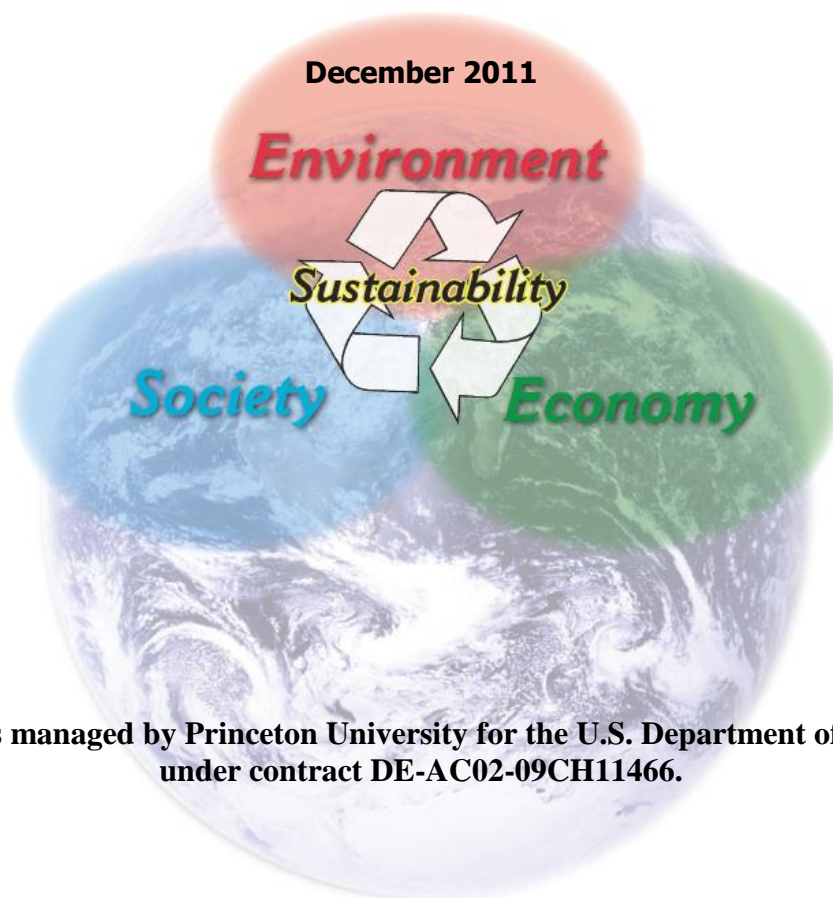


Site Sustainability Plan FY2012

Princeton Plasma Physics Laboratory

December 2011



PPPL is managed by Princeton University for the U.S. Department of Energy
under contract DE-AC02-09CH11466.



U.S. DEPARTMENT OF
ENERGY

Office of Science

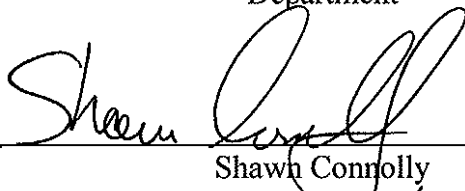
This page intentionally left blank.

PLAN APPROVAL



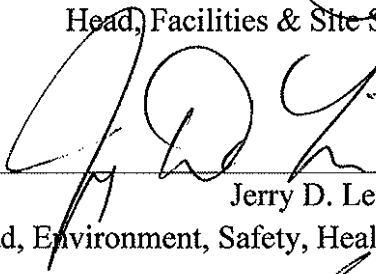
Robert S. Sheneman

Deputy Head, Environment, Safety, Health & Security
Department



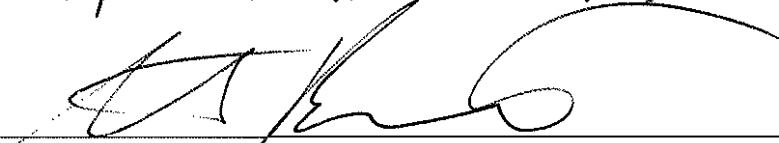
Shawn Connolly

Head, Facilities & Site Services Division



Jerry D. Levine

Head, Environment, Safety, Health & Security Department



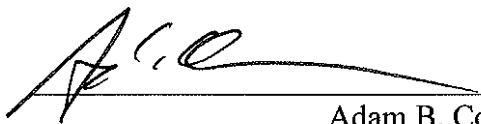
Steve Baumgartner

Head, Information Technology Department, CIO



Michael D. Williams

Associate Laboratory Director, Engineering & Infrastructure



Adam B. Cohen

Deputy Laboratory Director, Operations

List of Acronyms

AFV – Alternative Fuel Vehicle
BAS – Building Automation System
CEDR – Comprehensive Energy Data Report
DESC – Defense Energy Support Center
DLA – Defense Logistics Agency
ECM – Energy Conservation Measure
EISA07 – Energy Independence and Security Act of 2007
EMS4 – DOE’s Energy Management System v. 4
EO13423 – Executive Order 13143, *Strengthening Federal Environmental, Energy and Transportation Management*
EO13514 – Executive Order 13514, *Federal Leadership in Environmental, Energy and Economic Performance*
EPACT05 – Energy Policy Act of 2005
ESPC – Energy Savings Performance Contract
EUI – Energy Utilization Intensity
FEWG – Fugitive Emissions Working Group (DOE)
FIMS – DOE’s Facilities Information Management Systems
GHG – Greenhouse Gas
GPP – General Plant Projects
HEMSF – High Energy Mission Specific Facility
HPSB – High Performance Sustainable Buildings
HVAC – Heating, Ventilation and Air Conditioning
HVST – High Voltage Switch Tube
ISO-14001 – International Organization for Standards, Standard 14001, *Environmental Management Systems – Requirements with guidance for use*
LEED – Leadership in Energy and Environmental Design
LSB – Lyman Spitzer Building
MSW- Municipal Solid Waste
NSTX – National Spherical Torus Experiment
O436.1 – DOE Order 436.1, *Departmental Sustainability*
PPTRS – DOE’s Pollution Prevention Tracking and Reporting Systems
SF6 – Sulfur Hexafluoride

Table of Contents

1.	Executive Summary	1
2.	Goal Performance Review and Plans	6
2.1	Scope 1 & 2 Greenhouse Gas Reduction	6
2.2	Energy Intensity Reduction.....	11
2.2.1	Training & Awareness	13
2.3	Energy Metering	14
2.4	Cool Roofs	15
2.5	Renewable Electricity Consumption.....	16
2.6	On-Site Power	17
2.7	Off-site Renewable Energy Purchases.....	18
2.8	Renewable Energy Certificate (REC) Purchases	18
2.9	Alternative Fleet Fuel Use	18
2.10	Reduce Departmental Fleet Petroleum Use by 2 Percent Annual	19
2.11	Alternative Fuel Vehicles (AFVs)	20
2.12	Fleet Reduction Initiative.....	20
2.13	Scope 3 Greenhouse Gas Emissions Reductions	20
2.14	High Performance Sustainable Design – Existing Buildings	24
2.15	High Performance Sustainable Design – New Construction	25
2.16	Potable Water Intensity.....	26
2.16.1	Water Metering	27
2.17	Industrial, Landscaping & Agricultural (ILA) Water Use.....	27
2.17.1	Stormwater Management	29
2.18	Recycling and Waste Diversion.....	30
2.19	Sustainable Acquisition	33
2.20	Data Centers and Electronics Stewardship	34
2.21	Regional and Local Planning.....	38
2.22	Site Innovation and Government-Wide Support.....	38
3.	Climate Change Adaptation	40
4.	Sustainability Transformation Team.....	41
5.	High Energy Mission Specific Facilities.....	42

List of Tables

- Table 1 – DOE Goal Summary Table
Table 2 – Summary of Scope 1 & 2 GHG Emissions for FY2008, FY2010, and FY2011
Table 3 – Summary of Actual and Projected Renewable Energy Use and REC Purchases
Table 4 – Summary of Scope 3 GHG Emissions for FY2008, FY2010, and FY2011
Table 5 – Actual and Projected HEMSFC Electricity Use (MWh/yr), FY2010-2020

List of Figures

- Figure 1 – Annual summary of PPPL’s GHG emissions (mtCO₂e) for FY2008, 2010, and 2011
Figure 2 – Actual and projected Scope 1 & 2 GHG emissions (mtCO₂e), FY2008-2020
Figure 3 – Actual and projected Scope 3 GHG emissions (mtCO₂e), FY2008-2020
Figure 4 – Summary of Scope 1 & 2 GHG emissions by category, FY2008, 2010 & 2011
Figure 5– Summary of annual SF₆ emissions, FY2008-FY2011

Figure 6 – PPPL’s non-exempt energy utilization intensity (EUI) in Btu/gsf from FY2003 to FY2010

Figure 7 – FY2010 non-exempt fleet fuel use by type

Figure 8 – Annual non-exempt fleet petroleum fuel use between FY2005 and FY2010

Figure 9 – Summary of Scope 3 GHG emissions by category for FY2008, 2010, and 2011

Figure 10 – PPPL annual water use from FY2000 to FY2011

Figure 11 – Annual MSW recycling rate from FY2003 to FY2011

Figure 12 – Annual C&D recycling rate from FY2006 to FY2011

1. Executive Summary

The Princeton Plasma Physics Laboratory (PPPL) conducts world-leading collaborative scientific research into plasma physics to develop and demonstrate the practical application of fusion power as a sustainable global alternative energy source. This research mission enables the fundamental technology discoveries that advances DOE's energy, national security and sustainability mission. Fusion energy research experiments are by nature high-energy intensive devices – designed to replicate deep space and stellar conditions. Development of magnetic fusion energy as a viable global energy source could dramatically change the course of fossil fuel use and global climate change by providing a globally available environmentally attractive carbon-neutral energy alternative. PPPL is located on Princeton University's James Forrestal Campus in Plainsboro Township, Middlesex County, New Jersey, and has operated at the current site since 1958.

PPPL has institutionalized a comprehensive approach to fulfilling the requirements of Executive Orders 13423 and 13514, as well as applicable DOE Orders to advance the DOE energy, national security and sustainability missions. PPPL has successfully reduced its Scope 1 and 2 Greenhouse Gas (GHG) emissions by 32% in FY2010 and by 50.2% in FY2011 compared to the FY2008 baseline GHG inventory. This significant reduction in GHG emissions, achieved in only three years, is largely due to the focused efforts to control fugitive losses of sulfur hexafluoride (SF6) and reduced emissions from on-site combustion of fuel through improved boiler operations and boiler control upgrade projects. We have also cut fleet fuel emissions by 17.2% since FY2008 through careful fleet management and the use of cleaner burning alternative fuels like E85 and B20. GHG emissions were calculated using the methods outlined in the *Federal Greenhouse Gas Accounting and Reporting Guidance and Technical Support Document*, dated October 6, 2010 or using calculations contained in the DOE reporting tools. GHG footprint reduction is a significant environmental objective in PPPL's Environmental Management System (EMS) which is targeted for registration against the ISO-14001 standard in FY2012.

PPPL is a key member of the Greater Philadelphia Innovation Cluster for Energy Efficient Buildings (GPIC Hub), an interagency program to accelerate energy innovation and commercialization. This \$129 million interagency center includes representatives from 11 academic institutions, private corporations and government R&D institutions and is focused on improving the energy efficiency of small commercial and multi-family residential buildings – especially existing buildings.

PPPL's Sustainability Transformation Team is an ad hoc team with representatives from the research, engineering, administrative and support staffs and graduate students, as needed. The team is led by the Deputy Head of Environment, Safety, Health & Security (ESH&S). The STT is charged with identifying and developing innovative ways to further reduce PPPL's GHG footprint, identifying innovative operational and research opportunities, and institutionalizing the behavioral changes necessary to make PPPL's operations more sustainable.

Table 1 provides a summary of FY2011 performance and planned actions to attain the goals. The performance status for each goal is color coded: blue for exceeded the goal, green for met/meeting the goal, yellow for not met but on target, and red for at risk or no significant contributions available for SC portfolio. Figure 1 provides a graphical summary of GHG emission reductions from FY2008 to FY2011 showing the dramatic reductions in he

Laboratory's GHG footprint in only three years. Figure 2 presents a summary of projected GHG emissions based on the management approach outlined in this plan.

Table 1 - DOE Goal Summary Table

SSPP Goal #	DOE/ SC Goal	Performance Status	Planned Actions & Contribution
1.1	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline	EXCEEDED 50.22% reduction in FY11 v. FY08	Continue to focus on SF6 emissions, purchased electricity, and on-site fuel use.
1.2	30% energy intensity reduction by FY 2015 from a FY 2003 baseline	EXCEEDED 52.2% reduction through FY11	Continue to emphasize energy efficiency; improve building energy performance.
1.3	Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) where life cycle cost effective. The site <i>may</i> also report on potable water and chilled water as applicable.	ON TARGET 9 meters installed	Continue installing advanced meters for electricity and natural gas as practicable. Standard meters for water with use of BAS.
1.4	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30	MET 1 building with cool roof. 1 project roof insulation to R-30	R-30 is new standard for roof installation. Additional cool roof installations planned for FY2012.
1.5	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010 – 2012)	MET FY11 REC Purchases = 1.042 MWh	ESPC and PPA were not financially viable. Continue to explore other renewable energy options and integration of renewable energy into new building construction project.
1.6	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline	EXCEEDED 22 times higher than FY05	Continue acquiring AFVS and supporting CNG, E85, and B20 vehicles. Goal 1.9 may impact future performance.
1.7	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline	EXCEEDED 60% reduction from FY05	Continue supporting CNG, E85, and B20 vehicles. Goal 1.9 may impact future performance.
1.8	75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2000 and thereafter. Starting in FY 2015 100%	EXCEEDED 100%	Continue acquiring AFVs.
1.9	Reduce fleet inventory by 35% within the next 3 years relative to a FY 2005 baseline	ON TARGET 5 vehicles returned in FY11	Additional fleet reductions scheduled for FY12 and FY13 to meet goal. Note: this goal may impact 1.6 and 1.7 performance.
2.1	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline	ON TARGET 7.7% reduction in FY11 from FY08	Increasing international collaborations may impact performance on this goal
3.1	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015	ON TARGET LEED-EBOM Gold certification for LSB in FY11	Additional assessments planned in FY2011; energy efficiency may enable three additional buildings to meet HPSB goal.

SSPP Goal #	DOE/ SC Goal	Performance Status	Planned Actions & Contribution
3.2	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs and where the work exceeds \$5 million, each are LEED® – NC Gold certification or equivalent	ON TARGET All new buildings will be LEED-Gold	Science and Technology Center targeted for LEED® Gold certification.
4.1	26% water intensity reduction by FY 2020 from a FY 2007 baseline	AT RISK 88.7% reduction achieved prior to baseline year	Additional water reductions projects are limited. Water conservation measures targeted for new building construction. Operational needs require flexible water use goals.
4.2	20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline	AT RISK FY10 baseline established	Additional water reductions projects are limited. Water conservation measures targeted for new building construction. Operational needs require flexible water use goals.
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	EXCEEDED 58.2% of MSW was recycled in FY11	Continue to maximize recycling. Five year average recycling rate is 55%.
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	EXCEEDED 97.2% C&D of waste recycled in FY11	Continue to maximize recycling. Five year average recycling rate is 55.5%.
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	MET	Continue to identify opportunities to implement sustainable acquisition requirements.
7.1	All data centers are metered to measure a monthly PUE (100% by FY 2015)	MET PPLCC meters installed in FY11	PPLCC metering completed in FY2011
7.2	Maximum annual weighted average Power Utilization Effectiveness (PUE) of 1.4 by FY 2015	AT RISK Baseline PUE established.	Additional energy efficiency opportunities for PPLCC being evaluated
7.3	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	ON TARGET	ENERGY STAR power management function enabled. Significant barriers to full implementation still exist.

