighting improvements, and building controls upgrades. BNL feels it is prudent to further evaluate and verify the actual savings from the Phase I effort before proceeding with a Phase II. However, during FY16, we will continue to refine the potential scope and begin preliminary preparations for a Phase II.

Challenges to Alternative Financing Vehicles

There are a number of challenges to the use of alternative financing, which include:

- More complicated and lengthy development and procurement process
- Availability of resources (funds) to cover project development and administration
- Additional costs to monitor and track actual progress and savings over the project life
- Savings are based on various assumptions that change
    - Changing facility/building missions over the project life
    - Ensuring facilities are operated in accordance with baseline/original assumptions
    - Energy costs can go down resulting in lower cost savings
    - "Performance guarantees" (for ESPCs) are contingent on operating and baseline assumptions
- Maintaining a sufficient maintenance budget to ensure proper system operation
- UESCs: Financing payments must be made even if savings do not materialize
- ESPCs: Pressure is on the site/owner to prove systems are operated and maintained according to the baseline assumptions
- Additional costs associated with financing and project administration.

9.1 EPEAT Purchases

95% of eligible acquisitions each year are EPEAT-registered products.

Performance Status

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. Servers procured for administrative computing are primarily blade architecture, which are approximately 25% more energy efficient than conventional servers. Efficiency is further increased through extensive use of server virtualization software, which allows multiple servers to run on a single piece of hardware (a single blade can typically handle 5 to 10 virtual instances). The implementation of this technology has allowed the Laboratory to shed over 100 kw of power from its data centers.

Plans and Projected Performance

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

9.2 Power Management

100% of eligible PCs, laptops, and monitors have power management enabled.

Performance Status

All systems in the BNL domain that are capable of power management have the setting enabled. Users have control over this through LANDesk self-service. All laptops by default have stricter power management settings, mostly to conserve battery life. The majority of the Laboratory's Macs fall into this category. Macs are a small percentage of BNL's systems and are not centrally managed to enforce power management.

BNL performed a number of tests on existing PCs to determine their power use. Due to constant software and system upgrades and replacements, the vast majority of PCs at BNL have built-in power management. We observed that virtually all of the modern PCs consume very little power when inactive, even when power management is not enabled. We estimate the cost of trying to centrally manage every single PC would far outweigh the small amount of potential savings from the few systems that may not have their power management enabled.

Plans and Projected Performance

BNL will continue to evaluate the feasibility of extending the desktop computer power management policy to other operating systems. However, as indicated above, the potential savings are very small and cannot be economically justified.

As we continue to replace PCs through the normal cycles, units with automatic power management systems will increase.

9.3 Automatic Duplexing

100% of eligible computers and imaging equipment have automatic duplexing enabled.

Performance Status

In FY15, the BNL Office of Institutional Improvement published Managed Printing guidelines, which recommend the use of network or department-wide printers configured for black ink only and duplex printing. The goal was to reduce the expense of paper and toner.

Plans and Plans and Projected Performance

The majority of printers and copiers are not centrally managed at BNL. The Information Technology Division (ITD) does not currently monitor or configure duplex printer settings.

Resources permitting in FY16, ITD will investigate centralized printer management and make recommendations for future upgrades.

BNL will continue to communicate the importance and benefits of duplex printing and encouragement of greater centralization for improved printer management.

9.4 End of Life

100% of used electronics are reused or recycled using environmentally sound disposition options each year.

Performance Status

The average life span of a BNL computer is in excess of five and a half years, which is above the industry norm. BNL computers are tracked on-site (via bar codes), making it relatively easy to follow the life history of any computer. When a computer becomes available (due to upgrades, project completion, etc.), it goes into a Property Management pool, where it becomes available for other Laboratory use. During FY15, over 24 tons of BNL computers and peripherals were reused internally.

Once a computer researches the end of its useful life, it is either put aside for the Computers for Learning Program or is recycled through the Laboratory's computer recycling vendor. BNL's computer recycling vendor is a Responsible Recycling (R2)-certified vendor that recycled 45 tons of electronics during FY15 in an environmentally responsive manner.

Plans and Projected Performance

BNL will continue to reuse or recycle electronics in an environmentally sound manner.

10.1 Incentivize Planning for Impacts of Climate Change

Update policies to ensure planning for, and addressing the impacts of climate change.

Objective 1: Determining Risk

Researchers at BNL are developing new insights into how the intensity and frequency of major storms in the region might change as a result of a change in global climate. However, this requires new approaches which are still under development.

For BNL, major storms, like Superstorm Sandy, are likely to disrupt operations. While the site is far above sea level, many of the personnel live in coastal areas prone to major disruption (flooding, interruption of power, and inaccessibility of roads as a result of debris), which then impacts their ability to come to work. Storms like Sandy also lead to power interruptions away from the flood zones, impact delivery of fuel and supplies, and negatively impact staff to travel to the site. With all major airports (John F. Kennedy International Airport [JFK] and LaGuardia) located in flood zones, travel to and from the Laboratory by staff or guests can be delayed or impossible during major storms leading to a storm surge. Some climate models predict an increase in frequency and intensity of extreme weather events; hence, it is likely that interruptions as a result of extreme weather events will be more common in the future.

BNL has initiated several collaborative efforts with academic institutions and the National Oceanic and Atmospheric Administration (NOAA) to position it for a leadership role in the development of a regional climate model that will allow for an improved capability to predict frequency and intensity of extreme events.

Researchers at BNL have prepared news articles to inform Laboratory personnel of the climate vulnerabilities of the electricity distribution infrastructure. These materials are disseminated through the BNL website, in addition to climate-related news items, which are regularly featured on the BNL website to raise awareness.

Objective 2: Current Activities

BNL has already dealt with a number of extreme weather events over the last few decades. There are emergency response programs in place that have been tested during real storms. Aspects of climate change that are not related to extreme weather events, such as the possibility of increased frequency and intensity of heat waves, have not been considered in long-range planning. However, the output from various climate models remains too uncertain to provide a clear indication that heat waves will be more frequent and intense. Hence, planning for this type of impact of climate change on local energy use and working conditions has not been the focus of efforts at BNL.

Objective 3: Future Activities

BNL remains committed to increase coordination and interaction with the various levels of government in the region. The desired outcome is better coordination and interaction in the event of an extreme weather event that impacts the region.

The Laboratory has been working with several utility companies on ways to use real time radar data to forecast possible damage to their electricity distribution systems. This effort, funded by New York State, is a demonstration project that could lead to strategies that can be adopted by other companies in the region. With possibly more severe extreme events as part of a changing climate, this effort can limit the duration of outages.

BNL maintains an on-site meteorological measurement station. This station provides real time data and historical data. The data collection has continued through FY15 and is posted on a dedicated BNL website as an open access resource. Local meteorological instrumentation is also used to determine the solar irradiation in real time and compare this data to the performance of the on-site LISF. This information is important to develop strategies to forecast the performance of solar arrays in the northeast. Several companies are interested in working with BNL on this.

BNL scientists, led by the Associate Laboratory Director (ALD) for the Environment, Biology, Nuclear Science, and Nonproliferation (EBNN) Directorate, will continue to position BNL for a leadership role in the study of the interaction of urban environments and the atmosphere. One of the key questions is the effect of climate change on temperatures in cities, which are generally higher than in the surrounding areas (so called Urban Heat Island). Power consumption for cooling in cities during heat waves leads to peak loads, which may strain the region's power generation capacity.

