

3. Environmental Program Information

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Lawrence Livermore National Laboratory (LLNL) is committed to enhancing its environmental stewardship and to reducing any impacts its operations may have on the environment. This chapter describes LLNL's Environmental Management System (EMS) and Pollution Prevention/Sustainability Program (P2S).

3.1 Environmental Management System

LLNL continues to enhance its EMS through systematic process improvements and increased focus on establishing specific environmental objectives and performance measures contained in Environmental Management Plans (EMPs). Progress toward goals is regularly measured and provided to senior management and other interested parties through a variety of means, including periodic senior management reports and the yearly update of this Environmental Report. The Laboratory's EMS has successfully maintained its International Organization for Standardization (ISO) 14001 registration since 2009 and is audited annually by a third-party internationally recognized ISO registrar for continued conformance and certification.

3.1.1 Environmental Management Plans

EMPs are designed and implemented to address the Laboratory's most significant environmental effects (aspects) and to achieve environmental objectives and performance measures that substantively reduce such effects. EMPs are updated annually to incorporate new initiatives and effectively demonstrate LLNL's commitment to continuous improvement. **Table 3-1** lists the eight EMPs for FY2016, along with the significant environmental aspects each addresses, the Lab-wide environmental objectives, and the related DOE sustainability goals. LLNL's status toward meeting each of the DOE sustainability goals listed in **Table 3-1**, along with planned actions to ensure continued progress toward attaining these goals can be found in the *LLNL FY16 Site Sustainability Plan* in **Appendix D**.

3. Environmental Program Information

Table 3-1. Environmental Management Plans (EMPs) and Related DOE Sustainability Goals.

Title	Significant Environmental Aspect(s) Addressed	EMP Objective(s)	Related DOE Sustainability Goal(s)
Sustainable Acquisition	<ul style="list-style-type: none"> • Nonhazardous Materials Use • Municipal Waste Generation 	Promote Lab-wide Site Sustainability Goal 6.1 and to support DOE in meeting its sustainable acquisition requirements by including necessary provisions and clauses to affect new purchases, such as ensuring a procurement preference for EPEAT-registered electronic products.	<p>6.1: Procurements meet sustainability requirements and include sustainable acquisition clause (95% of applicable contracts each year).</p> <p>9.1: Purchases – 95% of eligible acquisitions each year are EPEAT-registered products.</p> <p>9.3: Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled.</p>
Municipal Waste Reduction	<ul style="list-style-type: none"> • Municipal Waste Generation 	Divert at least 50% of non-hazardous solid waste; divert at least 50% of construction and demolition debris to meet Site Sustainability Goals 7.1 and 7.2 and increase recycling.	<p>7.1: Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris.</p> <p>7.2: Divert at least 50% of construction and demolition materials and debris.</p> <p>2.6a: Net Zero Buildings: 1% of the site’s existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY2025.</p> <p>9.4: End of Life – 100% of used electronics are reused or recycled using environmentally sound disposition options each year.</p>

3. Environmental Program Information

Table 3-1. (cont.) Environmental Management Plans (EMPs) and Related DOE Sustainability Goals.

Title	Significant Environmental Aspect(s) Addressed	EMP Objective(s)	Related DOE Sustainability Goal(s)
Greenhouse Gas Reduction	• Greenhouse Gas Emissions	Reduce Scope 1 & 2 GHG by 50% from the FY2008 baseline by FY2025 (Site Sustainability Goal 1.1).	1.2: 25% Scope 3 GHG reduction by FY2025 from an FY2008 baseline.
	• Fossil fuel consumption	Reduce Scope 3 GHG by 25% from the FY2008 baseline by (Site Sustainability Goal 1.2).	5.1: 30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY2025 from a FY2014 baseline. 5.2: 20% reduction in annual petroleum consumption by FY2020 relative to a FY2005 baseline; maintain 20% reduction thereafter. 5.3: 10% increase in annual alternative fuel consumption by FY2015 relative to a FY2005 baseline; maintain 10% increase thereafter. 5.4: 75% of light duty vehicles acquisitions must consist of alternative fuel vehicles (AFV). 5.5: 50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY2025.
Hazardous Materials Use and Hazardous Waste Generation	• Hazardous Materials Use Hazardous Waste Generation	Reduce the use and inventory of hazardous materials. Chemical reduction efforts should be closely coordinated with ChemTrack inventory efforts to provide greater efficiency. Minimize the generation of routine hazardous, mixed low-level, and/or low-level waste.	n/a
Ecological Resources Disturbances	• Ecological Resources Disturbances	Protect native species, preserve wetland areas, and prohibit the release of invasive species in support of DOE/NNSA's compliance and long-term natural resource stewardship responsibilities.	n/a