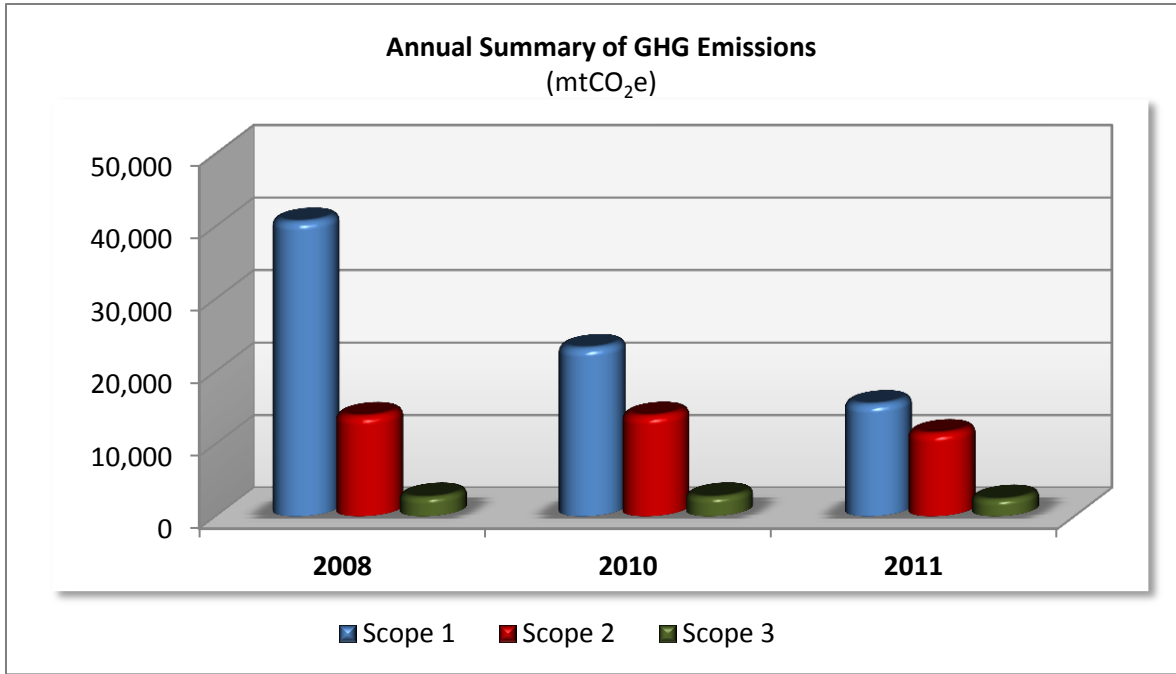


Figure 1 – Annual summary of GHG emissions (mtCO₂e), FY2008, 2010 and 2011. See Tables 2 and 3 for supporting data.

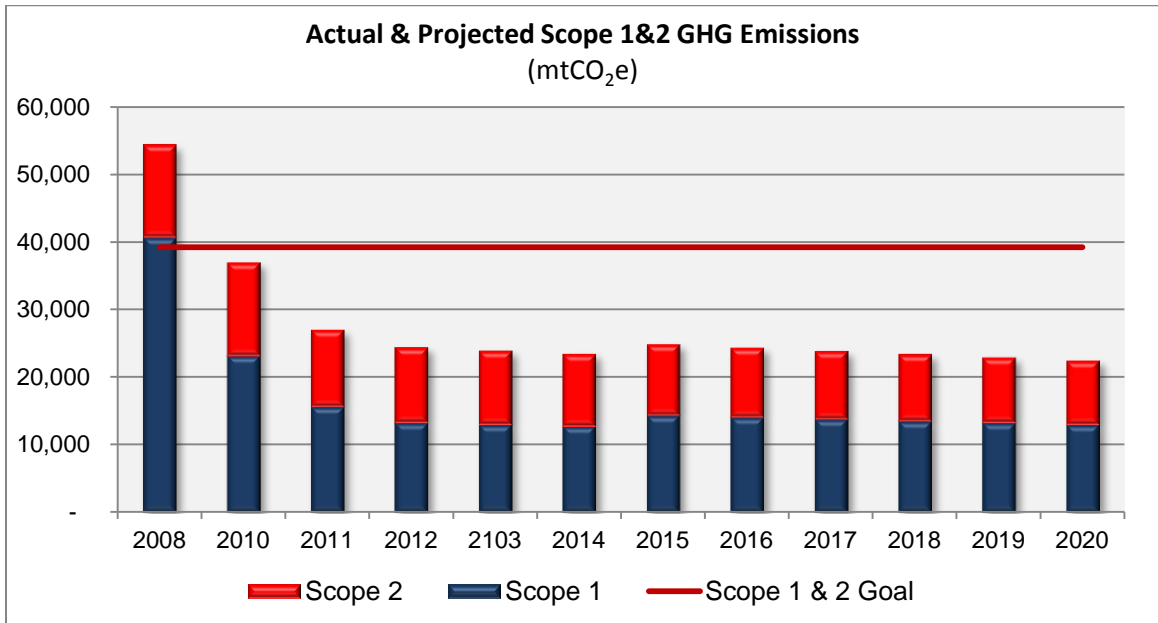


Figure 2 – Actual and projected Scope 1 & 2 GHG emissions (mtCO₂e), FY2008 - 2020.

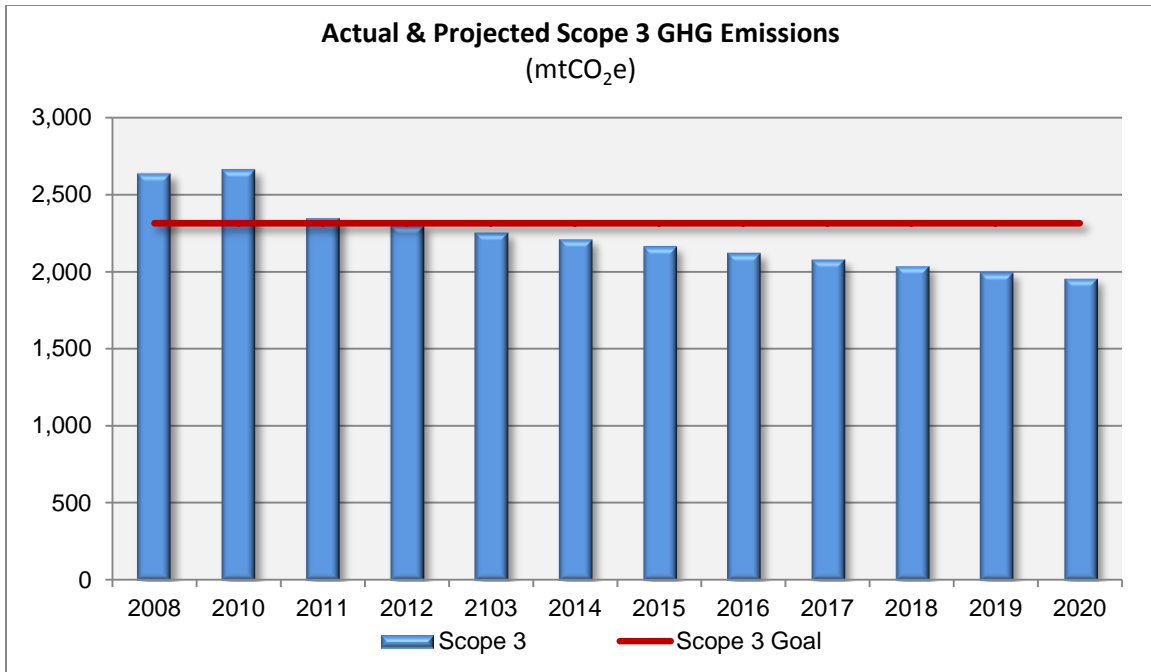


Figure 3 – Actual and projected Scope 3 GHG emissions (mtCO₂e), FY2008 - 2020.

2. Goal Performance Review and Plans

2.1 Scope 1 & 2 Greenhouse Gas Reduction

The Princeton Plasma Physics Laboratory (PPPL) will maintain and continue to reduce its Scope 1 and 2 Greenhouse Gas (GHG) emissions below the 28% target for fiscal year (FY) 2020 as compared to the FY2008 baseline. PPPL already achieved a 32% reduction in FY2010 compared to the FY2008 baseline year. In FY2011, PPPL reduced its Scope 1 and 2 GHG emissions by 50.2% from the baseline. Some of these emission reductions result from a very limited run period for PPPL's major experiment, the National Spherical Torus Experiment (NSTX). NSTX is beginning a multi-year an upgrade project (NSTX-U) to increase its experimental capabilities. Electricity use, and the resulting GHG emissions, will increase in FY2014 when NSTX-U begins experimental operations.

PPPL may encounter challenges in sustaining this performance if there is other programmatic growth for our fusion energy research and related programs. PPPL's magnetic confinement fusion energy research experiments are energy intensive devices, recreating deep space and stellar conditions in the terrestrial environment. This research is PPPL's primary mission and is dedicated to understanding plasma science and technology and developing a carbon-neutral sustainable global energy source for the future. Further information on PPPL's experimental systems is provided in Section V, discussing High Energy Mission-Specific Facilities (HEMSF).

In order to maintain its GHG reduction goal, PPPL will plan and implement energy efficiency projects, and operational improvements, and will encourage employee behavioral change to control and reduce GHG emissions. In addition to ongoing energy efficiency improvements aimed at reducing GHG emissions, we continue to focus on reducing fugitive emissions specifically related to sulfur hexafluoride (SF₆). PPPL uses SF₆ in specialized high-voltage equipment supporting its experimental devices. Emphasis will also be placed on employee behavioral changes that promote energy efficient and sustainable practices such as increased awareness, the use of task lighting, and reduced document printing. The expanded use of employee car pooling, vanpooling, mass transportation, and other evolving programs to reduce Scope 3 GHG emissions due to commuting and business travel are being addressed by the Sustainability Transformation Team.

PPPL's Scope 1 & 2 GHG emissions for the baseline year of FY2008 totaled 54,447.4 metric ton CO₂ equivalent (mtCO₂e). In FY2010, Scope 1 and 2 GHG emissions had been cut by 32% from the baseline year to 37,051.2 mtCO₂e. In FY2011, these emissions were further reduced to 27,121.2 mtCO₂e – a reduction of over 50% from the baseline. A summary of these data are presented in Table 2, below.

Table 2 – Summary of Scope 1 & 2 GHG Emissions from FY2008, 2010, and 2011

GHG CATEGORY	2008	2010	2011
Fugitive - SF6	38,360.0	21,042.8	13,555.8
Purchased Electricity	13,816.0	13,855.0	11,442.6
On-Site Fuel Combustion	2,015.0	1,823.8	1,556
Fugitive - HFCs	160.0	241.2	482.9
Fleet Vehicles	96.4	88.4	83.9
TOTAL	54,447.4	37,051.2	27,121.2

This significant reduction in GHG emissions, achieved in just three years is largely due to the focused efforts to control SF6 losses that are detailed in section 2.1.1. GHG emissions for the on-site combustion of fuel were lower primarily due to improved boiler operations and the boiler control upgrade project described in Section 2.2. We also cut fleet fuel emissions by 8.3% through careful fleet management and the use of cleaner burning alternative fuels like E85 and B20. The details of our fleet fuel use improvements are detailed in Sections 2.9 and 2.10. A graphical summary of Scope 1 and 2 emissions for FY2008, FY2010 and FY2011 is presented in Figure 7, below.

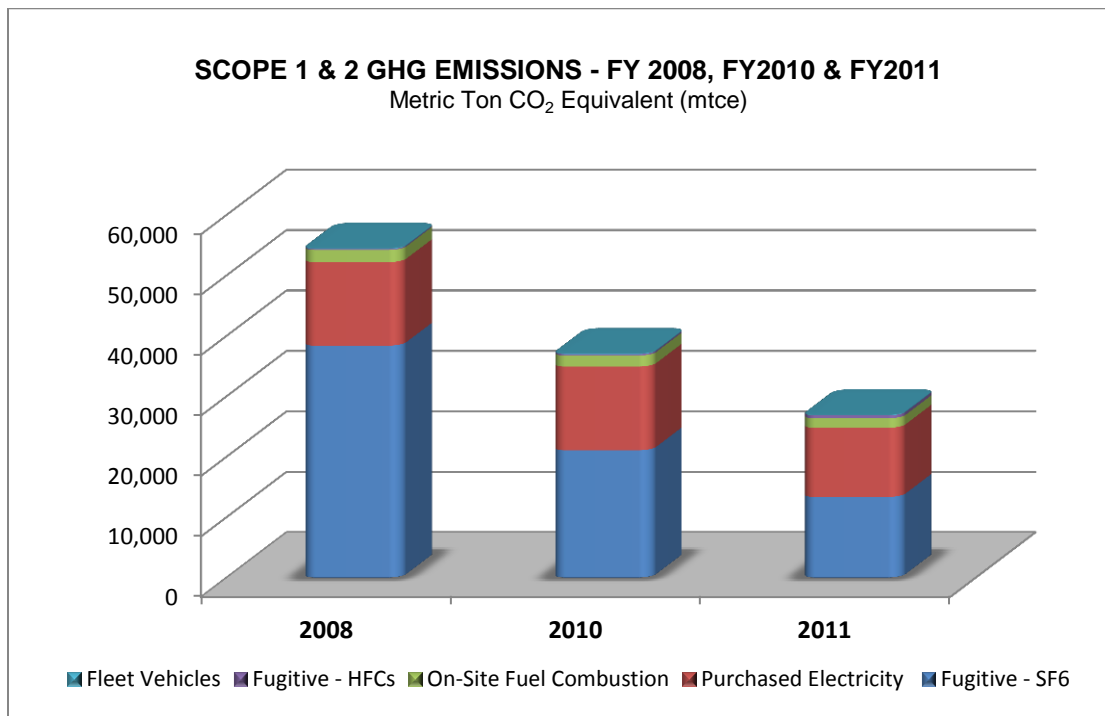


Figure 4 – Summary of Scope 1 & 2 GHG emissions by category, FY 2008, 2010 & 2011.

Planned Actions

PPPL will continue to focus on the broad range of actions described in detail above to control SF6 emissions, improve the central steam/chilled water plant efficiency, improve building energy performance, reduce fleet fuel consumption, and affect employee behavioral changes to reduce our overall GHG footprint. PPPL’s Sustainability Transformation Team is charged with

identifying and developing innovative ways to further reduce PPPL's GHG footprint and institutionalizing the behavioral changes necessary to make PPPL's operations more sustainable.

A gap analysis is not necessary for achieving Scope 1&2 GHG reductions, as PPPL has already exceeded the established target. In regard to renewable energy, we will continue to evaluate Energy Saving Performance Contract and Power Purchase Agreement mechanisms for financing such projects as resources allow. The evaluations may include large-scale ECMs such as solar power energy generation, combined heat and power, and chilled water storage.

2.1.1 Fugitive Emissions - SF6 Reduction

PPPL has established a program to reduce or eliminate non-carbon dioxide (CO₂) fugitive emissions from sulfur hexafluoride (SF₆). PPPL is an active member of the DOE Fugitive Emissions Working Group (FEWG) coordinated by HS-22. The FEWG has already reduced DOE's overall fugitive GHG emissions by half and was recognized with a 2011 Secretarial Achievement Award for its efforts.

Performance Status:

PPPL operates experimental equipment with high voltage capability that requires SF₆ insulating gas for its voltage standoff properties. Experimental heating systems, namely the Neutral Beam Injection (NBI) and Radio Frequency (RF) systems, are the principal users of SF₆. The NBI uses SF₆ in power supplies, high voltage enclosures, high-voltage transmission lines, and ion source enclosures. The RF system uses SF₆ in six coaxial transmission lines. These lines extend hundreds of feet to reach the experimental areas but have good seal designs and do not usually need entry for maintenance. These systems are sealed systems. NBI and RF use an SF₆ recovery and supply skid, a portable reclamation unit, and purchased cylinders to replenish, recover, and store SF₆ inventories. Cylinder delivery systems are used on NBI Modulator/ Regulator (M/R) power supplies. Both the ion sources and M/Rs have SF₆ molecular sieve scrubbers on them to remove water vapor and maintain very low dew points, providing improved electrical insulating and reducing the chance of electrical arcing and the resultant need to vent contaminated SF₆ to the atmosphere.