BNL scientist, Wei Wu, participated in Urban Climate science conference in Toulouse, France and presented two papers that deal with improving our modeling of severe storms around urban centers and modeling the contribution of waste heat in the city to an urban heat island based on case studies of NYC. This work was the result of collaboration with City College of NY (CCNY) and the National Weather Service at Upton, NY. The CCNY graduate student who worked on the urban heat island study was partially supported by BNL and received an award for outstanding presentation at the conference.

Objective 4: Real Property and Supply Chain Resilience

Brookhaven Lab has a tailored 10-year strategy to strengthen the infrastructure needed to achieve our mission. This strategy focuses on four components: investing in the core buildings that are essential for our science; downsizing our overall footprint to eliminate legacy hazards; renewing utility infrastructure;

and working with federal, state, and local stakeholders to establish Discovery Park—a transformative opportunity to improve the area that currently encompasses the aging apartment area on-site.

The Laboratory site contains more than 300 buildings with a total of 4.85 million square feet. Some buildings have reached the end of their life cycle and need to be demolished—particularly those from the World War II era. The Laboratory is committed to reducing our building footprint by 10 percent in the next decade. Eliminating these buildings will reduce the overall footprint to help minimize the costs of addressing maintenance, health and safety, and fire protection issues. Other buildings need substantial renovations, requiring new electrical systems and "fume hoods," as well as state-of-the-art upgrades for stringent controls to protect the environment and enable new research capabilities.

Building "Discovery Park" in the Laboratory's current apartment area will provide greatly improved facilities for our guests and users as they arrive at the Laboratory site and during their stay. As a joint-land-use partnership being developed with New York State and local and regional governments, as well as private industry, it could also facilitate stronger collaborations among those developing and deploying energy technologies, increase the impact of science and technology education, and promote economic development in the region.

Objective 5: Regional and Local Coordination

In addition to collaborative efforts like Discovery Park, BNL scientists coordinate with academic institutions, as well as NOAA scientists, to study the interaction of the urban environment and climate. BNL also has strong interactions with the Stony Brook University (SBU) Storm Surge program, which provides surge forecasts for the region. Climate research conducted by BNL scientists is regularly featured on the BNL website to inform the general audience.

Objective 6: Removing and Reforming Barriers

The Laboratory has not identified policies or programs that unintentionally discourage or disallow investments by external partners or contract recipients that would improve preparedness for climate impacts.

10.2 Emergency Response Procedures

Update emergency response procedures and protocols to account for projected climate change, including extreme weather events.

Performance Status

The BNL Office of Emergency Management (OEM) maintains the Site Emergency Plan, which is an ongoing program for the planning, preparation, and response to all hazards, including extreme weather events. OEM maintains a Severe Weather Planning Guide that serves as the foundation of the program and includes responsibilities for planning and response to all types of extreme weather events, including hurricanes and severe snow events. OEM also maintains a Hurricane Plan and a Site Loss of Power Plan that describes the actions to take in the event of an extreme weather event. All BNL OEM plans and procedures are reviewed or updated on an annual basis as required by DOE O151.1C.

In FY15, OEM provided preparedness and operational planning to implement the Severe Weather Plan for 28 snow events and Hurricane Joaquin. Actions included the following:

- Conducted 6 Continuity of Operations Plan (COOP) Level 2 activations during 30.5 hours of site closure
- Managed the Essential/Emergency Personnel designation lists during the snow events, allowing key scientific operations to continue
- Conducted 26 coordination briefings for senior leadership on Laboratory planning and status
- Provided 97 weather-related notifications
- Ensured no disruption to any BNL mission essential functions.

Operational Experience Level 1 (OE-1) Beyond Design Basis Requirements

OEM completed the DOE Operational Experience Level 1 (OE-1) requirements by conducting the Beyond Design Basis Exercise in October 2014. This exercise validated BNL's ability to respond to a Beyond Design Basis Event (severe weather event for multiple facilities). It included a tornado strike on BNL affecting two Emergency Preparedness Hazard Assessment (EPHA) facilities and an Emergency Operations Center (EOC) activation and response from our emergency responders to multiple events without the assistance from outside agencies.

OEM also reviewed our Site Hazards Survey and found that the list of potential emergency conditions addresses all aspects of severe events and the survey was completed in accordance with the DOE Guide instructions. The Hazard Survey and E-Plan identify severe natural hazards that can impact not only BNL but the surrounding communities.

Plans and Projected Performance

BNL OEM will continue to maintain and update our ongoing program by conducting After Action Reports for each event or exercise. All OEM plans and procedures will be reviewed or updated on an annual basis as required by DOE O151.1C.

The BNL 2016 Annual Exercise will be a Table Top Exercise focusing on the effects of a Category 2 Hurricane hitting Long Island. This exercise will be a discussion-based exercise, where the Emergency Response Organization (ERO) and other parts of the Laboratory will be challenged with a scenario that will have an impact on BNL and the surrounding communities. The focus will be preparation for impact, and then the steps to recover after impact.

10.3 Workforce Protocols & Policies

Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.

Performance Status

The Laboratory has a number of workforce policies and programs in place that reflect our understanding of climate change and its projected impact on human health and safety, in particular severe weather events.

In 2008, the Laboratory formalized its flexible work arrangements program, offering three options for employees to establish flexible work schedules with their supervisors/managers—Flex Month, CoreHours, and TeleWork. While this was a good start in establishing greater flexibility for employee work schedules as an intended recruitment and retention tool, the available options were somewhat restrictive and not as agile in responding to event-driven reasons for needing flexible work arrangements. Therefore, in FY14, BNL adapted its policies to increase ease of use of these programs and to take into account the impacts of climate change, namely severe weather events.

Specifically, BNL changed its policy related to snow closings and how exempt employees report their time when the site is closed. Exempt employees who are not authorized to be on the Laboratory site during a closure must still meet their target hours for the month. With the policy change, exempt employees may offset the site-closure period by performing work off-site (telecommuting), using the flexible work hours option, or using vacation time. This not only ensures safety during a site closure, but allows employees to continue to be productive during closures and enables the Laboratory to improve the cost of doing business. In addition, the revised policy clarified that formal written agreement processes were not required for nominal or as-needed teleworking or variations to work schedules. The revised policy also introduced the concept of compressed work schedules for both exempt and non-exempt employees as long as the employee is able to effectively manage their work and hit their monthly (or weekly for non-exempt employees) target hours. These additional changes increased the flexibility for both exempt and non-exempt employees to modify their work schedules in response to climate-driven events. A description of the formal flexible work arrangements that are currently in place are provided below:

- **Compressed Work Schedule:** A work arrangement in which exempt and nonexempt monthly staff work a schedule of more than 8 hours on certain days so that they may have a regularly scheduled full or partial day on which they are not normally expected to work.
- **CoreHours:** A work arrangement in which full-time non-bargaining, non-exempt weekly employees work five 8-hour days per week that include the required core hours between 10:00 a.m. and 3:00 p.m., Monday to Friday. The balance of the 8-hour day is worked before and/or after those hours. Employees have a weekly schedule with an established start time each day of the week, but the start time is permitted to vary for each weekday.
- **TeleWork:** A work schedule in which a portion of an exempt employee's work schedule is performed away from the main office, usually at their home.