3. Environmental Program Information

Table 3-1. (cont.) Environmental Management Plans (EMPs) and Related DOE Sustainability Goals.

Title	Significant Environmental Aspect(s) Addressed	EMP Objective(s)	Related DOE Sustainability Goal(s)
Energy Conservation	<ul style="list-style-type: none"> • Electrical Energy Use • Greenhouse Gas Emissions • Fossil Fuel Consumption 	<p>Reduce energy intensity (BTU per gross square foot) as described in the Site Sustainability Plan in support of the Executive Order goal of reducing Federal Agency use by 25% by FY2025 from the FY2015 baseline (Site Sustainability Plan Goal 2.1).</p>	<p>2.1: 25% energy intensity (BTU per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY2025 from a FY2015 baseline.</p> <p>2.2: EISA Section 432 energy and water evaluations.</p> <p>2.3: Meter all individual buildings for electricity, natural gas, steam and water, where cost-effective and appropriate.</p> <p>2.4: 17% of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the Guiding Principles (GPs) of HPSB by FY2025, with progress to 100% thereafter.</p> <p>2.6a: Net Zero Buildings: 1% of the site’s existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY2025.</p> <p>3.1: “Clean Energy” requires that the percentage of an agency’s total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY2016-2017, working towards 25% by FY2025.</p> <p>3.2: “Renewable Electric Energy” requires that renewable electric energy account for not less than 10% of a total agency electric consumption in FY2016-2017, working towards 30% of total agency electric consumption by FY2025.</p> <p>9.2: Power management –100% of eligible PCs, laptops, and monitors have power management enabled.</p> <p>9.5: Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.</p>

3. Environmental Program Information

Table 3-1. (cont.) Environmental Management Plans (EMPs) and Related DOE Sustainability Goals.

Title	Significant Environmental Aspect(s) Addressed	EMP Objective(s)	Related DOE Sustainability Goal(s)
Water Conservation	<ul style="list-style-type: none"> • Water Use 	Reduce potable water intensity (Gal per gross square foot) as described in the Site Sustainability Plan in support of the Executive Order goal of reducing Federal Agency use by 36% by FY2025 from the FY2007 baseline (Site Sustainability Goal 4.1).	<p>4.1: 36% potable water intensity (gallons per gross square foot) reduction by FY2025 from an FY2007 baseline.</p> <p>4.2: 30% water consumption (gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY2025 from an FY2010 baseline.</p> <p>2.6a: Net Zero Buildings: 1% of the site’s existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY2025.</p>
Water Discharges	<ul style="list-style-type: none"> • Discharges to ground • Discharges to the storm drain system 	Minimize storm water quality impacts from outdoor metal and equipment storage. Reduce accidental releases of water onsite due to failed infrastructure.	n/a

3.1.2 EMS Audits and Reviews

The Laboratory successfully completed one external third-party independent audit of its ISO 14001 EMS program (May 2016) with recommendations from the auditor to re-certify LLNL's ISO 14001 registration. This independent audit was conducted by NSF International Strategic Registrations and validated the Laboratory's solid commitment to environmental stewardship.