NBI currently operates one beam line with three power systems and ion sources in service for NSTX. For operations and maintenance, these systems are filled and recovered to the SF₆ skid with minimal loss. The skid is replenished by releasing cylinders into the storage tank inventory for use as needed. RF systems and the Ion Source shop use cylinders to fill sealed volumes for testing and operations. Both of these systems use a portable reclamation unit to recover SF₆ to perform maintenance and testing.

All of the above systems experience a chronic leak rate associated with operations. The longer operating periods in recent years require systems to be pressurized for longer durations, which particularly affect the transmission lines and M/Rs. Several of these seal designs were suboptimal. Transmission lines, which are rubber booted high voltage gear, have overpressure reliefs to avoid backfilling and over pressurizing the transmission lines from either the ion source enclosure or high voltage enclosure.

As part of PPPLs' site sustainability best practices, the NBI and RF groups implemented comprehensive leak rate surveys and leak checks in FY2010 using both meters and leak detectors. All valves, tubing, gauges, and external components found to have minor leaks have been documented, repaired, and corrected. Daily rounds and readings are performed for operations that check pressures and identify failures almost immediately.

PPPL implemented several substantial SF₆ capture and recovery system projects in FY2011:

- **Transmission Line Overpressure Reliefs:** A capture ballast tank system to recover SF₆ from overpressure relief valves on RF transmission lines was designed and installed in FY2011. This system connects pressure relief valves to a bladder tank to capture SF₆ blow-off. The bladder tank is also plumbed into the SF₆ recovery line system which returns SF₆ to the recovery skid. The SF₆ skid can be employed to evacuate the tank and recover SF₆ captured from the relief valves. This system was installed and tested in later 2010 and will be available for use in future NSTX-U experimental campaigns. It is expected that this pressure relief recapture system will provide substantial reductions in future fugitive SF₆ emissions.
- **Modulator/Regulators (M/Rs):** System surveys indicate that the M/Rs have three main problems where the original design of this 30 year old equipment was suboptimal. The on-board SF₆ circulation system is older technology which was prone to leaks. The High Voltage Switch Tubes (HVSTs) use a fiberglass helmet for SF₆ insulation of the tube ceramic anode allowing the HVST to stand off up to 200 keV. The helmet seals were identified as a source of leaks for redesign. Lastly, high voltage bushings in the isolation transformer connected to the HVST housings were subject to chronic leaks. The redesign and modification of these systems were prioritized during experimental outages in FY2011. Improvements to the helmet seals and other system components were implemented during the FY2011 experimental outage. These system modifications are expected to provide substantial reductions in future fugitive SF₆ emissions.

A summary graph of annual fugitive SF₆ emissions in GHG equivalents for the past four fiscal years is provided in Figure 4, below. This graph shows that PPPL has reduced its fugitive SF₆ emissions by 55% since FY2008, contributing significantly to overall GHG emission reductions.

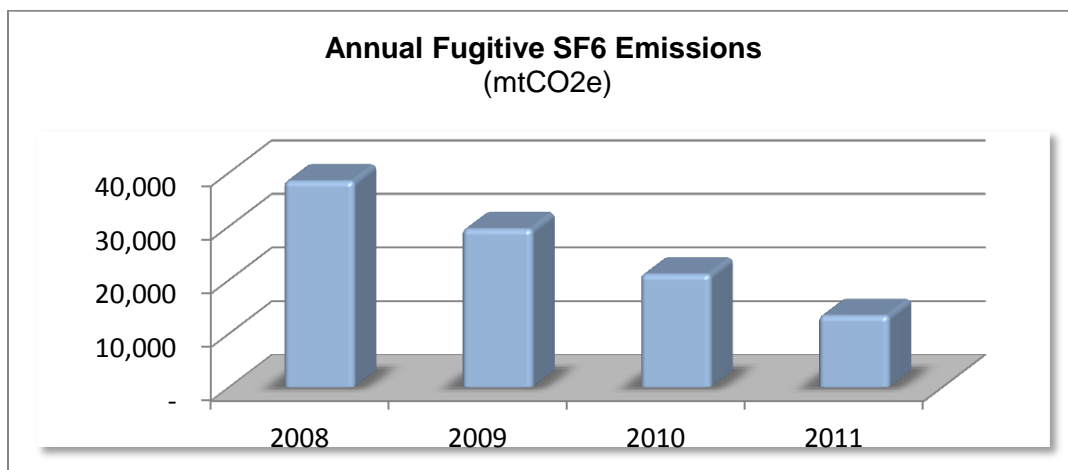


Figure 5 – Summary of annual SF₆ emissions, FY2008-FY2010.

Planned Actions:

Controlling SF6 emissions continues to be a high priority for PPPL, as fugitive SF6 emissions represent the single largest identified source of GHG emissions from Laboratory operations. PPPL has identified and evaluated several SF6 control and recovery opportunities. Funding for some measures has been identified in PPPL's operating budget. Other control measures may require additional funding to implement. PPPL's identified and planned SF6 control measures are summarized below:

- **Operator Training:** For maintenance, when an enclosure has to be entered to affect repairs, a recovery of SF6 is performed. Residual SF6 is pumped out and the enclosure volume is vented and purged with air for personnel confined space entry. The recovery and fill operations are performed by trained SF6 operators. An acute and non-recoverable release of residual SF6 occurs upon enclosure purge, but the total is very low as the enclosures are pumped out to a fraction of a Torr pressure. Sufficient time must be allowed to pump down to best levels. Problems can also occur due to the age and complexity of PPPL's SF6 recovery/supply skid. As part of best practices, the SF6 operators will receive ongoing on the job procedure training to refresh knowledge and awareness of fill and recovery procedures.
- In FY 2011 an engineering plan and cost estimate was developed to refurbish the central large-capacity SF6 pumping and recovery system. NSTX-U includes additional NBI heating capacity, which will raise the site's SF6 inventory. By refurbishing the SF6 pumping and recovery system, PPPL will provide sufficient gas recovery capacity in the event that all NBI systems require purging. Refurbishment of the SF6 recovery system is proceeding in parallel with the NSTX Upgrade Project utilizing operations and other project funding.
- PPPL will also continue to assess potential replacement technologies for SF6, leveraging the Laboratory's scientific and engineering expertise.

While the age and service conditions of PPPL's experimental heating systems SF6-filled equipment requires vigilance, procedures are in place to minimize SF6 emissions, redesigns are planned to improve systems and further reduce SF6 emissions, and renewed emphasis has been placed on operating procedures and training to avoid SF6 emissions at PPPL to the extent possible.

2.1.2 Fugitive Emissions – HFC Management

PPPL has established refrigerant management program to track and monitor fugitive GHG emissions from the loss of HFC refrigerants. PPPL's refrigerant technicians are certified to maintain these systems and to recover refrigerants during maintenance and repairs. In FY2011 one of three main chillers in the central chilled water plant experienced an equipment failure which resulted in a partial loss of refrigerant. Each of the three main chillers contains 600 pounds of refrigerant. When the leak was identified, the unit was shut down and repairs were made. As a result, PPPL's GHG emissions from fugitive HFC losses were significantly higher in FY2011 than in past years. PPPL has instituted a program of enhance inspections of chiller and refrigerant systems and a phased overhaul of the central plant chillers. The overhaul program includes inspection, repair, and testing of system components, calibration of gauges/sensors, and the extraction, cleansing and replacement of refrigerants. One unit has been completed, the second unit is in progress, and the overhaul project is scheduled for completion in FY2012.

2.2 Energy Intensity Reduction

The Energy Independence and Security Act of 2007 (EISA 2007) requires Federal agencies to reduce their energy intensity by 30% by FY2015 from a FY2003 baseline. All DOE sites are expected to aggressively strive towards the overall Departmental goal of a 30 percent reduction, but will not necessarily be individually held to the numerical goals. Actual energy reduction and GHG reduction targets will be defined by the DOE Under Secretary for Science.

Performance Status:

PPPL's current energy utilization intensity (EUI), based on its Consolidated Energy Data Report (CEDR) data as of October 11, 2011, is 83,711 Btu per gross square feet of building (84 kBtu/gsf), which is a 52.6% reduction as compared to the FY2003 baseline of 176,759 Btu/gsf (177 kBtu/gsf). PPPL's non-exempt buildings use less than half the energy per square foot than they did in 2003. For the past five consecutive fiscal years PPPL has exceeded the 30% EUI reduction goal established for FY2015 and will continue to pursue life-cycle cost effective energy efficiency improvements as funding allows. A graph of PPPL non-exempt EUI from 2003 to 2011 is shown in Figure 5, below.

The Lyman Spitzer Building (LSB), our main administration/office building received LEED-Gold certification under the U.S. Green Building Council (USGBC) Leadership in Energy & Environmental Design (LEED) rating system. This building is over 119,000 square feet and supports approximately 200 employees (45% of Laboratory employees). These employees include research and support personnel who are responsible for Laboratory management, accounting, payroll, procurement, and operations. The LSB also includes the control room and data acquisition systems for PPPL's largest experimental device the National Spherical Torus Experiment (NSTX). The LSB is an ENERGYSTAR[®] labeled building with a rating of 80 out of 100, making it among the top 20% of comparable commercial buildings nationwide in terms of energy performance.

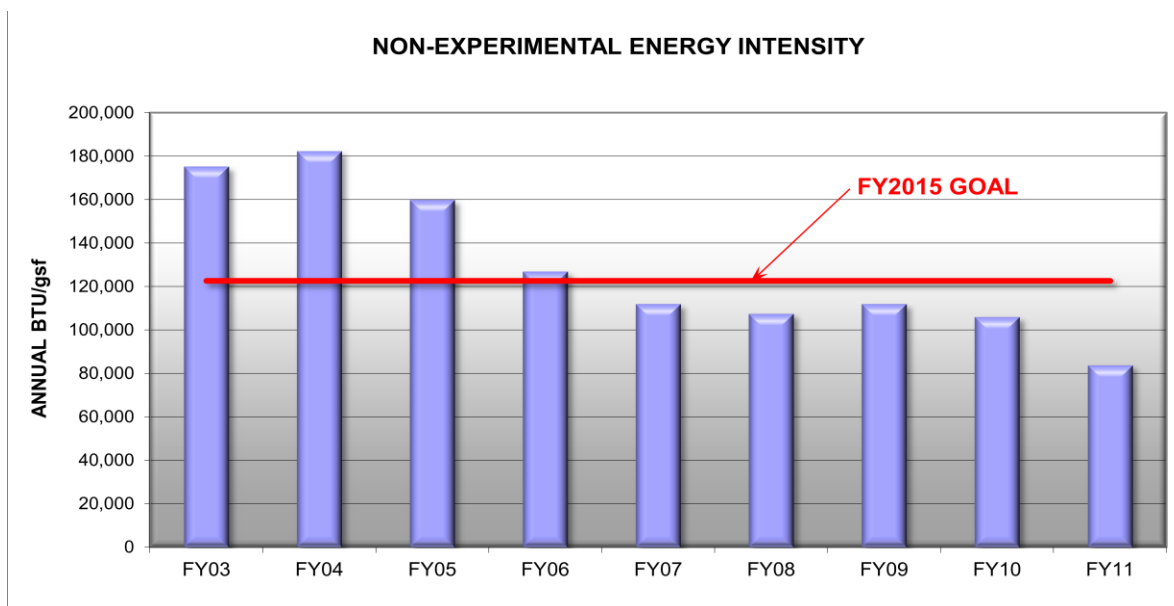


Figure 6 – PPPL's non-exempt energy utilization intensity (EUI) in Btu/gsf from FY2003 to FY2011

PPPL has implemented several energy conservation measures (ECMs) to achieve our current energy intensity reduction. State of the art direct digital boiler control systems were installed on three of our four central plant boilers over the past three years. Approximately 450 linear feet of cold and hot pipes were properly insulated replacing old 1-inch fiberglass insulation with 2-inch earthwool insulation.

Lighting Projects:

- Walkway 80 watt high pressure sodium lamps were replaced with new Philips LUMEC 40 watt LED fixtures.
- Twelve bollard lights using compact fluorescent lamps were replaced with six LED bollard fixtures equipped with Motion System Response controls. New bollard fixture LEDs stay on Low Level (8 watts) until motion is detected. LEDs increase to full light output (41 watts) when motion is detected.
- High bay 250 watt high pressure sodium fixtures were replaced with 100 and 150 watt induction lights in the warehouse.
- Energy efficient fluorescent and solid state LED fixtures and lamps were installed during ongoing facility renovations.
- Four doorway sconce fixtures equipped with 40-watt low-pressure sodium (LPS) lamps were replaced with Phillips Gardco 121 40-watt LED Motion System Demand Performance Sconce. The new LED lights maintain a 4-watt standby level until motion is detected, when they switch to 40-watt output.
- Six new high-efficiency 70-watt induction parking lot and roadway lights were installed as a pilot test, replacing 150-watt high pressure sodium lights. The parking lot lights have integrated motion sensors that reduce lighting 50% when the area is unoccupied. If the pilot test is successful, additional roadway and parking lot lights will be replaced in coming years.

Lighting in most areas the Laboratory is controlled with occupancy sensors and/or managed by PPPL's central Building Automation System (BAS) to minimize unnecessary electrical use. PPPL will continue to evaluate and implement additional lighting controls in conjunction with HSPB and building condition assessments. All desktop and laptop IT equipment purchased are EPEAT certified, and ENERGYSTAR[®] products are the default for the purchase of new electrical appliances and equipment.

Planned Actions:

PPPL will continue to identify and implement energy efficiency projects that are lifecycle cost effective in order to continue to reduce the energy intensity of its operations. PPPL selects projects primarily by evaluating life-cycle costs (less than or equal to 5-year simple payback is the initial goal). Tab 3.5 of the Consolidated Energy Data Report (CEDR) spreadsheet lists projects that, if funded and implemented, have the potential to reduce energy intensity by as much as 60% by the end of FY 2015. Planned facilities, along with estimates of their future energy consumption, are listed in the "New Construction" tab of the CEDR. All new buildings and major renovations will be USGBC LEED[®] Gold certified and will be designed to be low-energy consumption with an ENERGYSTAR[®] target rating of 90 or above.

PPPL has identified the following activities to further reduce energy intensity in FY2012. Additional projects are identified in the CEDR submittal, pending the availability of funding.

- Properly insulate approximately 1250 linear feet of cold and hot pipes, replacing old 1-inch fiberglass insulation with 2-inch earthwool insulation.
- Replace approximately 1800 linear feet of 12-inch concrete chilled water pipe with fiber reinforced plastic pipe.
- Solid state LED lighting is standard practice in office and hallway renovation projects. This technology is planned for implementation in several hallway, office and common area renovation projects and is projected to reduce these lighting loads in these areas by over 50%.

In addition to the projects noted above, PPPL's Facilities Division has adopted important ongoing sustainability efforts as part of its ongoing maintenance and renovation activities. These efforts include office, shop and lab renovations that incorporate energy efficient lighting and the extensive use of sustainable building products.

PPPL currently has five buildings excluded from the energy intensity goal. These buildings represent 223,000 gross square feet of building space, or 37%, of PPPL's overall building footprint, and they house critical experimental devices and support systems. The LEC Building (D-##) was inadvertently dropped from the excluded building list in FY2011; it will be included in the FY2012 and future listings as was the case prior to FY2011. PPPL has submitted the required waiver from the energy intensity reduction goals for these experimental facilities, but continues to develop and evaluate energy efficiency improvements that can be implemented in these areas. These projects will continue to be considered for implementation under our GPP and OPEX programs. PPPL's CEDR submittal identifies numerous potential energy efficiency projects for experimental systems that do not currently have funding available. Past projects in these areas that were completed with budgeted operating funds include lighting replacement in the former TFTR Test Cell, steam and condensate pipe replacement, and ongoing HVAC equipment optimization efforts. In addition, changes in the operation of certain experimental power and support systems have increased the overall efficiency of PPPL's experimental systems.

PPPL is currently designing and fabricating an upgrade to its major experimental device, the National Spherical Torus Experiment (NSTX), which is expected to be completed in FY2015. While this upgrade adds significant additional plasma heating capability in the form of an additional neutral beam line and adds other capability enhancements, the overall electrical power consumption for NSTX is expected to be flat. This is due to a longer duration between experimental pulses under the new operating regime compared to current operations.