In FY15, the Business Services Directorate reported that, conservatively, the Laboratory saved approximately $750,000 per site closure day of indirect cost because exempt employees were able to

work with their managers to find a way to complete their target hours for the month through use of the flexible work hours policy.

Plans and Projected Performance

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.

In a joint goal between HR and the Environmental Protection Division and with the support of Payroll and ITD, the Laboratory intends to revisit its Flexible Work Arrangement policies again in FY16 to determine ways that we can promote these policies from the perspective of reducing the carbon footprint (i.e., less travel time to and from the worksite) and/or establish better tracking mechanisms to measure the impact that existing flexible work arrangements at BNL have on reducing GHG emissions.

10.4 Management Commitment

Ensure site/lab management demonstrates commitment to adaptation efforts through internal communications and policies.

Performance Status

At Brookhaven, the Media & Communications Office provides information about the Laboratory to internal and external audiences through numerous communications vehicles. Within the Media & Communications Office, the Internal Communications group publishes the Laboratory's weekly e-news summary, Brookhaven This Week; a biweekly web-based Monday Memo, which contains news from the Laboratory Director and administrators and is e-mailed to the internal Lab community; and various brochures and fact sheets that are available online.

In FY15, the Internal Communications group promoted sustainability messages by way of articles, posters, videos, web features, and more. Messages throughout the year included guidance on how employees can be more sustainable, as well as information on both Laboratory-wide sustainability efforts and sustainability-related research activities.

This included promotion of recycling days, green purchasing, energy use reduction, Earth Day activities, ridesharing, UESC energy-efficiency upgrades at the Laboratory, and other green initiatives.

Specific examples are as follows:

- Department of Energy, National Grid, and Siemens Complete Major Energy-Efficiency Upgrade at Brookhaven Lab – September 22, 2015
- Car Free Day LI is Sept. 22: Two-for-Tuesday Can Work for You – August 28, 2015
- Battery Disposal at Brookhaven Lab: Guidance and Changes to Recycling Program –July 20, 2015
- Stony Brook Receives $2.5 Million DOE Grant for Transformational Energy Technology – July 10, 2015
- Workshop Participants Outline Projects to Advance Smart Grid Resilience – June 11, 2015
- Commuting by Bike to the Lab: Pilot Program Extended Following One-Year Review – May 11, 2015

- GSA Leasing of Vehicles to Begin at Brookhaven Lab – May 11, 2015
- Proper and Improper Management of Household Hazardous Wastes – April 27, 2015
- Earth Day 2015: On April 22, Consider the Sustainable Brookhaven Lab – April 13, 2015
- Brookhaven National Lab's Tom Butcher Honored for Biodiesel Research – March 16, 2015
- Successful Initiation of On-site White-tailed Deer Management – March 2, 2015.

Additionally, the Internal Communications group was a key contributor to the development of the Sustainable Brookhaven website at https://www.bnl.gov/about/sustainability/, and announced the website launch in October with a news feature article, "Site Sustainability, the Lab's Mission, and You."

Plans and Projected Performance

In FY16, Internal Communications will contribute to the updating and further development of the Sustainable Brookhaven website, expanded recycling messaging, promotion of networked printing initiative, reporting on the Laboratory's use of leased alternative fuel vehicles and temperature setback policies, and more.

10.5 Policies Reflecting Current Climate Change Science

Ensure that site/lab climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary.

Performance Status

BNL achieved this goal for FY15.

A project, funded by NYSERDA, to combine real-time radar data with power outages is underway. The goal is to develop strategies that allow radar data to guide pre-deployment of assets to shorten recovery time for a utility system impacted by severe weather.

BNL scientist, Wei Wu, participated in Urban Climate Science conference in Toulouse, France and presented two papers that deal with improving our modeling of severe storms around urban centers and modeling the contribution of waste heat in the city to an urban heat island based on case studies of NYC. This work was the result of collaboration with CCNY and the National Weather Service at Upton, NY. The CCNY graduate student who worked on urban heat island study was partially supported by BNL and received an award for outstanding presentation at the conference.

BNL collected, shared, and reported meteorological data for the BNL site, with weather data available via the web. In FY15, the Laboratory also funded an instrument upgrade.

The ALD for EBNN participated in a DOE roundtable on the Energy-Water nexus at the NYC Mayor's office. A separate meeting was also held with the NYC Mayor's office to discuss collaboration on Solar Forecasting (submitted proposal to NY Power Authority) and development of a city-wide meteorological sensor network.

Plans and Projected Performance

BNL scientist, Wei Wu, will publish a full-length paper on the work presented at the Urban Climate Science conference in Toulouse, France.

The upgrade of meteorological facilities at the Laboratory will be finalized.

BNL will explore the possibility of allowing the installation of a Federal Emergency Management Agency (FEMA) early warning station on site. This will provide additional capabilities and ties into a 125-station state-wide network funded by FEMA and operated by State University of NY at Albany. The data would also allow us to improve regional modeling of climate in the northeastern United States.

Along with Argonne National Laboratory (ANL), BNL is exploring the possibility of developing a dense meteorological sensor network for metropolitan NY. This effort is associated with DOE's Urban Sciences effort, which stems from the last Big Idea summit. The goal is to improve the representation of the contribution of urban centers in climate models. For FY16, the goal is to bring the stakeholders together, test sensors in a limited pilot project, and position the team for FY17 funding.

III. Fleet Management

The BNL Fleet Management organization consists of the BSA Fleet Manager (Staff Services Manager), BNL Fleet Manager, Motor Vehicle Maintenance Supervisor, Automotive Mechanics (5), and Administrative personnel.

BNL's Fleet Management Plan is derived from the Code of Federal Regulations (CFRs), Executive Orders, and best practices. It is aided by the contract with the U.S. General Services Administration (GSA), and captured in the Standards-Based Management System (SBMS).

The Laboratory's vehicle fleet currently contains 255 vehicles, 241 of which are leased. The average age of vehicles is currently about 11 years and falling. Working with GSA, the Laboratory ensures that all new vehicles are alternative fueled where possible. Periodic reviews are then conducted to determine the optimal size of the fleet, as well as the appropriate types of vehicles to meet each user's needs. The utilization review happens annually, with quarterly reviews on a smaller scale. Each vehicle's mileage is tracked monthly through trip logs and fueling information. At this time, there are no plans to increase or decrease the size of the fleet.

BNL has fueling infrastructure for biofuel, Compressed Natural Gas (CNG), and E-85. The biofuel station is open 24 hours a day, seven days a week and is the pit stop for refueling the Laboratory's 44 new biofuel Kubotas. The use of biofuel is one of many steps towards meeting the goals of President Obama's Executive Order to decrease our dependence on foreign oil and increase agency use of renewable energy.

The Laboratory provides guidance to employees and contractors regarding BNL site driving rules. All employees driving government vehicles are properly licensed. Vehicle users with alternative fuel vehicles have fueling cards that limit them to alternative fuels. When specialized vehicles are issued, the user group is given a briefing or training on the unique features of the equipment. The BNL site follows all NYS regulations. NYS limits idling to five minutes with exceptions for specific vehicles and conditions. Idle limiters are installed in some vehicles. Periodically, vehicle users are reminded to minimize vehicle idling whenever possible.