3.1.2.2 Internal Assessments and Reviews

In October 2016, Senior Management Reviews of the EMS were conducted, reaffirming management commitment to the Lab's environmental policy and stewardship through the implementation of EMS. In March of 2016, an internal audit (Joint Functional Area Line Management Assessment [JFLMA]) was performed to assess if LLNL continues to meet the requirements of the standard. This audit uses a management assessment model to ensure objectivity and impartiality is maintained during the process.

In accordance with LLNL's EMS, the Laboratory's environmental compliance is regularly evaluated through reviews of internal assessments including Management Self Assessments (MSAs); Management Observations and Inspections (MOIs); regulatory inspections; internal and external monitoring and compliance reports; and facility walk-throughs and work-control assessments. As a result of these reviews, LLNL identifies specific practices and recommendations for corrective and preventive measures, demonstrating the Laboratory's commitment to environmental compliance.

3.2 Pollution Prevention/Sustainability Program

LLNL's P2S Program operates within the framework of the Integrated Safety Management System (ISMS) and EMS and in accordance with applicable laws, regulations, and DOE orders as required by contract. It encompasses stewardship and maintenance, waste stream analysis, reporting of waste generation and P2S accomplishments, and fostering of P2S awareness through presentations, articles, and events. The P2S Program supports institutional and directorate P2S activities via environmental teams and includes implementation and facilitation of source reduction and/or reclamation, recycling, and reuse programs for hazardous and nonhazardous waste; facilitation of sustainable acquisition; and preparation of P2S opportunity assessments.

The P2S Program at LLNL strives to systematically reduce all types of waste generated and eliminate or minimize pollutant releases to all environmental media from all aspects of the operations at the Livermore Site and Site 300. These efforts help protect public health and the environment by reducing or eliminating waste, improving resource usage, and reducing inventories and releases of hazardous chemicals. These efforts also benefit LLNL by reducing compliance costs and minimizing the potential for civil and criminal liabilities under environmental laws. In accordance with EPA guidelines and DOE policy, the P2S Program uses a hierarchical approach to waste reduction (i.e., source elimination or reduction, material substitution, reuse and recycling, and, lastly, treatment and disposal), which is applied to all types of waste. Waste generation is tracked using Radioactive and Hazardous Waste Management's

(RHWM) HazTrack database. By reviewing the information in this database, program managers and P2S Program staff can monitor and analyze waste streams to determine cost-effective improvements to LLNL operations. The P2S Program efforts primarily focus on opportunities to reduce routine waste from ongoing operations and non-routine waste from construction and demolition activities. Data on non-routine hazardous, transuranic, and radioactive waste can be found in the 2016 Annual Yearbook for the LLNL SW/SPEIS (Quinly 2017).

3.2.1 Routine Hazardous, Transuranic, and Radioactive Waste

Routine waste listed in **Tables 3-2** and **3-3** includes waste from ongoing operations produced by any type of production, analysis, and research and development taking place at LLNL.

Table 3-2. Routine hazardous waste at LLNL, FY2012–2016.

Waste category	FY2012	FY2013	FY2014	FY2015	FY2016
Routine hazardous waste generated Metric Tons (MT)	232	131	202	170	142

Table 3-3. Routine transuranic and radioactive waste at LLNL, FY2012–2016.

Waste category	FY2012	FY2013	FY2014	FY2015	FY2016
Routine LLW generated (m ³)	862	741	896	860	284
Routine mixed waste generated (m ³)	46	32	31	19	25.5
Routine TRU/mixed TRU waste generated (m ³)	4.8	7.5	9.5	0.9	0.7

3.2.2 Diverted Waste

LLNL maintains an active waste-diversion program, encouraging recycling and reuse of both routine and non-routine waste which prevents waste from going to the landfill. Site sustainability goals require separate accounting for construction/demolition and municipal solid wastes as reflected in **Tables 3-4** and **3-5**.