2.2.1 Training & Awareness

PPPL Facilities, Engineering, and Environmental staff works together as an integrated functional team of engineers and technicians dedicated toward energy and water management and sustainable site operations. PPPL's Facilities and Site Services Division has staff dedicated to monitoring and operations of the BAS, central steam and chilled water plant, HVAC systems, and water systems. Boiler operators are Blue Seal[®] Certified. One technician is dedicated full time to the management, monitoring, programming, enhancement, and maintenance of the BAS. He is trained by the system manufacturer and interacts monthly with the manufacturer representative on system configuration and improvement issues.

PPPL's Energy Manager is a Certified Energy Manager. She interacts regularly with Engineering and Facilities staff on energy management and efficiency issues. General awareness training on energy conservation, environmental protection, and recycling are incorporated into the General Employee Training (GET) program. In addition, progress in meeting sustainability goals and highlights of our sustainability programs are communicated regularly to employees through the "Sustainable PPPL" column in our ESH&S Newsletter, bulletin boards around the Laboratory, and targeted staff briefings. Key members of the facilities and environmental staff participate in government and industry educational seminars, such as GovEnergy, Labs21, GreenGov, Greenbuild, and industry workshops to enhance their professional knowledge and remain current on new technologies and best practices.

Consistent with the DOE initiative to institutionalize behavior changes that will drive GHG reductions and improved energy performance, PPPL continues to regularly disseminate information about its sustainability programs and environmental performance to employees and will expand these efforts under its ISO-registered EMS. Employee awareness training on energy conservation, environmental protection, and recycling are incorporated into the General Employee Training (GET) program. Progress in meeting sustainability goals and highlights of our sustainability programs are communicated regularly to employees through the "Sustainable PPPL" column in our ESH&S Newsletter, bulletin boards around the Laboratory, and targeted staff briefings.

2.3 Energy Metering

PPPL will continue to install energy meters, either advanced or standard, to the maximum extent practicable in buildings and other facilities for electricity, natural gas, steam, and water as outlined below. To the maximum extent practicable, PPPL will continue to connect energy and water meters to its site-wide building BAS. Installation targets are:

- advanced metering for electricity (by October 2012),
- steam and natural gas (by October 2016), and
- Standard meters for water.

Performance Status:

Advanced Electric Metering: PPPL's Advanced Electrical Metering Plan has been submitted annually since FY2007, as required by EPACT05. In FY 2011 two advanced electric meters were installed at PPPL main computer center area (PPLCC). PPPL currently has nine advanced electrical meters, including meters for the main site-wide electrical service. Building- and system-level metering represents over 50% of site-wide electrical consumption.

Steam & Natural Gas Metering: Natural gas meters have been installed in all buildings using natural gas as the primary heating source of energy: Module #6, Site Protection Building, and CAS/RESA Building. A new HVAC unit with natural gas supply for the Princeton University High Energy Physics tenant has a separate natural gas meter. Steam metering exists on the Lyman Spitzer building (LSB) and is connected to the PPPL Building Automation System (BAS) for remote reading of the meters and recording ENERGYSTAR[®] data. The new LSB front entrance snow melt system has a separate steam meter so the system will not count as building heat energy against the ENERGYSTAR[®] rating of the LSB. One advanced steam meter

was installed in Engineering Wing during FY2011. Additional steam meters were installed in the Warehouse and Facilities buildings and on the steam supply to D-Site. Finally, each boiler in the central steam plant is now equipped with individual gas and steam meters. These meters are connected to the BAS to allow for performance monitoring through data collection and trending.

Planned Actions:

PPPL's advanced electric metering program will be completed by the end of FY2012 as outlined in the latest Advanced Electric Metering Plan, submitted in August 2011. The Advanced Electric Metering Plan will be updated in August 2012.

Where additional energy metering is required for High Performance Sustainable Buildings (HPSB) rating, PPPL will utilize the ENERGYSTAR[®] Portfolio Manager rating system to track energy usage in targeted buildings. As part of the HPSB evaluation and rating program, PPPL will:

- Continue to install advanced electrical metering as outlined in the Advanced Electric Metering Plan,
- Continue installing standard meters for steam and natural gas and utilizing the BAS for data collection and trending whenever feasible,
- Continue installing standard meters for water consumption and utilizing the BAS for data collection and trending whenever feasible,
- Calculate and monitor the PUE for the PPLCC using data from the advanced electric meters to document planned energy efficiency improvements, and
- Evaluate an ENERGYSTAR[®] rating for buildings that are independently metered.

2.4 Cool Roofs

PPPL has one cool roof installed and is studying the suitability of cool roofs in this geographic region. The solar reflectance (SR) and thermal emittance (TE) of several existing roofs are being evaluated. In addition, vegetative roofs are under consideration if existing programmatic funding allows, providing they are compatible with the existing structure and roofing warranties. PPPL will enhance overall building thermal performance by ensuring that all new roofs and roof replacements will have a thermal resistance of at least R-30, consistent with Secretary Chu's memorandum of June 1, 2010. Because PPPL is located near the boundary between USDA Climate Zones 4 and 5, highly reflective cool roofs are not always clearly cost effective over the lifecycle of the installation.

Performance Status:

PPPL installed its first cool roof in 2005 on the Admin building (Building C-13) totaling 20,000 square feet. This newly installed roof was an ENERGYSTAR[®] rated Carlisle Corp. EPDM "Sure Seal" reflective roof. In 2010, PPPL installed a 16,500 square foot R-30 rated roof on Building C-20, Engineering Wing however this was not considered a cool roof under DOE guidelines. One identified barrier is the limited availability of cool roofing materials that carry a 30 year warranty and meet the requirements of PPPL's engineering standard for roofing systems. PPPL will track all roof replacements and upgrades in the FIMS database and will report annually on cool roof replacements in the Site Sustainability Plan.

Planned Actions:

Engineering standards for roofs will be updated to require R-30 and applicable cool roof specifications for facility improvements and the terms and conditions for new construction. During FY12 the building C01 (LSB) and PPLCC will have roof replacements. The LSB will be divided into three projects. A 29,605 square foot white R-30 roof is to be installed on 81% of the building. The auditorium, which constitutes 7% of the building, will have a 2,418 square foot white R-30 roof. The remaining 12% of the LSB roof is to be fitted with a 2,174 square foot R-30 black roof and a 2,174 square foot R-30 white roof. This 12% section of the roof will be equipped with probes to gather data to compare the performance of white and black roofs in the region. The PPLCC will have a 5,959 square foot R-30 white roof. Some of the planned roofing upgrades will be coordinated with building energy efficiency research projects at PPPL which are being supported by the Greater Philadelphia Innovation Cluster for Energy Efficient Buildings (GPIC Hub). Further discussion of this research effort is provided in Section 2.22, "Site Innovation and Government-wide Support."

2.5 Renewable Electricity Consumption

Under EPCACT05 and EO13423, DOE facilities are required to have 7.5% of their electricity consumption from renewable energy sources by FY 2013 and are encouraged to have on-site renewable energy installations.

Performance Status:

PPPL and the DOE Princeton Site Office (PSO) have pursued renewable energy projects for several years, engaging the Federal Energy Management Program (FEMP) and the National Renewable Energy Laboratory (NREL) to conduct feasibility studies for a large-scale photovoltaic solar power installation. The latest NREL feasibility study was updated in October 2008 to address current New Jersey energy market conditions and on-site technical considerations.

In 2007 Constellation Energy visited PPPL as part of DOE Mid-Atlantic Super Energy Savings Performance Contract (ESPC) program to evaluate potential projects for inclusion in an ESPC at the site. Their Initial Proposal was received in December 2007. It identified five Energy Conservation Measures (ECMs) including a 1.16 MW solar photovoltaic project. After careful consideration of the ECMs and financial considerations, DOE and PPPL agreed that the proposed ESPC would require significant up-front investment and was not financially justifiable. PPPL has continued to pursue ECMs identified by the Laboratory prior to and during the ESPC process where they are cost effective as funding permits.

In 2009 and 2010 PPPL and DOE-PSO engaged the Defense Energy Support Center (DESC) and Federal Energy Management Program (FEMP) to pursue a potential on-site photovoltaic (PV) renewable electricity project through a long-term power purchase agreement (PPA). Tax credits, state rebates, solar renewable energy certificates (SRECs) and other economic incentives that contribute substantially to the financial success of PVs are not available to DOE and Princeton University, but could contribute to a third party-financed project. A Request for Proposal (RFP) for installation and operation of a 1.0 MW PV through a PPA was issued in early 2009. A final cost proposal for the project was received in early calendar year 2010. Evaluation of the final

cost proposal by DESC, DOE, and PPPL determined that a large-scale solar photovoltaic project was not financially viable due to several constraints including the property lease duration for the PPPL site, the financial risks associated with solar energy credits, and a 10-year statutory limit on PPAs. The unit price for electricity through the PPA would be more than three times what PPPL was paying in early 2010. DOE terminated the PPA process in March 2010 because it was not financially viable. PPPL's Comprehensive Energy Data Report (CEDR) submittal includes a 1.0MW or larger solar PV project proposal that would meet or exceed the statutory requirement for 7.5% renewable electrical energy, should funding for such projects become available.

Planned Actions:

PPPL has ongoing pilot tests of several options for solar-powered parking and pathway lighting. Installations of solar lighting at targeted on-site locations had to be delayed from FY2010 to FY2011 due to other facility infrastructure needs. While these installations represent a small percentage of PPPL's overall electrical use and have long return-on-investment (ROI) periods, they will contribute to the DOE goal of having some renewable power at every site. PPPL continues to identify and evaluate a portfolio of smaller scale on-site renewable energy projects, including solar lighting, solar water heating, and small-scale wind energy. PPPL will pilot test these technologies and incorporate them into ongoing energy efficiency efforts if they are cost effective as existing programmatic funding permits. PPPL is well positioned to implement such projects on an expedited basis if funding for such projects becomes available.

In September 2010 PPPL received CD-0 approval for a non-major construction project to enhance the science and technology support infrastructure at the Laboratory through construction of a new Science and Technology Center and the renovation of key core Laboratory facilities that date to the original construction of PPPL. The project will provide for the construction of a new, contemporary Science and Technology Center and the relocation of associated science and technology research from extremely outdated and inefficient 50 year-old facilities. Both the new building and the major renovation projects are targeted for LEED-GOLD[®] certification and will incorporate, to the maximum extent practicable and life-cycle cost effective, such sustainable building practices as on-site renewable energy, rainwater harvesting, daylighting, cool roofs and the integration of sustainable building products.

2.6 On-Site Power

As discussed in Section 2.1, PPPL has pursued on-site renewable power projects of approximately 1 MW in size through both ESPC and PPA processes. These projects were found not to be financially viable. While not successful in bringing on-site power generation to PPPL, they identified key institutional, policy and statutory barriers to implementation. PPPL will continue to pursue smaller scale renewable power systems where suitable. We will evaluate new alternative financing options, such as an Energy Savings Performance Contract-Power Purchase Agreement (ESPC-PPA) for financial viability under anticipated budget constraints. PPPL does not currently have plans for significant on-site power generation, such as a combined heat and power system. Instead, PPPL has chosen to invest in significant upgrades to improve the efficiency of its central steam plant.

2.7 Off-site Renewable Energy Purchases

PPPL's electrical power is supplied by GDF-Suez Energy and delivered via a 138 kV transmission line by Public Service Electric & Gas (PSE&G). Natural gas is purchased from Colonial Gas and delivered by PSE&G. PPPL purchases energy through a multi-facility contract administered by the Defense Logistics Agency (DLA). There are currently no plans to modify this contract to specify the purchase of renewable energy.

2.8 Renewable Energy Certificate (REC) Purchases

PPPL purchases Renewable Energy Certificates (RECs) to meet the 7.5% renewable electricity requirement. As reported in tab 3.4 of the CEDR spreadsheet, PPPL purchased a total of 1,368 megawatt-hours (MWh) of RECs in FY2010 and 1,042 MWh in FY2011. PPPL will continue to purchase a comparable number RECs as allowable to meet its renewable energy goals until a suitable on-site renewable energy project can be identified and/or renewable energy purchasing is incorporated into our multi-facility DLA power purchase contracts. A summary of projected renewable energy use and REC purchases is provided in Table 3, below.

Table 3 - Summary of Actual and Projected Renewable Energy Use and REC Purchases

	Actual FY11	Planned FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
Renewable Energy(MWHs) Plan	0.65	.75	.75	.75	.75	.75	.75	.75	.75	.75
Renewable Energy Credits (MWHs)* Plan	2084	2000	2010	2090	3000	3000	3000	3010	3010	3020
Actual/Planned/ Estimated Cost	\$930	\$900	\$950	\$1000	\$1400	\$1440	\$1475	\$1500	\$1550	\$1575
Unit Costs (\$/MWHs)	0.446	0.45	0.46	.47	.48	.49	.49	.50	.51	.52

2.9 Alternative Fleet Fuel Use

EOs 13423 and 13514 require agencies to increase alternative fuel use by 10% annually through FY 2015 against the FY2005 baseline. PPPL has already exceeded this goal by expanding the use of E85, B20 and CNG.

Alternative fleet fuel use in FY2011 was 22 times higher than FY2005. This represents 60% of PPPL's total covered fleet fuel use (see Figure 4, below). In FY2011 PPPL expanded the use of alternative fuels to include its ambulance and fire engine even though the emergency service vehicles are exempt from the fuel goals. In addition, a gasoline-only vehicle was replaced with a hybrid.

It should be noted that the General Services Administration (GSA) Federal Automotive Statistical Tool (FAST) system converts the 20% biobased portion of B20 fuel to B100 for reporting purposes and the remaining 80% petroleum fraction is reported as regular diesel fuel. PPPL's data reflect this reporting protocol.

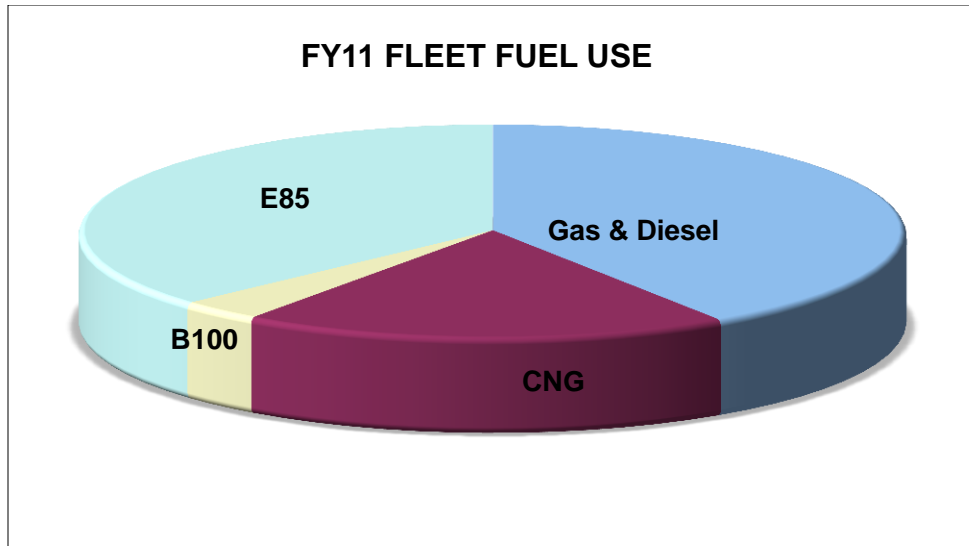


Figure 7 – FY2011 non-exempt fleet fuel use by type

2.10 Reduce Departmental Fleet Petroleum Use by 2 Percent Annual

EOs 13423 and 13514 require agencies to decrease fleet petroleum consumption by 2% annually and increase alternative fuel use by 10% annually through FY 2015 against the FY2005 baseline. PPPL has already exceeded the fleet management goals established for FY2015 of reducing fleet petroleum consumption by 2% compounded annually against the FY2005 baseline (see Figure 5, below).