IV. Funding

Summary of Sustainability Project Funding ($K)				
Category	**FY14 Actual**	**FY15 Planned**	**FY15 Projected**	**FY16 Projected**
Sustainability Projects	$ 699	$ -	$ -	$ -
Sustainability Activities other than projects	$ 432	$ 536	$ 536	$ 550
SPO Funded Projects (SPO funding portion only)	$ -	$ 469	$ 469	$ -
Site Contribution to SPO Funded Project	$ -	$ 201	$ 201	$ 200
ESPC/UESC Contract Payments (if applicable)	$ 1,805	$ 1,419	$ 1,419	$ 1,462
UESC Support	$ 826	$ 232	$ 232	$ 236
Renewable Energy Credits (REC) Purchase Costs (if applicable)	$ 59	$ 70	$ 70	$ 107
Total	$ 3,821	$ 2,927	$ 2,927	$ 2,555

V. Electrical Energy Projections and High-Energy Mission-Specific Facilities

This section provides an overview of the High-Energy Mission-Specific Facilities (HEMSFs) at BNL: ISB-I, CFN, NSLS-I, NSLS-II, and RHIC. These descriptions include the scientific equipment, buildings, and associated support systems that comprise the HEMSFs.

Interdisciplinary Science Building I (ISB-I)

ISB-I is designed to group energy research scientists together into one facility with gathering spaces to facilitate and realize the scientific benefits of multi-disciplinary collaboration. The project is 37 percent more energy efficient than conventional design, exceeding the Federal mandates and DOE directives in the area of energy efficiency. Design strategies used to optimize energy conservation include: orienting the building along the north-south axis, installation of a coil loop heat recovery system for the laboratories requiring 100% outside air, installation of high-performance fume hoods with automatic sash closing feature, increased natural day lighting with vacancy and occupancy light sensors, and enhanced building envelope design.

ISB-I received LEED Gold certification from the U.S. Green Building Council on November 19, 2013. The sustainable design elements of the building meet the prerequisites of the Environmental Performance Criteria produced by LABS 21 program and align with the DOE Guiding Principles (GPs). ISB-I has a thermoplastic roof with a high solar reflectance (Solar Reflectance Index [SRI] 78), which meets the criteria for DOE's Cool Roof program. It also meets Secretary Chu's July 2010 directive for all DOE new and replacement roofs to be cool roofs and have a minimum R-value of 30, if economically feasible.

The ISB also notably reduced potable water use by 55% from the calculated baseline design through the installation of low-flush and low-flow fixtures throughout the building and by using native/drought tolerant planting in the landscaping design. The use of permeable concrete, bio-retention ponds, and underground storm water chambers allows 90% of the storm water to be captured and treated within the building footprint.

Interdisciplinary Science Building I

Center for Functional Nanomaterials (CFN)

The CFN provides state-of-the-art capabilities for the fabrication and study of nanoscale materials, with an emphasis on atomic-level tailoring to achieve desired properties and functions. The CFN is a science-based user facility, simultaneously developing strong scientific programs while offering broad access to its capabilities and collaboration through an active user program. The overarching scientific theme of the CFN is the development and understanding of nanoscale materials that address the nation's challenges in energy security, consistent with the DOE mission.

Center for Functional Nanomaterials

The CFN is one of five nanoscale science research centers across the United States funded by the DOE-SC. The CFN supports the Laboratory's goal of leadership in the development of advanced materials and processes for selected energy applications.

As a premier user facility for conducting interdisciplinary nanoscience research, the CFN serves as a focal point and enabler of advanced materials study in the northeastern United States.

The CFN, NSLS, and NSLS-II complement each other to facilitate the nanoscale revolution. The synergy among these world-class machines, with BNL's own scientific staff working collaboratively with university, industrial, and government laboratory researchers, offers unique opportunities for breakthroughs in energy research.

The science at the CFN is organized around these five scientific themes:

- Electronic Nanomaterials
- Interface Science and Catalysis
- Electron Microscopy
- Soft and Biological Materials
- Theory and Computation.

The experimental capabilities at the CFN are arranged into seven laboratory facilities:

- Synthesis and Characterization
- Advanced Optics
- Nanofabrication
- Proximal Probes
- Electron Microscopy
- Theory and Computation
- CFN End stations at NSLS.

Access to the user program at the CFN is provided through a simple, peer-reviewed proposal process with a call for proposals that takes place three times per year. This facility is not designated in the Federal Information Management System (FIMS) as "excluded."

National Synchrotron Light Source (NSLS-I)

As a national user research facility funded by the DOE-SC, the NSLS-I provides intense beams of infrared, ultraviolet, and x-ray light for basic and applied research in physics, chemistry, medicine, geophysics, environmental, and materials sciences. This allows scientists to examine materials and processes at a scale that is not possible at other types of research labs or facilities. The NSLS has approximately 2,100 visiting scientists per year from more than 400 national and international universities, laboratories, and other research institutions.

National Synchrotron Light Source

Synchrotron radiation facilities provide unique and powerful tools for characterizing the temporal and spatial evolution of working catalysts. The properties of catalysts can be studied using a wide range of x-

ray techniques, such as x-ray powder and/or single-crystal diffraction, small-angle x-ray scattering, and many x-ray spectroscopy methods.

Condensed matter physics deals with the macroscopic physical properties of matter. In particular, it is concerned with "condensed" phases, which occur when the number of constituents in a system is extremely large and the interactions between the constituents are strong. The most familiar examples of condensed phases are solids and liquids, but more exotic condensed phases include the superfluid and the Bose-Einstein condensate found in certain atomic systems at very low temperatures, superconductivity, and the magnetic phases of spins on atomic lattices.

One major thrust of biological and soft-matter research at synchrotron facilities is protein crystallography, which uses x-rays to see the crystal structure of proteins and other biological molecules. Other research focuses on using x-rays to image tissue and cells, and to "watch" biological processes that occur on very short time scales, such as protein folding. The information learned from these fundamental studies is used to design drugs and treatments for disease, predict and detect disease, and understand the vast array of biological processes that govern life. This facility is designated in FIMS as "excluded."

National Synchrotron Light Source II (NSLS-II)

The purpose of NSLS-II is to provide extremely bright x-rays for basic and applied research in biology and medicine, materials and chemical sciences, geosciences and environmental sciences, as well as nanoscience.

National Synchrotron Light Source II (aerial view)

National Synchrotron Light Source II (wide view)

The new NSLS-II facility will have extremely high brightness and flux, exceptional beam stability, and a suite of advanced instruments, optics, and detectors. Taking advantage of these new capabilities, scientists will be able to image materials with nanoscale resolution and determine chemical activity in fine detail.

The NSLS-II will accommodate more than 60 beamlines using 27 straight sections for insertion-device sources and 31 bending-magnet or three-pole-wiggler sources, with additional beamlines possible through canted insertion devices and multiple branches.

Six beamlines were selected in 2008 and are now funded within the NSLS-II project. These project beamlines encompass research programs in inelastic x-ray scattering, hard x-ray nanoprobe, coherent hard x-ray scattering, coherent soft x-ray scattering and polarization, submicron resolution x-ray spectroscopy, and x-ray powder diffraction. This facility is designated in FIMS as “excluded.”

NSLS-II achieved "first light" on October 23, 2014, when operators opened the shutter to begin commissioning the first experimental station (called a beamline), allowing powerful x-rays to travel to a phosphor detector and capture the facility's first photons. While considerable work remains to realize the full potential of the new facility, first light counts as an important step on the road to facility commissioning.