3.2.2.1 Municipal Solid Waste

Together, the Livermore Site and Site 300 generated 3,039 MT of routine nonhazardous solid waste in FY2016. This volume includes diverted waste (e.g., material diverted through recycling and reuse programs) and landfill waste.

Both sites combined diverted a total 2,263 MT of routine nonhazardous waste in FY2016, which represents a diversion rate of 74%. The portion of routine nonhazardous waste sent to landfill was 776 MT, see **Table 3-4**. In 2016, LLNL recycled 3,065 computers, monitors, and laptops, which were resold or managed as universal waste. LLNL recycled 26 MT of large and small batteries, which were also managed as universal waste and recycled.

3. Environmental Program Information

LLNL continued to expand recycling opportunities for plastics beyond the comingled recycling program. In 2016, 14 MT of plastics were recycled despite a declining plastics recycling market. The comingled recycling and composting program initiated in May 2011 was continued during 2016, diverting 43 MT of comingled recycling and 65 MT of compostable material from the landfill. To make separation easier for employees and decrease the amount of waste sent to landfill, the disposable foodservice products in the on-site cafeterias are compostable.

During 2016, a corporation yard clean out effort at Site 300 resulted in the recycling of nearly 1.2 million pounds of carbon steel and mixed metals.

3.2.2.2 Construction and Demolition (C&D) Waste

C&D wastes include excavated soils, wastes and metals from construction, decontamination and demolition activities. The Livermore Site and Site 300 generated a total of 3,839 MT of waste related to construction and demolition activities in FY2016. The two sites combined diverted 2,200 MT of non-routine nonhazardous solid waste through reuse or recycling, which represents a diversion rate of 57% in FY2016. Diverted C&D waste includes soil and concrete reused either on site for other projects or as cover at Class II landfills. See **Table 3-5**.

Table 3-4. Routine municipal waste in FY2016, Livermore Site and Site 300 combined.

Destination	Waste description	Amount in FY2016 (MT)
Diverted	Baled paper	59
	Corrugated cardboard	90
	Cooking grease (including grease traps)	25
	Mixed metals	1,144
	Scrap lead (Pb)	7
	Plastic	14
	Office paper	94
	Toner cartridges	13
	Greenwaste (chips, compost, mulch)	409
	Wood	300
	Comingled recycling	43
	Compost (food scraps, paper towels, food containers)	65
		TOTAL diverted
Landfill	Compacted (landfill)	776
		TOTAL landfill
TOTAL routine nonhazardous waste		3,039

Table 3-5. Construction and Demolition waste in FY2016, Livermore Site and Site 300 combined.

Destination	Waste description	Amount in FY2016 (MT)
Diverted	Class II cover soil (reused on-site or as landfill cover)	1,538
	Class II concrete (reused at the landfill for roads, pads, etc. or as cover)	650
	Scrap metals (recycled)	11.5
TOTAL diverted		2,200
Landfill	Construction and demolition (non-compacted landfill)	1,639
	TOTAL landfill	
TOTAL non-routine non-hazardous waste		3,839

3.2.3 Sustainable Acquisition

LLNL has a comprehensive Sustainable Acquisition program that includes preferential purchasing of recycled content and bio-based products. In 2016, the Sustainable Acquisition program continued to include a preference for Electronic Product Environmental Assessment Tool (EPEAT) registered computers and monitors, imaging equipment, and televisions. Ninety percent of all desktop electronics, imaging equipment, and television purchases in FY2016 were EPEAT Bronze, EPEAT Silver or EPEAT Gold, indicating that the products meet or exceed the Institute of Electrical and Electronics Engineers (IEEE) environmental performance standards for electronic products (1680.1-2009; 1680.2-2012; 1680.3-2012).

Additional sustainable acquisition highlights can be found in the *LLNL FY16 Site Sustainability Plan* in **Appendix D**.