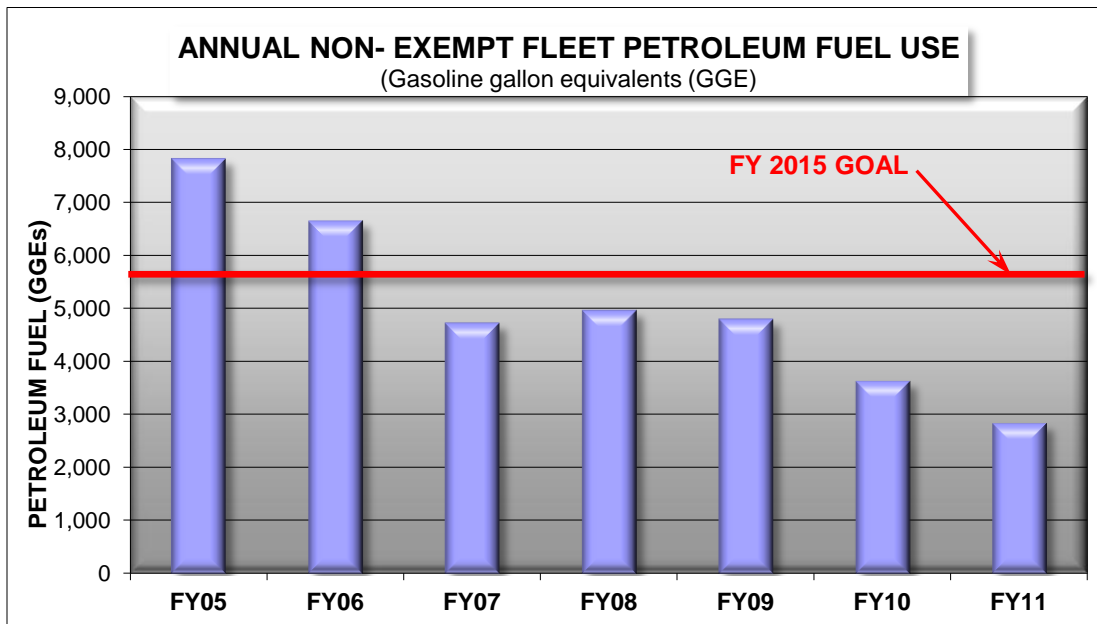


Figure 8 – Annual non-exempt fleet petroleum fuel use between FY2005 and FY2010

2.11 Alternative Fuel Vehicles (AFVs)

PPPL continues to exceed the goal for 75% acquisition of alternative fuel vehicle (AFV) for light duty vehicles by FY2015. PPPL specifies only AFVs as replacement lease vehicles through the GSA whenever a suitable AFV is available. Our present fleet, including exempt emergency vehicles, consists of 26 vehicles: one (1) DOE owned fire truck (B20) and (25) GSA leased vehicles. Of the 25 GSA leased vehicles we have two (2) electric hybrid, (18) vehicles using alternative fuels (E85, CNG or B20), and five (5) vehicles using petroleum products (gasoline or diesel). Thus, 80% of PPPL's fleet is made up of alternative fueled vehicles (AFVs). In addition to the use of alternative fuels in its covered fleet vehicles PPPL uses B20 in several pieces of heavy-mobile equipment, including a 15 ton forklift, backhoe, and skid steer loader. PPPL's fleet of John Deere Gator® vehicles run exclusively on B20. Following B20 pilot testing in FY2007 and 2008, PPPL expanded its on-site fleet refueling station to support the storage and dispensing of E85 and B20 fuels in addition to the existing CNG vehicle fueling system.

2.12 Fleet Reduction Initiative

PPPL has completed its FY2011 reduction of five vehicles by December 2011 as directed by DOE (vehicle reduction of 16%). In addition, PPPL will be returning five more vehicles in FY2012 and one vehicle in FY2013 to achieve vehicle reduction of 35% over a three year period. PPPL's three (3) CNG vehicles will be returned as part of the 35% vehicle reduction. PPPL will place the CNG fueling station in standby mode in FY2012. This will allow us to participate in the leasing of CNG vehicles in the future, if needed.

It should be noted that the fleet reduction initiative may result in an overall decrease in fleet fuel-efficiency as larger operations-critical vehicles are retained at the expense of smaller more efficient vehicles. In addition, several AFVs have been or are scheduled to be returned to GSA under this initiative. As a result, PPPL's percentage of petroleum fuel use may increase and alternative fuel use may decrease as a result of the fleet reduction initiative.

2.13 Scope 3 Greenhouse Gas Emissions Reductions

EO 13514 and DOE's SSPP commits the Department to reduce its Scope 3 GHG emissions by 13% from the FY2008 baseline by FY 2020. PPPL voluntarily reported the majority of its FY2008 Scope 3 GHG emissions in December 2009 as part of the Public Sector GHG Reporting Protocol beta testing program. Scope 3 emissions reported for FY2008 included business travel and off-site municipal solid waste (MSW) disposal. PPPL has expanded its Scope 3 reporting criteria and collected significant data on Scope 3 emissions for the FY2010 baseline. Not all data elements were available for past fiscal years. Our Scope 3 emissions for FY2010 include employee commuting, electricity transmission and distribution (T&D) losses, business travel, offsite wastewater treatment, and offsite waste disposal. These values were also calculated in 2011 using several methods. The CEDR provided methods for calculating all of the Scope 3 emissions and the data in this SSP is directly from the CEDR calculations.

Performance Status:

PPPL has established a comprehensive Scope 3 GHG emissions baseline for FY2008 that includes employee commuting, business travel, off-site solid waste disposal and off-site

wastewater treatment. In FY2010, scope 3 GHG emissions of 2,661.4 mtCO₂e represented 5.75% of PPPL’s total GHG emissions. In FY2011, Scope 3 GHG emissions of 2,345.9 mtCO₂e representing 7.3% of PPPL’s total GHG emissions, and a reduction of 7.7% reduction from the baseline year. The higher percentage is a result of significant reductions in other GHG categories. Tabular and graphical summaries of PPPL’s Scope 3 GHG emissions are provided in Table 3 and Figure 8, below.

Table 4 – Summary of Scope 3 GHG emissions for FY2008, 2010, and 2011

SCOPE 3 GHG CATEGORY	FY2008	FY2010	FY2011
Employee Commuting	992.8	945.5	817
Electricity T&D Losses	902.5	905.6	753.7
Business Travel	557.7	711.2	718.1
Off-site Solid Waste Disposal	57	66.0	52.4
Off-site Wastewater Treatment	3.6	3.8	4.7
TOTAL	2513.6	2,632.1	2345.9

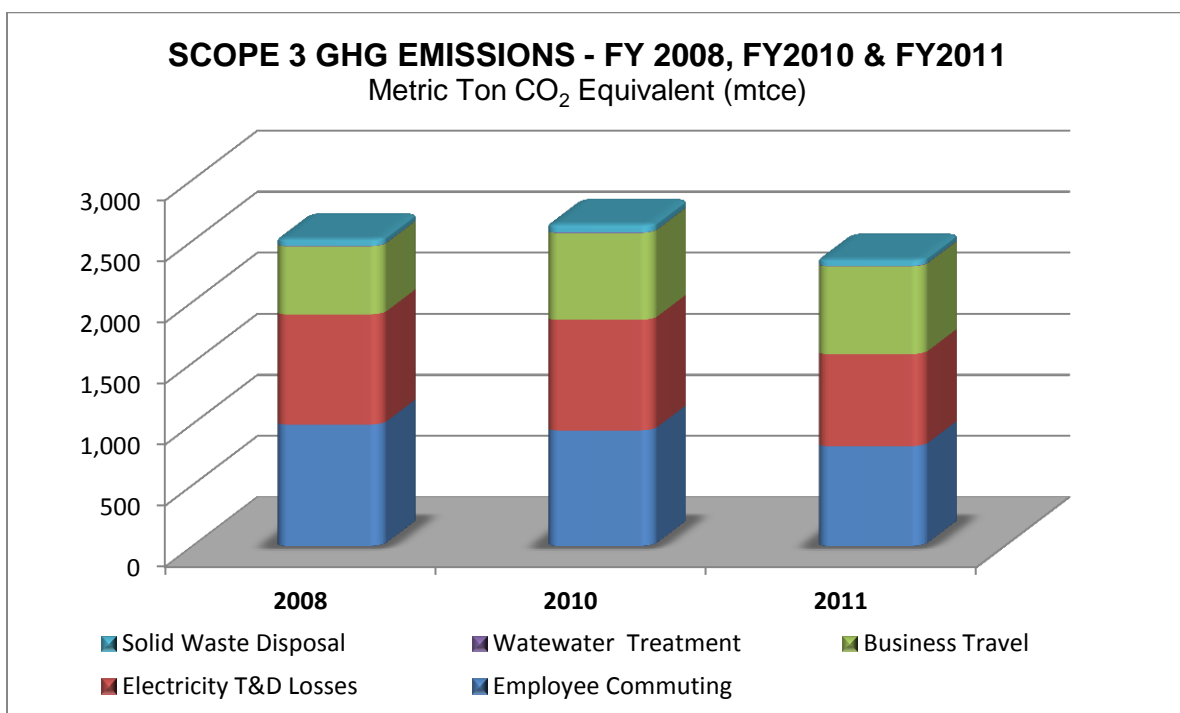


Figure 9 – Summary of Scope 3 GHG emissions by category for FY2008, 2010, and 2011

Employee Commuting: PPPL initiated an employee commuting survey in FY2008 as part of a voluntary GHG inventory. The survey was expanded FY2010 to identify commuting patterns and to calculate our GHG emissions attributable to commuting for LEED certification of the LSB. Over 95% of employees responded to the survey. The survey revealed that over 10% of employees utilize one of these programs or walk/bike to work. Princeton University recently established a Transportation Demand Management Office, providing employee incentive programs for vanpooling and mass transit use, and has two shuttles that link PPPL with main

campus and the regional transportation system. GHG emissions from employee commuting were 945.5 mtCO₂e, in FY2010. Calculated GHG emissions from employees commuting were reduced to 817 mtCO₂e in FY2011, representing a 13.7% reduction from 2010 and a 17.7% reduction from 2008.

Electricity Transmission & Distribution (T&D) Losses: Electricity T&D losses were calculated for the electrical energy used by PPPL as contained in the CEDR spreadsheet. T&D losses are directly related to electrical energy use and, thus, reductions in electricity use will result in associated reductions in T&D losses. GHG emissions associated with electricity T&D losses were 905.6 mtCO₂e in FY2010 and 753.7 mtCO₂e in FY2011. This represents a year-to-year reduction of 16.8% and 16.5% from the FY2008 baseline. It should be noted that the CEDR uses the e-grid value of 517.7 kg/MW-hr as compared to the actual emission factor of 399 kg/MW-hr which was obtained from the utility. It should be further noted that NSTX only ran briefly in FY2011 and will not run in FY2012-2014. The scheduled return to experimental operations in FY2015 will cause upward pressure on Scope 3 GHG emissions.

Business Travel: Travel records from FY2011 were used to calculate GHG emissions from air travel in the short, medium and long trip categories. In addition, rental car mileage and rail travel were included in the calculation of business travel GHG emissions. GHG emissions calculated for business travel in FY2011 were 718.1 mtCO₂e, up slightly from the 711.2 mtCO₂e recorded for FY2010. PPPL employees traveled over 3.6 million air miles in FY2011 in support of our international collaborative energy research, representing approximately 2.44% of PPPL's total GHG emissions for FY2011. It should be noted that increasing international collaborations in support of PPPL's fusion energy development mission, especially in support of the ITER project and an emphasis in the Office of Fusion Energy Sciences (OFES) to utilize foreign research facilities will put upward pressure on PPPL's Scope 3 GHG emissions. PPPL avoided additional business travel through the use of web-based video conferencing with the "Ready-Talk" system. In FY2011, we conducted over 250 video conferences to foreign locations in China, France, Japan, Korea, and the UK as well as domestic locations such as ORNL, General Atomics, MIT and University of Wisconsin.

Off-site Wastewater Treatment: PPPL discharges all sanitary wastewater to the South Brunswick Municipal Utilities Authority for appropriate off-site treatment. Wastewater flow is metered at the main discharge point from PPPL with an ultrasonic flow meter and PPPL is billed based on flow meter readings. In past years, PPPL has identified and redirected industrial and process water discharges, such as once-through cooling water, to the sanitary sewer that unnecessarily increased wastewater flow. As appropriate, these discharges were either eliminated or redirected to other discharge locations. Water conservation implemented in previous years will continue to limit the volume of wastewater requiring offsite treatment. GHG emissions for off-site wastewater treatment were 4.7 mtCO₂e, an increase over the FY2010 value of 3.8 mtCO₂e. This figure represents only 0.02% of PPPL's total GHG emissions for FY2011. It should be noted that values in Table 3 for previous years have been recalculated using the FY2011 formula to provide comparable data.

Off-site Municipal Solid Waste Disposal: PPPL subcontracts for municipal waste collection and disposal services as well as certain recycling services (paper/cardboard, glass, food waste,

concrete, etc.) through a competitive bidding process. The current subcontractor is Waste Management, Inc. Municipal solid waste is collected at PPPL and transported to a permitted solid waste landfill for disposal. PPPL has a mature and effective waste minimization and recycling program that limits the amount of landfilled waste. For many years, PPPL has recycled concrete, asphalt, wood, roofing ballast and other building materials. PPPL has worked with Princeton University to compost leaves and yard maintenance waste and has incorporated recycling requirements into appropriate subcontracts, such as landscaping, renovation and maintenance services. In FY 2011 PPPL recycled 58.2% of the municipal solid waste generated at the site. In FY2011 PPPL expanded the food/compostable waste composting program that collects food/compostable waste from the cafeteria to include several work-area collection sites. Organic waste composting and greater recycling contributed to a drop in GHG emissions associated with off-site solid waste disposal from 66 mtCO_{2e} in FY2010 to 52.4 mtCO_{2e} in FY2011. This value represents 0.18% of PPPL's total GHG emissions for FY2011.

Planned Actions:

Employee Commuting: PPPL will continue to promote the programs offered by Princeton University to encourage employees to use mass transit, car pools and van pools. PPPL's Sustainability Transformation Team is studying reduction of GHG emissions related to employee commuting in its charter; however it should be noted that significant policy changes may require University approval. It should also be noted that the sustained reduction of GHG emissions related to employee commuting may be difficult to meet in the face of growing or changing site missions that increases the number of Laboratory employees.

Business Travel: PPPL will continue efforts to control business travel by encouraging employees to utilize video, web, and teleconferencing services in lieu of travel. As noted above, in FY2011 PPPL conducted over 250 video conferences to foreign locations in China, France, Japan, Korea, and the UK as well as domestic locations such as ORNL, General Atomics, MIT and University of Wisconsin. Where feasible, train travel will be encouraged over short-haul airline travel. In some instances, current travel guidelines requiring use of the lowest airfare combination (e.g., connecting flights) actually result in higher GHG emissions than a more expensive direct flight. It should also be noted that the sustained reduction of GHG emissions related to employee business travel may be difficult to meet in the face of growing or changing site missions that increases the number and extent of international scientific collaborations, especially the ITER Project. With business travel representing approximately 30% of Scope 3 GHGs and limited other opportunities to reduce other Scope 3 emissions, increased international scientific collaborations may put upward pressure on PPPL's overall Scope 3 GHG emissions.

Electricity Transmission & Distribution (T&D) Losses: Electricity T&D losses are directly related to electrical energy use; thus, reductions in electricity use will result in associated reductions in T&D losses. PPPL will continue its energy efficiency efforts in order to reduce electrical energy use and will continue identify opportunities for the introduction of on-site renewable energy as ways of reducing GHG emissions associated with electricity use and associated T&D losses. We also recommend that calculations for T&D losses be performed using emissions factors from the utility provider when available as this will enable DOE to account for improvements in the electricity grid as they are implemented.

Off-site Wastewater Treatment: PPPL will evaluate additional water conservation projects to reduce waste water discharge. In past years, PPPL has installed low-flow fixtures throughout the facility and has identified and redirected industrial and process water discharges to the sanitary sewer that unnecessarily increased wastewater flow. As similar flows are identified, they will be eliminated or redirected to appropriate discharge locations. It should be noted that the sustained reduction of GHG emissions related to off-site wastewater treatment may be difficult to meet in the face of growing or changing site missions that increases the number of Laboratory employees. With off-site wastewater treatment accounting for only 0.02% of PPPL's overall GHG footprint, there are higher priority GHG reduction measures that will require more attention in the near term.