Relativistic Heavy Ion Collider (RHIC)

RHIC is the first machine in the world capable of colliding heavy ions, which are atoms where the outer cloud of electrons has been removed. RHIC primarily uses ions of gold, one of the heaviest common elements, because its nucleus is densely packed with particles.

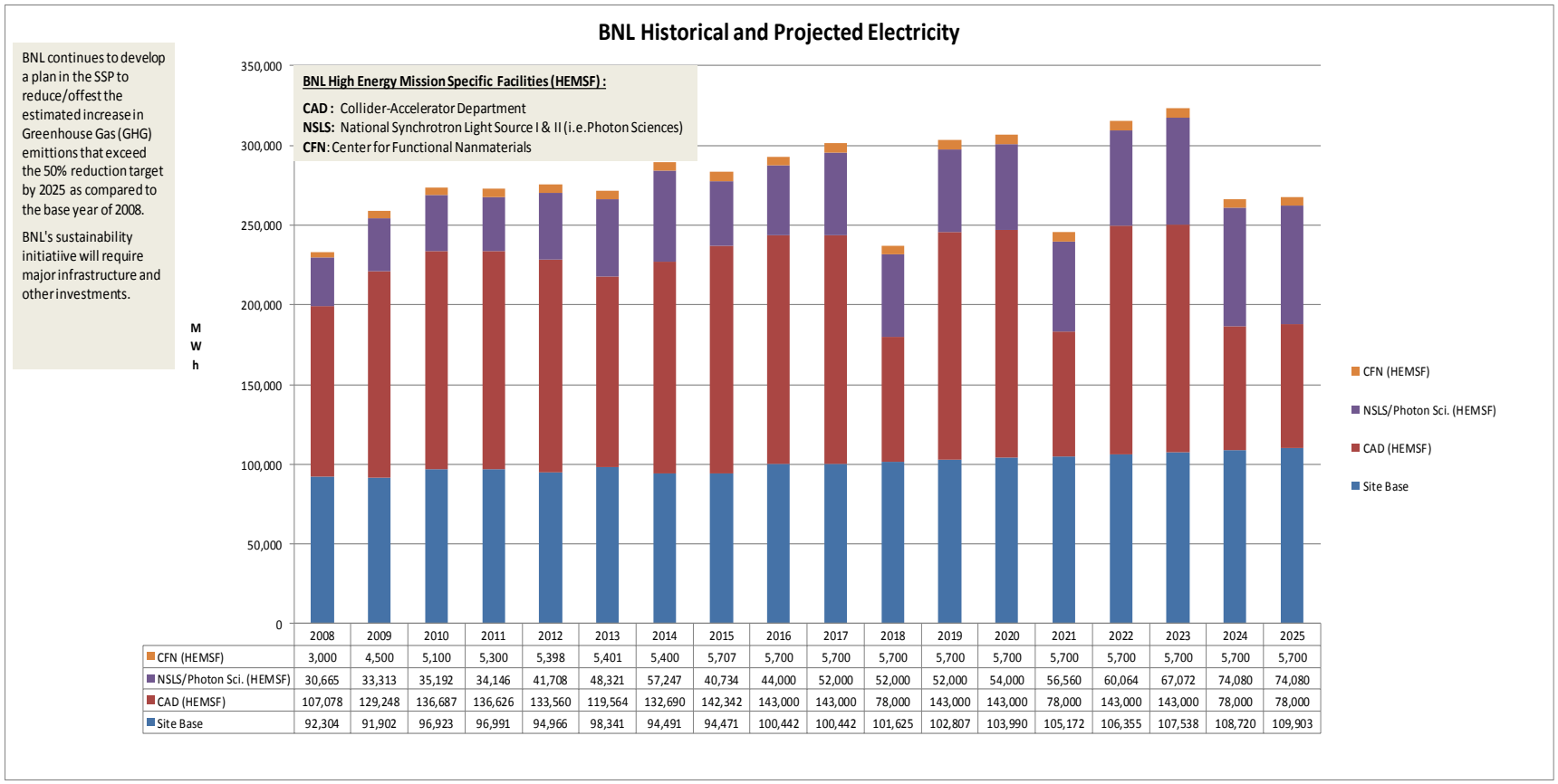
RHIC collides two beams of gold ions head-on when they're traveling at nearly the speed of light (what physicists call relativistic speeds). The beams travel in opposite directions around RHIC's 2.4-mile, two-lane "racetrack." At six points, the lanes cross, leading to an intersection. When ions collide at such high speeds fascinating things happen.

Relativistic Ion Collider (RHIC), aerial view and tunnel

Research at RHIC can be applied in nuclear physics (the study of atomic nuclei), particle physics (the study of the atom's constituents), astrophysics (the study of stars and planets), condensed matter physics (the science of solid matter) and cosmology (the study of the universe).

The following experiments and collaborations take place at RHIC: PHENIX, STAR, pp2pp, Electron Ion Collider Collaboration, and Zero Degree Calorimeter. This facility is designated in FIMS as “excluded.”

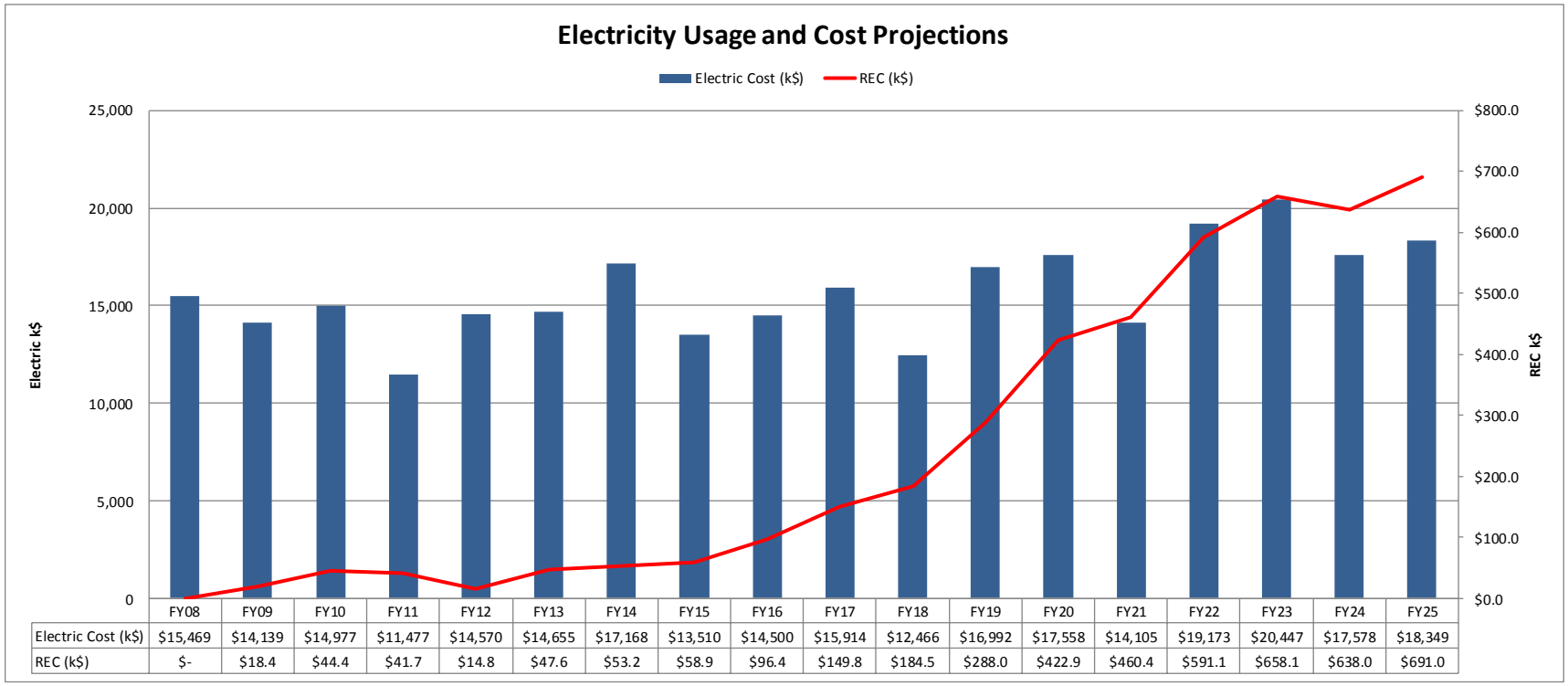
The following chart summarizes BNL's historical and projected electricity usage for HEMSF and the Site Base.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
CFN (HEMSF)	3,000	4,500	5,100	5,300	5,398	5,401	5,400	5,707	5,700	5,700	5,700	5,700	5,700	5,700	5,700	5,700	5,700	5,700
NSLS/Photon Sci. (HEMSF)	30,665	33,313	35,192	34,146	41,708	48,321	57,247	40,734	44,000	52,000	52,000	52,000	54,000	56,560	60,064	67,072	74,080	74,080
CAD (HEMSF)	107,078	129,248	136,687	136,626	133,560	119,564	132,690	142,342	143,000	143,000	78,000	143,000	143,000	78,000	143,000	143,000	78,000	78,000
Site Base	92,304	91,902	96,923	96,991	94,966	98,341	94,491	94,471	100,442	100,442	101,625	102,807	103,990	105,172	106,355	107,538	108,720	109,903