Off-site Municipal Solid Waste Disposal: PPPL will continue to emphasize its mature and effective waste minimization and recycling programs to reduce the amount of solid waste shipped offsite for disposal. The food/organic waste composting program was expanded to areas outside the cafeteria in FY2011 and further expansion is planned in FY2012. Our new cafeteria subcontractor emphasizes compostable food service items and our composting program is becoming more effective in reducing waste. Our waste hauler recently began participating in a single stream recycling program in our county which we are planning to implement at PPPL. This should simplify recycling and improve employee participation. PPPL will continue to identify and act on opportunities to reduce the volume of MSW waste shipped off-site for disposal, which will help reduce Scope 3 GHG emissions. With off-site waste disposal accounting for only 0.18% of PPPL's overall GHG footprint, higher priority GHG reduction measures will require more attention in the near term.

2.14 High Performance Sustainable Design – Existing Buildings

This section discusses the status and plans to achieve high performance sustainable building goals. EO13423 requires that at least 15 percent of enduring buildings are compliant with the Federal Guiding Principles for High Performance Sustainable Buildings. EO 13514 and the DOE SSPP revised the goal to be 15% of the number of buildings – not square footage – and that only a building greater than 5,000 square feet (sf) are subject to the goal. Additionally, EO 13514 and the SSPP require 15% by FY2015 while stipulating continued progress towards 100%.

Performance Status:

In April 2011, the LSB achieved LEED-EBOM[®] Gold certification under the U.S. Green Building Council's (USGBC) Leadership in Energy & Environmental Design LEED[®] rating system. This building is over 119,000 square feet and supports approximately 200 employees (45% of Laboratory employees). The LSB also includes the control room and data acquisition systems for PPPL's largest experimental device the National Spherical Torus Experiment (NSTX). The LSB is an ENERGYSTAR[®] labeled building with a rating of 80 out of 100, making it among the top 20% of comparable commercial buildings nationwide in terms of energy performance. In addition, a third-party retrocommissioning study was conducted on five targeted buildings and PPPL's central chilled water plant to provide an energy baseline and recommended actions to qualify selected buildings as HPSB under the Guiding Principles.

Planned Actions:

PPPL will prioritize HPSB infrastructure projects on those buildings identified with the greatest potential for meeting the Guiding Principles to meet the 15% HPSB goal, with a long-term objective of 100% HPSB buildings. It must be noted that meeting the goal of having 100% of PPPL buildings qualified as HPSBs under the Guiding Principles is not feasible in the near-term with current GPP and maintenance funding. ENERGYSTAR[®] Portfolio Manager will be used to document progress in meeting these goals. Renovations or other building improvements required to meet the Guiding Principles will be incorporated into PPPL's OPEX and GPP planning process for inclusion in out-year plans. It is anticipated that the current level of GPP and OPEX funding will not be sufficient for all the required improvements. As illustrated in the CEDR worksheet on tab 5.3 "HPSB-Existing Buildings," five buildings have been identified for evaluation and three are targeted for upgrades to meet the Guiding Principles by FY2015. Two buildings are identified in PPPL's SLI Project for major renovation and/or expansion. Building C-13, Administration Wing, has been targeted for expansion through the addition of second and third floors. Building C-22, the Lab Wing, is targeted for major renovation as part of the SLI Project. It should be noted that approval of the proposed SLI project without inclusion of the existing building renovations will endanger PPPL's ability to meet the 15% goal for high performance sustainable buildings and will be detrimental to PPPL's overall energy and GHG performance.

2.15 High Performance Sustainable Design – New Construction

Executive Order 13423 stipulates that all new buildings and major renovations with a value exceeding \$5 million must achieve the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED[®]) Gold certification. Any buildings below the \$5 million threshold will be required to meet the Guiding Principles for Federal Leadership in High-Performance and Sustainable Buildings (Guiding Principles) of HPSB design. In addition, per Section 109 of EPACT 2005, all new buildings in design shall be designed such that their energy consumption is 30% below applicable ASHRAE standards.

Performance Status:

PPPL does not currently have new facility construction projects that have progressed beyond the CD-0 stage.

Planned Actions:

In September 2010 PPPL received CD-0 approval for a non-major construction project to enhance the science and technology infrastructure at the Laboratory through construction of a new Science and Technology Center and the renovation of key core Laboratory facilities, some of which date to the original construction of PPPL. The project will provide for the construction of a new, contemporary Science and Technology Center and the relocation of associated science and technology research from extremely outdated and inefficient 50 year-old facilities. This capability is important to the future of the U.S. fusion research program as it also serves to provide the setting for much of the undergraduate, graduate and postdoctoral research that will create future scientific program leaders. PPPL has begun conceptual design studies for this building.

If fully funded, this project will provide the added benefit of reducing building inventory and deferred maintenance. Once vacated, the 50 year-old Laboratory Building will be completely rehabilitated and modernized as a contemporary Laboratory Support Services Building. The associated staff will be moved from three other deteriorating buildings (one of which is a modular facility) allowing for the demolition of these buildings and their removal from the PPPL inventory. The project will also include the rehabilitation and conversion of the 50 year-old unutilized C-Site MG Building into a Component Assembly Facility and the removal of two additional buildings from the existing property inventory. Both the new building and the major renovation projects are targeted for LEED® Gold certification and will incorporate, to the maximum extent practicable and life-cycle cost effective, such sustainable building practices as on-site renewable energy, rainwater harvesting, daylighting, cool roofs and the integration of sustainable building products.

It should be noted that partial funding of this project to only include construction of the new Science and Technology Center and not rehabilitation of key existing buildings would likely jeopardize PPPL's ability to continue to meet energy efficiency and GHG reduction goals because the Laboratory would increase its overall building footprint and would continue to be burdened with aging, underutilized, and energy inefficient buildings.

2.16 Potable Water Intensity

EO 13514 establishes the following goals for Federal agencies with respect to water conservation and efficiency:

- potable water, reducing water intensity by no less than 16% by FY 2015 relative to the established FY 2007 baseline, and
- 20% reduction of Industrial/Landscaping/Agriculture (ILA) water consumption is being sought by FY 2020 from a FY 2010 baseline.

Performance Status

It should be noted that PPPL operations require cross-connection between the potable and non-potable water systems. This cross-connection is necessary to ensure sufficient water for non-contact and fire protection purposes in the event that the D&R Canal Pump House is off-line. Thus, operational conditions may result in dramatic annual fluctuations in potable water use. Total water use is a more useful measure at PPPL.

PPPL made significant progress in water conservation prior to the FY07 baseline year. Our efforts began in 1996 and continue to progress to the present time. Five significant efforts have been implemented since 1996 to conserve potable and industrial (process) water with combined usage in FY1996 of over 124 million gallons to the FY2007 baseline value of 13.96 million gallons, a reduction of over 88%. The combined annual total of 14 to 16 million gallons of potable of process water represents a stable and necessary level of water use for the facility.

Proactive water conservation practices implemented prior to recent Executive and DOE Orders have reduced water consumption at PPPL and presents additional challenges in achieving the reduction goals. The FY 2007 potable water baseline is 5.45 million gallons.

New low flow faucets have been installed throughout all PPPL buildings with a setting of 0.125 gallons per minute flow rate. These faucets are providing annual reduction of over 620,000 gallons of potable water. In 2008, new flushometers were installed in all of the urinals and commodes in the LSB, providing significant reduction in flush volume. In this building alone, the reduction was over 200,000 gallons annually.

Planned Actions

Past success in reducing potable water consumption presents a challenge in identifying new conservation measures. One conservation measure that is being considered is the installation of lower volume flushometers, dual flush valves, and high-efficiency commodes at additional locations. The proposed SLI project for construction of a Science and Technology Building is scheduled for construction in FY2014 which will require significant water conservation efforts to maintain or reduce water use in accordance with the stated goals. Rain water collection and reuse in grey water systems, high-efficiency fixtures, and other water optimization technologies, will be included in the design considerations for this new building.

2.16.1 Water Metering

In conjunction with ongoing energy metering efforts and HPSB building evaluations, PPPL will continue to install standard building or process water meters for both potable and industrial water and will connect them to its site-wide building BAS to the maximum extent practical.

2.17 Industrial, Landscaping & Agricultural (ILA) Water Use

EO 13514 establishes the following goals for Federal agencies with respect to water conservation and efficiency:

- potable water, reducing water intensity by no less than 16% by FY 2015 relative to the established FY 2007 baseline, and
- 20% reduction of Industrial/Landscaping/Agriculture (ILA) water consumption is being sought by FY 2020 from a FY 2010 baseline.

As discussed above, PPPL operations require cross-connection between the potable and non-potable water systems. This cross-connection is necessary to ensure sufficient water for non-contact and fire protection purposes in the event that the D&R Canal Pump House is off-line. Thus, operational conditions may result in dramatic annual fluctuations in potable water use. Total water use is a more useful measure at PPPL.

Performance Status

PPPL made significant progress in water conservation prior to the FY07 baseline year. Our efforts began in 1996 and continue to progress to the present time. Five significant efforts have been implemented since 1996 to conserve potable and industrial (process) water with combined usage in FY1996 of over 124 million gallons to the FY2007 baseline value of 13.96 million gallons, a reduction of over 88%. In FY2011 PPPL used a total of 12.4 million gallons of water, a reduction of 11% from the FY2007 baseline. The combined annual total of 12 to 16 million gallons of potable of process water represents a stable and necessary level of water use for the facility.

Measures implemented to date include:

- Adjusting boiler plant steam pressure and improving condensate returns, resulting in 550,000 gallons per year,
- Replacement of a 15 year-old water-cooled air conditioning unit with an air-cooled direct expansion saving 5.5 million gallons per year,
- Replacement of two water-cooled air compressors with air cooled compressors saving 7.8 million gallons per year, and
- Improved cooling tower operations and equipment upgrades to reduced system blowdown saving approximately 3.8 million gallons per year.

During FY2011, the D&R Canal Pump House was out of service for a major infrastructure refurbishment project that included electrical service upgrades, water treatment system improvements, and replacement of sections of the main canal water line. This prevented use of our canal water system for industrial cooling, requiring use of potable water instead of canal water for non-contact cooling and fire protection. It should also be noted that NSTX ran for a limited time during FY2011 and will not run again until FY2015. Non-contact cooling water use is expected to increase again when NSTX-U begins experimental campaigns again.

Figure 9, below provides a summary of potable and ILA water use from 2000 to 2011. PPPL does not routinely irrigate lawns or landscaped areas. Canal water is used only temporarily for irrigation of new landscaping.

Planned Actions

PPPL's main cooling tower is inefficient when compared to today's technology. This cooling tower is nearly 30 years old and requires regular repairs to maintain operations. It represents a single point of failure in PPPL's cooling water systems. Replacement of the central cooling tower is one of the few remaining water conservation projects with significant water savings potential. PPPL's GPP program has identified a replacement high-efficiency cooling tower as a necessary site investment, but limited GPP funding has precluded initiation of the project in order to execute other critical infrastructure repairs or replacements.

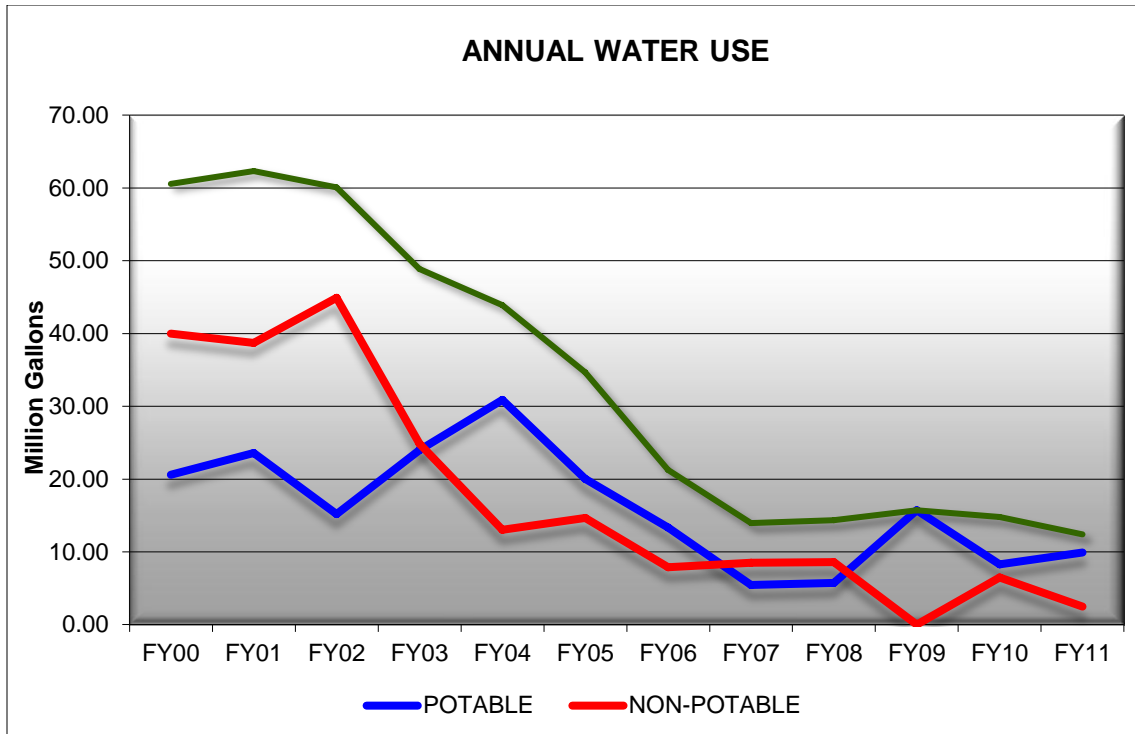


Figure 10 - PPPL annual water use from FY2000 to FY2011

2.17.1 Stormwater Management

EISA Section 438 stipulates that, “The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.”

The quantity of the site’s impervious surface is limited by a regional stormwater requirement of no more than 60 percent of the developmental area be impervious. PPPL is included in the Princeton Forrestal Center’s Stormwater Management Plan that was approved by the Delaware and Raritan Canal Commission (D&RCC), which has jurisdiction for stormwater impacts and the permitting of development along its corridor. Additionally, a Soil Erosion and Sediment Control Plan must be submitted and approved by the Freehold Soil Conservation District prior to soil disturbance of 5,000 square feet or greater for covered projects.

PPPL’s Beneficial Landscaping Plan documents its projects and progress toward a sustainable landscape. Included in these projects are improvements to the site’s stormwater swales with the removal of accumulated sediments and the planting of grasses and other vegetation to prevent soil erosion. Rain gardens and bioswales improve groundwater infiltration and reduce stormwater runoff. PPPL has installed rain gardens at three locations through the removal of compacted soils and replacement with topsoil and vegetation (grass, trees, and shrubs). In addition, several drainage swales have been restored with vegetation to enhance infiltration and reduce erosion. The overall effect of these efforts has been to reduce the quantity of stormwater runoff and improve its quality by reducing erosion. Additional beneficial landscaping projects

are planned for coming years. A tree-maintenance program has improved the overall health of PPPL's trees. Air-spading and mulching the soil around the roots, removing dead or dying limbs, and re-locating trees have been beneficial for these trees and prevented them from becoming diseased or lost entirely.

Planned Actions

PPPL will continue its efforts to remove sediment from stormwater swales, plant vegetation along roadways to reduce erosion, clean-out stormwater catch basins, improve compacted soils to enhance infiltration, and plant native wetland species and rain gardens.