Figure 6: BNL Historical and Projected Electricity

The chart below shows electricity and REC costs history and projections. REC pricing rates through FY15 are actual. Rates going forward are currently estimated to be ~$2/MWh in FY16 and increase gradually to $5/MWh by 2025. These assumptions are based on discussions with a few REC providers.



	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25
Electric Cost (k$)	$15,469	$14,139	$14,977	$11,477	$14,570	$14,655	$17,168	$13,510	$14,500	$15,914	$12,466	$16,992	$17,558	$14,105	$19,173	$20,447	$17,578	$18,349
REC (k$)	$-	$18.4	$44.4	$41.7	$14.8	$47.6	$53.2	$58.9	$96.4	$149.8	$184.5	$288.0	$422.9	$460.4	$591.1	$658.1	$638.0	$691.0

Figure 7: Electricity Usage and Cost Projections

Appendix A: Energy Consuming Excluded Buildings and Trailers List

The Energy Consuming Excluded Buildings and Trailers List is provided as part of the Consolidated Energy Data Report (CEDR).

Appendix B: Policy and Program Status Table

SSPP Goal – Policy/Program	In Place (Y/N)	Last Update (MM/YY)	Additional Information
Goal 1: Greenhouse Gas Reduction			
Program: Sulfur hexafluoride (SF_6) capture	Y	---	To more accurately account for and effectively manage leaks of sulfur hexafluoride (SF_6) associated with gaseous dielectric used in its high voltage electric equipment, BNL finalized a High Energy Equipment Management Plan for the Energy & Utilities (EU) Division's Electric Distributions Group to follow in FY15.
Plan: Commuter reduction	Y	Ongoing	Commuter Choice / RideShare Program
Policy: Teleworking and/or alternative work schedule	Y	09/2014	Flexible Work Arrangements Subject Area
Goal 2: Sustainable Buildings			
Policy: Space management	Y	06/2014	Space Management Subject Area
Policy: Cool roof installation	Y	---	The BNL Modernization Project Office (MPO) designs all new roofs to meet the cool roof requirements. Requirements are documented in MPO's Standard specifications and in the Design Manual provided to A/E firms working for MPO.
Policy: Design new Federal buildings to achieve net-zero energy by FY 2030	N	---	
Program: Participation in critical local and regional efforts and initiatives	Y	---	BNL has been participating since the 1980's.
Plan: Update agency/site policy and guidance (EIS's and EA's)	Y	06/2014	Space Management Subject Area
Policy: Dispose and consolidate excess and underutilized property	Y	---	BNL SC Lab Plan outlines planned efforts to consolidate staff and right-size the footprint. The results of the evaluation of the building utilization are documented in FIMS.
Policy: Reduce need for new building and field office space	N	---	
Policy: Conserve, rehabilitate, and reuse historic Federal properties	Y	---	Cultural (Historical) Resource Management Plan
Policy: Incorporate sustainable practices into new/renew leases	N/A	N/A	BNL does not have any nor is planning any new leases at this time
Plan: Green buildings roadmap	N	---	---
Program: Sustainable landscape	N	---	---
Plan: Metering	Y	---	Robust metering for all energy streams
Policy: Data center	Y	---	Working towards additional consolidation.

SSPP Goal – Policy/Program	In Place (Y/N)	Last Update (MM/YY)	Additional Information
consolidation			
Goal 3: Clean & Renewable Energy			
Policy: Prioritization of on-site renewable	Y	---	BNL purchased 43 million kWh of RECs for FY15. This equals about 8.94% of BNL's total usage of electric and thermal energy. When the 720,000 kWh output for the NSERC facility is included, the total is 9.1%.
Policy: Purchase renewable energy from sources on tribal land	N	---	
Policy: Prioritization of on-site clean or alternative energy	Y	---	In FY15, the LISF provided 51.4 million kWh/yr of clean renewable energy to Long Island. NSERC (BNL's 500 kW solar research array) to be expanded by 230 kW using SPOFOA funding. Additional expansion to be pursued.
Goal 4: Water Use Efficiency & Management			
Policy: Storm water management	Y	---	Storm water at BNL is managed by collecting runoff form paved surfaces, roofs, and other impermeable surfaces and directing it to recharge basins via underground piping and above-grade vegetated swales.
Policy: Water reuse	Y	---	Over 80% of BNL's water consumption is recharged back to the ground.
Plan: Water	Y	---	BNL Water Management Plan
Goal 5: Fleet Management			
Program: Fleet Optimization/Vehicle Allocation Methodology (VAM)	Y	08/2014	The Government Vehicle Subject Area addresses this topic. Vehicles are selected to best accomplish the user's mission with the most energy efficient vehicles.
Program: Sustainable transportation options	Y	---	Commuter Choice / RideShare Program
Program: Vehicle sharing/pooling	Y	---	Commuter Choice / RideShare Program
Policy: Fleet-wide per mile greenhouse gas emissions	Y	---	With the advent of GSA leasing, the expectation is to replace many vehicles with alternative fuel vehicles and decrease the age of our vehicles, thereby increasing the fuel efficiency.
Program: Zero Emission Vehicles	N	---	Currently, through GSA, plug-in hybrids and zero emissions vehicles are not available.
Goal 6: Sustainable Acquisition			
Policy: Inclusion of FAR sustainability clause	Y	---	The requirements for Sustainable Acquisition are incorporated into all of BNL's Terms and Conditions issued by the PPM Division.
Policy: Inclusion of bio-based products	Y	---	The requirements for bio-based products are incorporated into all of BNL's Terms and Conditions issued by the PPM Division.
Policy: Inclusion of energy efficient products (e.g. Energy Star, FEMP-	Y	---	When purchasing desktop or laptop computers, BNL selects products that are registered with the Electronic Product Environmental Assessment Tool (EPEAT) and Energy Star-