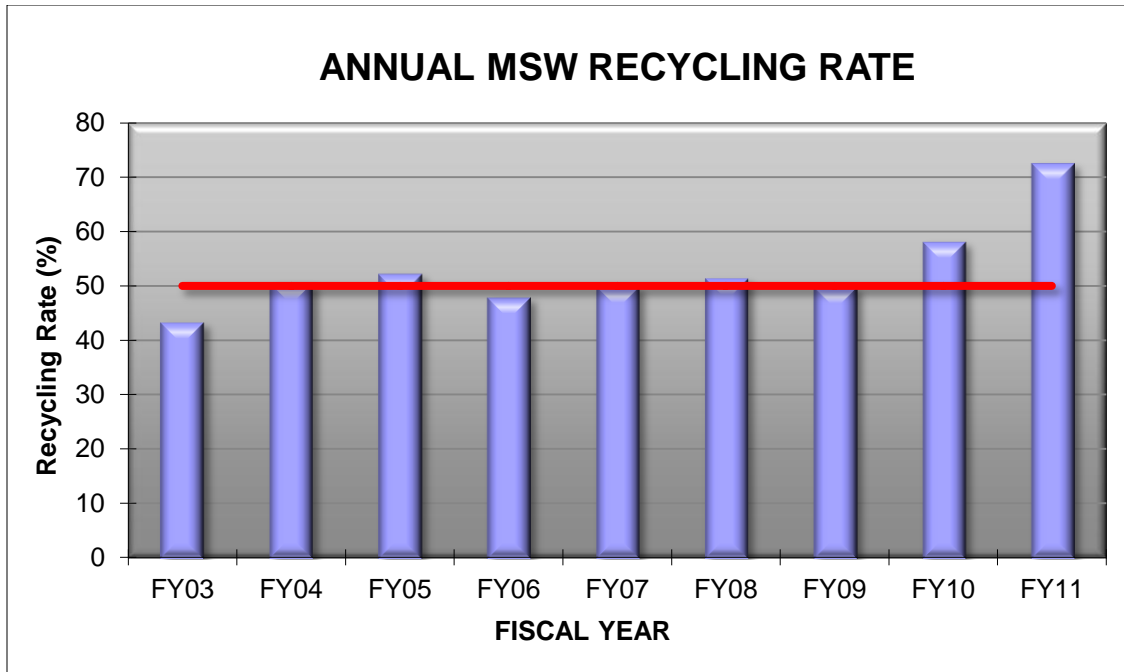
Design of a new Science and Technology Building will evaluate using either a green roof or a rainwater collection and reuse system. An evaluation of bio-swales or other methods to be retrofitted adjacent to roadways, sidewalks and other impermeable areas may be undertaken in order to facilitate infiltration and reduce runoff from these areas.

2.18 Recycling and Waste Diversion

This section discusses the pollution prevention (P2) programs and waste reduction efforts to meet the goals contained in EO13423, EO13514, and the DOE SSPP. These goals include the recycling of at least 50% of municipal solid waste (MSW) and non-hazardous, non-contaminated construction and demolition (C&D) materials and debris by FY2015 and to increase the diversion of compostable waste and organic material from the waste stream. In addition, PPPL strives to identify and implement sustainable pollution prevention best practices and to reduce use of toxic, hazardous, and GHG-emissions contributing chemicals that are acquired, used or disposed of through source reduction, the use of acceptable alternative chemicals and processes, and recycling.

Performance Status:

Solid waste data, including construction, composting, and recycling is reported annually I DOE's Pollution Prevention tracking and Reporting System (PPTRS). PPPL continues to exceed the FY2015 goal of a 50% recycling rate for both MSW and C&D waste by achieving recycling rates of 72.6% and 97% in these categories for FY2011 (see Figures 10 and 11, below). Over the past six years, PPPL has maintained average recycling rates for MSW and C&D waste streams of 55% and 89% respectively, exceeding the targets established in EO13514. The combined recycling rate for MSW and C&D waste streams was an impressive 95.4%.



**Figure 11 – Annual MSW recycling rate from FY2003 to FY2011.
Red line indicates the 50% Federal recycling goal.**

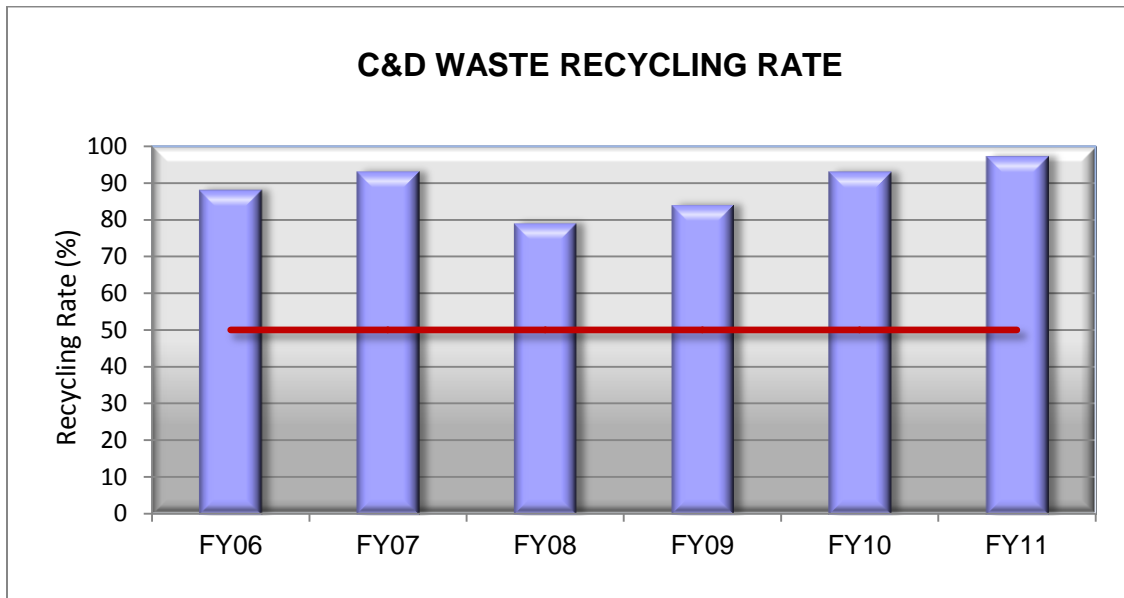


Figure 12 – Annual C&D recycling rate from FY2006 to FY2011.

Municipal solid waste is collected and PPPL and transported to a permitted solid waste landfill for disposal. PPPL has a mature and effective waste minimizations and recycling program that limits the amount of waste disposed in landfills. For many years, PPPL has recycled concrete, asphalt, wood, roofing ballast and other building materials. PPPL coordinates with Princeton University to compost leaves and yard maintenance waste for reuse in campus landscaping. PPPL has incorporated recycling requirements into appropriate subcontracts. In FY 2011 PPPL recycled 58.8% of the municipal solid waste generated at the site.

In FY2011 PPPL continued food/compostable waste composting program collecting compostable waste from the site cafeteria and satellite locations for off-site processing. Our new cafeteria vendor has embraced the composting program by supplying compostable food service items and establishing practices that minimize waste disposal. PPPL's first full fiscal year of composting yielded over 10.7 tons of recycled compost. Through lab wide "Zero Waste" events and the new "Zero Waste" cafeteria contract, PPPL hopes to increase compost while decrease waste to landfills.

PPPL will continue to maximize the recycling of C&D waste and should continue to meet or exceed the 50% goal. In addition, subcontracts for construction and facility renovation services will include provisions to maximize recycling. Recycling contracts are in place for many waste streams (i.e., electronics, scrap metal, wood, paper, plastic, glass, tin, cardboard, etc.) and all recycling data are reported in PPTRS.

Actions to improve the management of chemicals have been underway for years (e.g., inventory management, redistribution of excess chemicals, and improved lifecycle chemical use planning). PPPL continues to utilize bulk biobased cleaners in all restroom cleaning. The use of bulk supplies also reduces the MSW stream by minimizing packaging. PPPL also continues to explore non-toxic and non-hazardous alternatives such as the ACCU-Lube® machining cutting oil system and the use of non-toxic antifreeze in PPPL owned vehicles and mobile equipment. Specific improvements in the area of chemical management will be provided in the annual PPTRS data submittal.

In order to control the quantity of toxic/hazardous chemicals brought on-site, all chemicals and items which could have an adverse affect on safety, health or the environment, including those brought on site by subcontractors, are evaluated by Industrial Hygiene (IH) personnel of the Environment, Safety, Health and Security Department (ESH&S). Laboratory personnel requesting the purchase of such materials must complete a Chemical Requisition Review Sheet and provide this, along with a Material Safety Data Sheet (MSDS) for review by Industrial Hygiene (IH). IH also reviews proposed chemical purchases against a listing of environmentally sensitive chemicals. The MSDS must contain either a listing of hazardous components (by chemical name) or a statement to the effect that there are no hazardous components present. An MSDS, which contains neither or lists components as "trade secret" only, must also be reviewed by the Environmental Services Division (ESD) to determine if the material can be disposed of properly. ESD reviews all MSDSs forwarded to them by IH. Approval of the MSDS is communicated to IH for further processing of the chemical approval. Failure to obtain either an MSDS or the appropriate information for an MSDS results in delays or cancellation of a requisition. IH and/or ESD personnel recommend substitute products or processes for less hazardous substitute materials when appropriate.

PPPL has been proactive in searching for opportunities where product substitution is a viable alternative. For example, ethylene glycol was substituted with propylene glycol in all DOE-owned vehicles and machinery during a campaign in 2009. As a result, less hazardous waste has been generated. Also in 2009, de-icing rock salt was substituted by Magic Salt™. Magic Salt™ is less corrosive, biodegradable and environmentally friendly while still being a highly effective ice melting product.

The preferred method of disposing of hazardous and universal waste at PPPL is through recycling. One hundred percent (100%) of recyclable hazardous and universal wastes generated at PPPL are sent off site for recycling. This includes all mercury waste, lead-acid batteries, NiCad batteries, oils, capacitors (PCB and Non-PCB), and lighting ballasts. FY11 PPPL recycled over 60.01 metric tons of mineral oil, ballasts, bulbs and batteries.

PPPL's subcontracted pest management service has implemented integrated pest management (IPM) practices through its written IPM Plan. To the maximum extent practicable, chemical pesticides are minimized and animal-friendly capture and off-site release is used to remove unwanted animals. The interior application of pesticides is carefully controlled and minimized so as not to affect indoor air quality and to minimize potential employee exposure.

Document printing continues to be an essential element for conducting mission related research and publication, however, several improvements have been made and the culture is continuing to evolve to the use of more electronic media. PPPL purchases 30% postconsumer recycled content in for general use copy paper through the lab-wide office supply. PPPL encourages double sided printing when feasible and will work to expand the use of double-sided printing and copying as the default throughout the Laboratory. Through environmental education efforts, PPPL has decreased our paper purchases by 22.2% from FY2010 to FY2011, much of which can be contributed to duplex printing and the increasing use of wireless tablet computers.

PPPL was awarded Federal Electronic Challenge (FEC) Bronze Award for FY2011. Through our efficient End of Life Cycle electronics management, 100% of electronics waste was recycled in FY2011. PPPL uses UNICOR for reutilization and recycling of its scrap electronic equipment that is not redistributed, sold through GSA or donated.

Planned Actions:

PPPL will continue to expand its organic/food waste composting program in FY2012. In addition, opportunities to excess and/or recycle unneeded materials and equipment will continue to be identified and acted upon. PPPL will also continue its practice of carefully screening chemical purchases and will continue to identify and act upon opportunities to pilot test products that are less toxic, non-hazardous or biobased as substitutes for current chemical products. Finally, through its membership in the Federal Electronics Challenge, PPPL will expand its programs to encourage employees to use electronic document distribution and filing when appropriate and to set default printer /copier settings to duplex printing.

2.19 Sustainable Acquisition

DOE's and PPPL's goals in Sustainable Acquisition is to ensure that 95% of new contract actions, including task and delivery orders under new contracts and existing contracts, require the supply or use of products and services that are energy efficient (ENERGY STAR[®] or FEMP-designated), water efficient, biobased, environmentally preferable (including EPEAT-registered products), non-ozone depleting, contain recycled content, or are non-toxic or less toxic alternatives.

Performance Status:

PPPL's standard subcontract documents currently require the purchase of ENERGY STAR® and EPEAT products when applicable. PPPL's Environmentally Preferable Purchasing policy (P-082) encourages all employees to identify and specific suitable environmentally preferable products. Targeted contracts and/or purchase specifications contain standard requirements for ENERGY STAR®, WaterSense®, biobased, and recycled, or non-toxic products.

As applicable, vendors are required to report EPP purchasing data for inclusion in the Laboratory's PPTRS submittals. Examples include the paperless on-line office supply system that automatically directs users to recycled, remanufactured, and other "green" products, a standard specification for EPEAT-qualified electronics, and the exclusive use of recycled and biobased janitorial supplies. In addition, PPPL's Facilities Division has standardized its specifications to use an extensive array of energy efficient and sustainable building and maintenance products including solid-state LED and low-mercury lighting, R-30 roofing insulation, recycled content carpeting and ceiling tiles, and the use of ultra-low VOC paints and adhesives.

PPPL's Environmentally Preferable Purchasing policy (P-082) identifies a broad range of environmentally preferable products and outlines responsibilities to promote sustainable acquisition. It encourages all employees to identify and specific suitable environmentally preferable products in the course of their work. A new Sustainable Acquisition web page was developed to provide a convenient green product and services reference for employees. Existing Federal products guidance and listings are be linked to this page.

Planned Actions:

PPPL will continue reviewing its procurement process to identify suitable contracts for inclusion of the requirement for products and services that are energy efficient (ENERGY STAR® or FEMP-designated), water efficient, biobased, environmentally preferable (including EPEAT-registered products), non-ozone depleting, contain recycled content, or are non-toxic or less toxic alternatives. We will also continue to review and update applicable specification and purchasing guidelines to specify that applicable Federally-mandated designated products and services are included in relevant acquisitions and will identify opportunities to further strengthen implementation of the requirement for federally-mandated designated products in purchasing programs as appropriate.

2.20 Data Centers and Electronics Stewardship

Data Center Improvements: The main data center, known as the Plasma Physics Laboratory Computing Center (PPLCC), continued to be a major focus for energy conservation in FY2011. During the past few years, several information technology (IT) hardware improvements were implemented to reduce energy consumption and in some cases reduce the cooling demand of the IT equipment. A 4,800 watt SGI Altix system was replaced with a 600 watt blade system that runs data processing jobs 12 times faster. Network switch frames were replaced with stackable switches that consume far less energy. Windows servers were consolidated into a virtualized blade environment. PPPL is currently running 22 virtual machines with an estimated power

savings of 360 watts per machine or 7.92 kW. 21 UNIX servers were consolidated into 3 high availability servers, saving approximately 2 kW/hr of electricity. 200 dual single core servers were replaced in the research cluster with single dual core servers, saving approximately \$80,000 in energy use annually. PPPL's Facilities Division installed a hot aisle containment system in rows I and J of the data center to direct the exhaust air from these servers back to the air conditioning units and reduce hot/cold air mixing in the room. Additionally, diffusers were installed in the floor vents to lower the exit velocity of the cooled air so it would no longer bypass the equipment racks. The raised floor tile is being retrofitted to reduce leakage of air from beneath the tiles to the room. This retrofit is performed in stages to maintain the cooling system's functionality.

Implementation of the above actions enabled PPPL to raise the ambient temperature in the room from 67°F to 74°F while maintaining appropriate cooling for critical computer equipment. The combined actions provided significant immediate energy savings by reducing cooling load on the existing chillers. In July 2010, the average daytime high temperature was 92° F. An evaluation of chiller loads during these operating conditions revealed a significant reduction in cooling from the 65 tons noted for April 2010 to only 37.5 tons in July 2010. This represents a 42% reduction from the original cooling load for PPPL's main data center.

PPPL currently has approximately 900 desktop and laptop computer systems. Approximately 70% are Windows, 20% Macs and 10% Linux. PPPL has established the following goals to meet sound electronic stewardship and management of data centers.

- Reduce the energy consumed by computing resources through equipment upgrades, employee outreach/education, and the appropriate use of network power management solutions.
- Maintain environmentally-sound practices for disposition of all excess or surplus electronic materials.
- Continue efforts to reduce the energy consumption of the PPPL data center (PPLCC). The current progress is described in section 2.1.1 "Energy Intensity Reduction." In addition, a planned GPP roof replacement in FY2012 will further improve the energy performance of the PPLCC.

Performance Status

All workstations configured by the PPPL Information Technology Department (IT) are set to have the display turned off after 30 minutes. Because of the high level of non-Windows computers, traditional network power management solutions will have limited impact at PPPL.