SSPP Goal – Policy/Program	In Place (Y/N)	Last Update (MM/YY)	Additional Information
designated)			qualified where feasible. EPEAT standards have been approved for copiers, printers, and televisions, and Energy Star settings are in place when the systems come in from the supplier.
Policy: Inclusion of recycled content products	Y	---	Approximately 99% of the paper purchased at BNL has a minimum content of 30% post-consumer fiber, which meets the recycled content requirements of the EPA's Comprehensive Procurement Guidelines. In addition, Recycled Content Criteria are incorporated into the Lab's online purchasing program.
Policy: Inclusion of water efficient products (e.g. WaterSense)	Y	---	BNL specifies low-flow, WaterSense faucets and showerheads for new constructions, renovations, and maintenance.
Policy: Inclusion of environmentally preferable products/services (excluding EPEAT)	Y	---	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.
Plan: Environmentally preferable purchasing	Y	---	BNL actively reviews and incorporates EPA recommendations for specifications that designate environmentally preferred products and services on a case-by-case basis.
Policy: Paper containing at least 30% post-consumer fiber	Y	---	Approximately 99% of the Laboratory's paper has a minimum content of 30% post-consumer fiber.
Goal 7: Pollution Prevention & Waste Reduction			
Program: Reduce and minimize hazardous chemicals and materials	Y	---	Protocols and contracts established by the Procurement and Property Management Division have led to a streamlined, just-in-time method for ordering chemicals, which has minimized the Laboratory's footprint of on-site chemicals.
Policy: Integrated pest management and landscape management	Y	---	Integrated Pest Management Program
Policy: Increase use of acceptable alternative chemicals and processes	Y	---	The Laboratory is continually working with its scientists, custodians, and operators to find ways to minimize the use of toxic materials and substitute less or non-toxic surrogates in their procedures.
Policy: Report per Sections (301-313) of EPCRA of 1986	Y	---	BNL submits an annual EPCRA report
Program: Composting	Y	---	BNL has two programs for diverting compostable materials—(1) animal bedding used by the Medical Department is mixed in with wood-composted debris to form mulch or soil conditioner, and (2) food prep waste from the on-site Cafeteria is deposited into an inlet of the STP to supplement the existing food levels for the system's biological processes to achieve maximum efficiency.
Goal 8: Energy Performance Contracts			
Policy: Utilize performance contracts	Y	---	UESC Phase I completed in May 2015. Phase II scope under development. Awaiting verification of Phase I savings before

SSPP Goal – Policy/Program	In Place (Y/N)	Last Update (MM/YY)	Additional Information
			implementation of Phase II.
Goal 9: Electronic Stewardship			
Policy: Power management	Y	---	All systems in the BNL domain that are capable of power management have the setting enabled.
Policy: Print Management and Duplex Printing	Y	---	Duplex printing is at the discretion of departments; however, printing in duplex mode is strongly encouraged across the Laboratory.
Goal 10: Climate Change Resilience			
Plan: Update all appropriate plans to address climate change resiliency	Y	---	
Program: Identify or establish and participate in regional climate	Y	---	
Other			
Program: Cost savings reinvestment	Y	---	UESC to be paid for through energy savings. Cost avoidance from energy production from NSERC (solar PV array) used to support and maintain array.

Appendix C: Metering Plan

Brookhaven National Laboratory

Metering Plan

November 2015 Update

Changes Since Last Report

- 11 additional advance electric meters installed
- 1 additional advanced steam condensate meter was installed and connected to our energy management control system3 existing advanced steam condensate meters were connected to our energy management control system
- 2 malfunctioning advanced steam condensate meters where replaced
- 1 additional advanced chilled water meter installed
- Increased metered electricity from 95% to 97% of the site total
- Steam charge-back plan continuing

Existing Electric Metering Infrastructure Survey Findings

BNL receives electrical power at one of two substations where the 69 kV transmission voltage is reduced to 13.8 kV. Distribution of the electrical power on site is through two distribution systems, an underground 13.8 kV system and a 2.4 kV system with both underground and some overhead line distribution. All 13.8 kV feeders are metered as well as most transformer points.

Currently there are 308 electric meters metering building and process loads. Some meters have been removed due to building eliminations. 298 of these meters are connected to automated data recorders that record power consumption in 15 minute demand intervals which are then automatically interrogated on a daily basis to download load profile data to our database. 10 of the 308 electric meters are manually read meters that will eventually be connected to automated data recorders.

A continuing program is in place to install and upgrade electrical metering throughout the site. Data recorders and meters are being replaced with more advanced metering that incorporates both metering and recorder functions as well power quality and real time monitoring of electrical load. This type of meter cuts down on both equipment needed and installation costs. The data obtained by these meters are becoming more in demand by both the user and the engineer as electrical loads become more sophisticated, ie., supercomputing and electron microscopes.

Existing Steam and Chilled Water Metering Infrastructure Survey Findings

Brookhaven National Laboratory receives steam from its Central Steam Facility (CSF), which consists of 4 boilers with a total steam capacity of 475,000 pounds per hour at 125 psi (saturated steam). The boilers are equipped with multiple fuel capacity; natural gas, No.6 & No.2 fuel oils. The facility provides steam to 78 buildings with a total area of over 2.8 million square feet.

Currently there are 65 steam condensate meters and 5 steam meters, metering building and process loads. Some meters have been removed due to building eliminations. 36 of these meters are connected to our energy management control system. Steam or steam condensate flow is recorded hourly and totalized daily. The remaining 29 meters are manually read meters that will be connected to the energy management control system as appropriate based on various factors including usage and funding.

BNL has over 14,000 tons of major cooling equipment throughout the site, including a 9750 ton Central Chilled Water Facility (CCWF). The CCWF provides chilled water and compressed air to 23 buildings, with new buildings and meters being added at the design phase of new projects. All of these advanced chilled water meters are tied in to the energy management control system, which records delta-T, flow, and pressure on an hourly basis.

More advanced metering allows for customers to track their steam and chilled water consumption, providing the potential to conserve energy and save money. This type of metering also helps identify flaws in heating and cooling system. The data obtained by these meters is becoming more in demand by both the user and the engineer.

For the past two decades Brookhaven National Laboratory has been continually upgrading its metering capabilities in all areas of energy consumption which include electric, steam and chilled water.

How metered data will be used

BNL has been metering and billing internal Departments for electricity and chilled water for decades, and determined to be the most effective method of conservation. As is the case with existing advanced metering, data will be used to establish trends in consumption and provide timely information to the consumer. Energy metering provides data for reducing energy requirements and save on fuel and electric usage.

In 2010 BNL began the process of implementing a steam re-charge program. Once fully enacted all energy streams will be accounted for and charged to the appropriate users.

The electric metering system is also used for our participation in various electric demand response programs. BNL users are credited for their performance during curtailment events based on actual metered data.

Summary of site-wide building practicability screenings

All main feeders and most buildings already have advanced metering. Most other buildings will have advanced meters installed in the next few years, except for groups of buildings of similar usage, like storage buildings, trailers, and site lighting.