PPPL employees are encouraged to utilize centrally located, network printers rather than individual desktop printers. Due to budget reductions in the User Support area, expansion of the thin-client initiative was put on hold. The thin client rollout will be re-visited for FY2012.

PPPL is a member of the Federal Electronics Challenge and has lab-wide policies to manage excess or surplus electronic products in an environmentally-responsible manner. Best practices to manage equipment that meets PPPL requirements and is still usable are:

- Redeployed within PPPL to other staff,
- Listed for reutilization/transfer to other DOE facilities in Federal Disposal System/Energy Asset Disposal System (FEDS/EADS),
- Listed for reutilization/donation to Used Energy-Related Equipment (ERLE) & Computers for Learning (CFL) programs in FEDS/EADS,
- Listed for reutilization/transfer to federal agencies in FEDS/EADS,
- Listed for reutilization/donation to state agencies in FEDS/EADS,
- Offered for sale by GSA sales, and
- Unsold items are boxed and shipped to UNICOR for recycling.

In FY2010, PPPL commissioned a study of the air conditioning and air-flows within the PPLCC. Based on the results of the study several changes were made: Two aging 15 ton computer air conditioning (CAC) units were replaced with 2 newer, more efficient units; all servers were arranged in 'hot row' configurations; the scientific computing cluster, which is a concentration of high performance servers, were enclosed to further enhance the hot air containment and restrict leakage to 'cold' aisles; an aging 10-ton unit was powered off as it is no longer required in the new configuration. The new configuration will result in estimated annual savings of \$237,000. PPPL has reduced the cooling load by 42% and electrical consumption in the PPLCC by tens of kWh in recent years. The newly installed advanced metering for this data center will allow us to monitor performance and quantify savings. The replacement of older CAC units with new high-efficiency units in FY2011 also eliminated another source of ozone-depleting CFC-based refrigerants

Planned Actions

Goal 1: Two paths have been considered to save energy via desktop management:

- 1) Activate power management features on the workstations such as "sleep mode." This could provide approximately 50% energy savings per computer with "sleep mode" set to activate after 60 minutes of inactivity. However, in a pilot project performed by ORNL they experienced only 30% energy savings.
- 2) Deploy Thin Client workstations in place of traditional "fat client" systems. Thin clients produce energy savings of approximately 66% per workstation over the traditional fat client. PPPL is in the process of initiating a Thin Client Pilot Program. PPPL will be piloting Sun Ray 2 thin clients with 3 Sun Ray Controllers and Beacen Thin Client Software. PPPL will be able to create virtual thin client machines for Windows XP, Windows 7 and UNIX. MAC clients will not be part of the initial pilot program. The pilot program will consist of 50 technicians from several areas within the laboratory and some of the IT staff. If the pilot is successful PPPL intends to roll out thin clients to most administrative areas of the lab. It is expected that PPPL will be able to replace approximately 60% of Windows desktops with thin clients.

Barriers:

Following is a summary of issues expected with deployment of the “sleep mode” on fat client desktop systems:

Acceptance: Probably the greatest challenge implementing any IT project that interacts with end users is obtaining acceptance for the change. While many business environments simply mandate system settings across their entire enterprise, due to the unique nature of a Laboratory environment, this approach is rarely well received. This would apply to either local power management or thin client deployment.

- a. The pilot project performed at ORNL indicates that many users required a menu of alternative “sleep” schedules, i.e. the workstation would not go to sleep until after a certain time. ORNL’s “Application Development” department customized an application (GreenIT Utility) to interface with a commercial system (Verdiem Surveyor) to manage sleep times and power management. PPPL does not have an “Application Development” IT group. Power management of PPPL’s existing desktops would incur additional costs for licensing of a 3rd party management software plus custom application development. Our network environment is different than ORNL due to differences in network architecture and the high percentage of non-Windows computers, so it is doubtful if that ORNL’s GreenIT Utility could be successfully “copied” at PPPL.
- b. ORNL was not able to use the “built-in” power management capabilities within Windows and Macs. Verdiem Surveyor only manages Windows, which is 70% of ORNL’s and PPPL’s environment. There are no pathways at this time to manage Mac or Linux desktop computers.

Hardware Concerns: PPPL has a wide range of hardware and age of user systems. Partly because of extensive internal reutilization of desktop IT assets, the variety keyboards, network cards, USB ports, drivers, and BIOS setups may not allow the system to wake properly either locally or when accessed remotely. These issues will create support difficulties and hinder user acceptance of network power management solutions.

Global Updates: PPPL manages system updates and backups for most of our Windows systems and many Macs. Utilization of network power management solutions requires the systems to be “woken up” and decrease the effectiveness of the energy savings. In addition, there are concerns with our existing network architecture being able to support the remote “wake up” a system for updates, keeping it awake during the updates, and putting it back to sleep.

Existing Configuration Agents: PPPL currently employ three (3) agents on most desktops which help manage network access, anti-virus and configuration (updates). These agents reside on the desktop and communicate with their server counterpart. This communication would inhibit the “sleep mode”. These agents are critical to the success of PPPL’s Cyber Security Program Plan and desktop management required by DOE. An alternative may be to put the agents to sleep also; however, that would need to be tested for unexpected consequences such as loss of networking or unpatched systems.

Goal 2: PPPL will continue to utilize environmentally-sound practices for disposition of all excess or surplus electronic materials. In addition, we will look for opportunities to share our

experiences and to mentor other organizations in the best practices for e-waste management as a member of the Federal Electronics Challenge.

Goal 3: PPPL will continue to make hardware improvements to server equipment as funds are allocated. Improvements will continue to fabricate systems to provide proper air flow to equipment which will further reduce heat loads and required cooling capacity.

2.21 Regional and Local Planning

This section describes PPPL's plans to meet the regional and local planning goals contained in EO 13514. Stormwater management practices related to the EO EISA requirements are discussed in Section 2.17.1

PPPL is located at the Princeton Forrestal Center (PFC); Princeton University's 2,200 acre planned mixed commercial, office, research and residential development. Princeton University's mission in planning and developing PFC was to protect and enhance the quality of life in the region as Central New Jersey experienced significant population growth and development. It did this by implementing a master plan that protected the land's natural systems, required high quality design, and anticipated the expanding mobility and infrastructure requirements of the region. PPPL's overall site development, including the amount of impermeable cover (paving, buildings, etc.), are controlled by the PFC Master Plan. As part of the PFC, PPPL is an integrated into the regional planning process. PPPL has invested recently in significant beneficial landscaping and exterior infrastructure projects to facilitate pedestrian traffic and enhance wildlife habitat at the site. Additional similar improvements are ongoing as operational funding allows.

Princeton University has a Transportation Demand Management Office, providing employee incentive programs for vanpooling and mass transit use, and has two shuttles that link PPPL with main campus and the regional transportation system. PPPL continues to participate in other transportation management programs coordinated by the Greater Mercer Transportation Management Association.

2.22 Site Innovation and Government-Wide Support

PPPL's primary mission is to conduct world-leading collaborative scientific research into plasma physics and to develop and demonstrate the practical application of fusion power as a sustainable global alternative energy source. This research mission enables the fundamental technology discoveries that advances DOE's energy, national security and sustainability mission. Development of magnetic fusion energy as a viable global energy source could dramatically change the course of fossil fuel use and global climate change by providing a globally available environmentally attractive carbon-neutral energy alternative.

PPPL is a key member of the new Energy Regional Innovation Cluster (E-RIC), an interagency program to accelerate energy innovation and commercialization. This \$129 million interagency center, also known as the Greater Philadelphia Innovation Cluster (GPIC) is located at the Philadelphia Naval Shipyard and includes representatives from 11 academic institutions, private corporations and government R&D institutions. It is focused on improving the energy efficiency of small commercial and multi-family residential buildings – especially in existing buildings. It

is one of only three national energy innovation clusters funded by DOE and it shares funding from the, Department of Commerce, National Institute of Standards and Technology, Small Business Administration, Department of Labor, Department of Education, and the National Science Foundation. The hub will bring together diverse public and private sector resources to address the problem of building energy efficiency in new collaborative ways to overcome institutional, technological, policy, market, educational and behavior barriers to the broad adoption of energy efficient technologies and practices by focusing on the critical and often neglected middle stages of innovation - demonstration and commercialization. PPPL's Science Education program is the lead organization of the education and workforce development component of the GPIC. In addition, PPPL is involved in the "Policies, Markets and Behaviors" component. Our involvement in the GPIC makes the PPPL site extremely well positioned to demonstrate innovated energy efficient technologies, policies, and behavior drivers and to serve as a key interface between GPIC and the Office of Science. PPPL will be collaborating with several other GPIC members and partners on building energy efficiency R&D projects at PPPL during FY2012

Over the years PPPL has demonstrated its commitment to sustainability through its environmental stewardship programs. PPPL is frequently consulted by DOE Laboratories and other organizations for advice and experience in sustainable environmental performance. PPPL has received frequent recognition by State and Federal entities. For example, in 2007 PPPL received a New Jersey Department of Environmental Protection and EPA WasteWise award for sustained excellence in recycling. In 2008 PPPL received the first Federal Energy and Water Management Award for Fleet Management for its extensive use of alternative fuels. In 2011 PPPL received a DOE Sustainability Award for its use of biobased products and a DOE Management Award for its fleet management program. PPPL also received a Bronze Award from the Federal Electronics Challenge. Finally, PPPL was one of 10 organizations to receive the Secretary's Achievement Award for its contributions to the DOE Fugitive Emissions Working Group (FEWG).

Recognizing that our staff members are our greatest asset, we strive to create a work environment where they are intellectually challenged, supported in their work, and valued for their contributions to our nationally important mission. As part of our annual Earth Day observation, PPPL recognizes employee efforts to support our sustainability goals with the PPPL "Green Machine" awards. These awards recognize to individuals and work groups that have adopted sustainable environmental practices in the course of their work at the Laboratory. All of these programs are easily transferable to other Federal institutions.

3. Climate Change Adaptation

As a relatively small facility located in Central New Jersey, climate change represents a fairly limited direct risk to the PPPL facility. DOE's recently completed high level vulnerability assessment indicated that DOE sites will be exposed to general regional and location-specific effects of climate change. While there is uncertainty as to the exact local character and timing of climate change effects at specific sites, DOE facilities in every major U.S. climate region will be affected. DOE's mission, site operations and programs have varying degrees of sensitivity, depending on location and type of work. National and global climate change implications relevant to the DOE mission must also be considered. Potential impacts at PPPL include:

- Operational and budget impacts due to magnified water and energy/electricity shortages and/or prolonged droughts,
- Damage to facility infrastructure or operational disruptions due to flooding or extreme weather events,
- Operational constraints due to increased temperatures, supply and energy disruptions,
- Workforce issues due to heat, health, quality of life, and cost of living
- Reduced operational efficiency, increased costs and other operational constraints, disruptions, and/or delays due to regional and international impacts, and
- New mission opportunities, both domestic and international to enhance U.S. climate change resilience and ensure U.S. energy and economic security

Research indicates that severe weather events are more likely as a result of global climate change. Potential direct impacts from such events may include more frequent strong storms. The existing site stormwater infrastructure may need improvement or reconfiguration to accommodate such storms. Waterways and wetlands adjacent to the site may be subject to more frequent and more severe flooding. Buildings and infrastructure near these features have been identified for potential relocation to other parts of the site. Capital projects to support such relocations were previously identified for other purposes. Increased hot and cold weather extremes will impact the site's energy use profile, potentially resulting in increased GHG emissions from the added heating and cooling loads.

The disruption of energy supplies, materials, subcontracted services, and the displacement of employees are potential indirect risks to Laboratory operations. Increased severe weather events may affect regional infrastructure, such as roads and bridges, even if the Laboratory is not directly impacted. Such disruptions could result in reduced Laboratory operations and a resulting impact to scientific progress. As local, regional and state climate change adaptation efforts develop, PPPL will monitor these programs and participate as appropriate.

4. Sustainability Transformation Team

PPPL's Sustainability Transformation Team is an ad hoc work group with representatives from the research, engineering, administrative, and support staffs. This team is led by the Deputy Head of EMS Program Manager and is charged with identifying and developing innovative ways to further reduce PPPL's GHG footprint, identifying innovative operational and research opportunities, and institutionalizing the behavioral changes necessary to make PPPL's operations more sustainable. PPPL's primary mission is to conduct world-leading collaborative scientific research into plasma physics and to develop and demonstrate the practical application of fusion power as a sustainable global alternative energy source. This research has led to many spinoff technologies that have application in industry, space technology and other fields and may have many other applications.

5. High Energy Mission Specific Facilities

PPPL's High Energy Mission Specific Facilities (HEMSF) consists of six buildings excluded from the energy intensity goal. These buildings represent 228,000 gross square feet of building space, or 38% of PPPL's overall building footprint, and they house critical experimental devices, including NSTX, and support systems. As noted in Section 2.2, the LEC Building (building D-34) was inadvertently dropped from the excluded building list in FY2011; it will be included in the FY2012 and future listings as was the case prior to FY2011. PPPL's magnetic confinement fusion energy research experiments are energy intensive devices, recreating deep space and stellar conditions in the terrestrial environment. This research is PPPL's primary mission and is dedicated to understanding plasma science and technology and developing a carbon-neutral sustainable global energy source for the future. Experimental support systems include critical climate controls (temperature and humidity), ventilation (safety-related), power storage/distribution (motor-generators), high-voltage power conditioning systems, neutral beam heating systems, as well as critical experimental magnet, cryogenic, and vacuum systems. In addition to extensive experimental operation and support systems, the HEMSF also includes mission-critical experimental data collection on control systems.

PPPL has submitted a waiver from the energy intensity reduction goals for these experimental facilities, but continues to develop and evaluate energy efficiency improvements that can be implemented in these areas. These projects will continue to be considered for implementation under our GPP and OPEX programs. PPPL's CEDR submittal identifies numerous potential energy efficiency projects for experimental systems that do not currently have funding available. Past projects in these areas that were completed with budgeted operating funds include lighting replacement in the former TFTR Test Cell, steam and condensate pipe replacement, and ongoing HVAC equipment optimization efforts. In addition, changes in the operation of certain experimental power and support systems have increased the overall efficiency of PPPL's experimental systems. Finally, if PPPL is selected as the site for testing the CS magnets for the ITER project, the 1970s-vintage 1040W liquid helium refrigeration system will be targeted for replacement. The new refrigeration system would be significantly more energy efficient and would enable more efficient experimental operations.

Experimental systems in these buildings and the supporting infrastructure are not separately metered for electricity, steam, chilled water, etc. The configuration of these systems will not enable separate experimental metering without cost-prohibitive system modifications.

PPPL is currently designing and fabricating an upgrade to its major experimental device, the National Spherical Torus Experiment (NSTX), which is expected to be completed in FY2015. While this upgrade adds significant additional plasma heating capability in the form of an additional neutral beam line and adds other capability enhancements, the overall electrical power consumption for NSTX is expected to be comparable to prior years. This is due to a longer duration between experimental pulses under the new operating regime compared to current operations. It should be noted that experimental electricity use in FY2011 was lower than normal due to only a brief period of experimental operations. Experimental electricity use during the period FY2012 through FY2014 is also expected to be lower than normal, but will rebound to approximately FY2010 levels when NSTX-U begins operations. It should also be noted that

experimental energy use is significantly affected by the level of funding provided for operations. Our projections are based on a typical annual experimental run period of approximately 16 weeks. If experimental operations are expanded or reduce or significant experimental missions are added, energy use will change accordingly. Table 5, below, provides a summary of actual and projected experimental electricity use for FY2011 through FY2020.

The two-year upgrade project period will be used to study and document non-experimental energy use at D-Site in order to identify and prioritize potential energy conservation measures for implementation at our HEMSF. In addition, ongoing and planned energy efficiency improvements associated with lighting, HVAC, and other support infrastructure will continue to be implemented where lifecycle cost effective and as funding permits. These projects will contribute to the Laboratory's overall energy efficiency profile and enhance the efficiency of experimental operations.

Table 5 – Actual and Projected HEMSF Electricity Use (MWh/yr), FY10-FY20

FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
18,245	16,744	16,430	16,450	16,450	18,255	18,255	18,250	18,245	18,240	18,240