Most all buildings connected to the district steam loop have steam condensate metering. Most are hand read meters, but in some buildings, usage is estimated. We would like to first provide steam condensate meters to the buildings whose usage is estimated; second will be to connect the hand read condensate meters to the energy management control system; and lastly will be to add supplemental steam meters.

Installation Schedule for new advanced meter applications

The installation schedule will continue to take place over fiscal years 2014 - 2016. All buildings that pass the practicality test will have advanced meters installed.

Tentatively in FY13 BNL will begin a charge-back system for steam consumption in buildings. Steam metering is currently being installed in large use buildings where there are currently failed meters or in a few cases no steam metering, and upgraded in buildings with old style steam metering. All steam metering data will be captured in MV90xi for billing and load analysis.

Site Metering Data Acquisition Plan

BNL has in the past used the industry standard Itron MV90 software to interrogate and store meter data for load profile and billing information. BNL completed the MV90 upgrade from version 5.0 to version MV90xi. Along with the new version of MV90, BNL is also utilizing Itron's Energy Management Suite to predict power purchase costs for different load profiles in a real time power purchase environment. This information can also be used to generate the Labs electrical bill based upon projected load profiles. Data from MV90xi can also be migrated into the Energy Management Suite for tracking building consumption trends and building power costs.

MV90xi has been upgraded with the new TCP/IP data acquisition module. Going forward, all meters installed will have the ability to communicate with MV90xi via the Ethernet saving meter interrogation time and costs that were associated with maintaining and leasing a copper based analog interrogation system. Utilizing the TCP/IP communication protocol, data can also be shared with other platforms using MODBUS over IP as well as analyzing real time electrical data and power quality information.

Site Metering Financing Plan

Designs will continue to be performed utilizing in-house resources. Materials will be procured and installed using a current electrical subcontractor. IGPP funds will be budgeted in the Ten-Year Site Plan to support this Electric Metering Plan.

Site wide metering program support requirements

The site metering program will require 0.25 man-years and $40,000 for maintenance, repair and calibration of meters annually. The total annual budget requirement is about $100,000. The total cost for advance meter purchases and installation is approximately $30,000/year.

List of site staff accountable for metering program activities

All metering program activities will be accomplished by the Facilities and Logistics Management department:

Metering Analysis – Energy Project Engineer – Ed Phillips
Metering Installation – Staff Electrical Engineers and Line Crew - Various
Meter Data Analysis – Energy Project Engineer – Mary Ellen Chieco

Brookhaven National Laboratory

Energy Metering Summary

Update: 11/12/2015

Metering Systems	Quantity	No. Smart Meters	% of Total Energy Read	MWh	mmBtu	Billed
Electric						
Advanced Electric Meters w/recorders and/or IP	298	298	98.0%	276,785		Yes
Electric Meters without Recording	10		2.0%	5,649		Yes
Total Electric Meters	**308**		**100.0%**	**282,434**		Yes
Electric Meters with Live Data (Web Based)	59		100.0%	282,434		
Steam						
Steam Condensate Meters	65	36	76.0%		346,971	Pending
Steam Meters	5	5	15.0%		68,481	Pending
Total Steam Meters	**70**	**41**	**91.0%**		415,452	
Chilled Water						
Chilled Water Meters	34	34	100.0%		271,519	Yes
Natural Gas						
Natural Gas Meters	4	4	100.0%		655,052	Yes

Appendix D: Consolidated Energy Data Report (CEDR)

The Consolidated Energy Data Report is provided as a separate file.

Appendix E: List of Acronyms & Abbreviations

AFV	alternative fuel vehicle
ALD	Associate Laboratory Director
ANL	Argonne National Laboratory
BAS	Building Automation System
BHSO	Brookhaven Site Office
BMP	best management practice
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
Btu	British thermal unit
C&D	Construction & Demolition
CAFE	Corporate Average Fuel Economy Standards
CCNY	City College of New York
CEDR	Consolidated Energy Data Report
CFN	Center for Functional Nanomaterials
CFR	Code of Federal Regulations
CFR	Core Facility Revitalization
CHP	Combined Heat and Power
CNG	compressed natural gas
COOP	Continuity of Operations Plan
D&D	Decontamination & Decommissioning
DLA	Defense Logistics Agency
DOE	Department of Energy
EBNN	Environment, Biology, Nuclear Science, and Nonproliferation Directorate
EISA	Energy Independence and Security Act
EO	Executive Order
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPD	Environmental Protection Division
EPEAT	Electronic Product Environmental Assessment Tool
EPHA	Emergency Preparedness Hazard Assessment
EPP	Environmentally Preferable Purchasing
ERO	Emergency Response Organization
ES&H	Environment, Safety and Health
ESDC	Empire State Development Corporation
ESPC	Energy Savings Performance Contract
EU	Energy & Utilities
F&O	Facilities and Operations
FAR	Federal Acquisition Regulation
FCA	Facility Condition Assessment
FCM	Facility Complex Manager
FEMA	Federal Emergency Management Agency
FEMP	Federal Energy Management Program
FIMS	Federal Information Management System
FPM	Facility Project Manager

FY	fiscal year
gal	gallons
GHG	Greenhouse Gas
GP	Guiding Principle
gpf	gallons per flush
GSA	U.S. General Services Administration
gsf	gross square feet
HEMSF	High-Energy Mission-Specific Facility
HPSB	High Performance Sustainable Buildings
HR	Human Resources
HVAC	heating, ventilation, and air-conditioning systems
ILA	industrial, landscaping, and agricultural
ISB-I	Interdisciplinary Science Building I
ITD	Information Technology Division
JFK	John F. Kennedy International Airport
kW	kilowatt
kWh/yr	kilowatt hour per year
LEED	Leadership in Energy & Environmental Design
LI	Long Island
LISF	Long Island Solar Farm
LOB	Laboratory-Office Building
LPD	Laboratory Protection Division
mmBtu	one million Btu
MPO	Modernization Project Office
$MtCO_2e$	metric tons of carbon dioxide equivalent
MW	megawatts
MWh	megawatt hours
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Protection Act
NHTSA	National Highway Traffic Safety Administration
NOAA	National Oceanic and Atmospheric Administration
NSERC	Northeast Solar Energy Research Center
NSLS-I	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source II
NYC	New York City
NYPA	New York Power Authority
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
OEM	Office of Emergency Management
P2	Pollution Prevention
PHENIX	Pioneering High Energy Nuclear Interaction Experiment
PM	preventative maintenance
PPM	Procurement and Property Management
PUE	power utilization effectiveness
PV	photovoltaic
RCA	recycled concrete aggregate
REC	Renewable Energy Credit

RHIC	Relativistic Heavy Ion Collider
RSB	Research Support Building
SBMS	Standards-Based Management System
SBU	Stony Brook University
SEQRA	State Environmental Quality Review Act
SNAP	Significant New Alternative Policy
SPO	Sustainability Performance Office
SPOFOA	Sustainability Performance Office Funding Opportunity Announcement
SRI	Solar Reflectance Index
SSP	Site Sustainability Plan
SSPP	Strategic Sustainability Performance Plan
STAR	Solenoidal Tracker at RHIC
STP	Sewage Treatment Plant
TEC	total estimated cost
UESC	Utility Energy Service Contract
UPS	Uninterruptible Power Supply
USDA	U.S. Department of Agriculture
VAM	Vehicle Allocation Methodology
WTP	Water Treatment Plant