3.2.4 Pollution Prevention/Sustainability Activities

3.2.4.1 Environmental Stewardship Accomplishments and Awards

Each year, the P2S Program submits nominations for the NNSA environmental awards and DOE Sustainability awards programs, which recognize exemplary performance in integrating environmental stewardship practices to reduce risk, protect natural resources, and enhance site operations. P2S also submits nominations for various other awards recognizing excellence in P2S projects.

LLNL submitted two award nominations to NNSA and DOE for work performed in FY2016. One nomination was submitted in the waste reduction and pollution prevention category for a newly installed three-dimensional printer system that uses significantly less resources and generates less waste than the previous electronics prototyping process. The other nomination was submitted in the renewable energy category for an onsite solar electrical generation system, which is expected to generate approximately 6,300 MWh annually and supply approximately 5% of the laboratory's electrical demand at peak power. NNSA and DOE will announce award winners later in 2017.

3. Environmental Program Information

LLNL was awarded a Federal Green Challenge Achievement Certificate in 2016 for increasing the amount of material recycled by 14.4% between 2014 and 2015. This improvement is equivalent to avoiding annual greenhouse gas emissions from 156 passenger cars. The Federal Green Challenge is sponsored annually by EPA to encourage organizations to set annual reduction goals of at least 5% in a variety of areas (such as waste, water use, sustainable purchases, transportation, etc.) and strive to meet those goals over the year. Reporting is in December for the prior year (and notification is almost 9 months later). LLNL has participated in the Federal Green Challenge since its inception in 2013.

3.2.4.2 High-Performance Sustainable Buildings and Energy Conservation

The Operations & Business (O&B) Principal Directorate manages the implementation of DOE Order 436.1 objectives related to sustainable building materials and practices.

Due to the unavailability of funding for the continuation of the High Performance Sustainable Building (HPSB) Assessments in FY2016, no new buildings were studied and assessed using the HPSB Assessment tool. While a list of potential buildings to be studied has been compiled, funding for these building assessments has not yet been identified for FY2016 and is not probable for FY2017.

One of LLNL's sustainability goals is to meter all individual buildings for electricity, natural gas, and water, where cost-effective and appropriate. LLNL has developed a metering plan that outlines the approach to repair meters and upgrade existing legacy metering. In FY2015, audits to collect vital information necessary to plan and schedule meter replacements and upgrades were conducted.

LLNL has implemented many on-going sustainability efforts to increase the energy efficiency of data center facilities including the installation of Cold Aisle Containment systems, increasing ambient temperatures and reducing occupancy lighting in several key data center facilities, server consolidation, and server virtualization (i.e., using software to divide one physical server into multiple isolated virtual environments). LLNL also continues to identify and decommission data centers that are no longer needed.

Additional information on energy conservation goals can be found in the *LLNL FY16 Site Sustainability Plan* in **Appendix D**.

3.2.5 Pollution Prevention/Sustainability Employee Training and Awareness Programs

The P2S Program conducted awareness activities during the year. Articles on pollution prevention were published in Newsline (LLNL's internal online newsletter) and the ES&H Newsletter; and the P2S Program continued to provide support for implementation of green events. The P2S Program continues to conduct training for purchasing staff on Sustainable Acquisition requirements, and a Green Hotline continues to provide support for employees with questions, suggestions, or ideas regarding LLNL's pollution prevention and waste diversion endeavors, as well as other environmental issues.

3. Environmental Program Information

The P2S Program also holds events each year to celebrate and bring awareness to Earth Day. In April 2016, nearly 100 employees attended an author talk and book giveaway of *Tri-Valley Trails*, a book providing highlights, tips, and maps of over 60 hikes in the Tri-Valley area.

In FY2016, LLNL and neighboring Sandia National Laboratory (SNL), celebrated the 2nd annual Bike to Work Day. Employees were encouraged to bike to work on May 14, 2016 and visit an energizer station during the morning commute. The P2S Program used this event as an opportunity to gather data on the number of bike commuters, commute distance, number of days per month each employee bike commuter rides to work, and the number of first time bike commuters. Statistics were also collected through the Green Hotline for those riders who could not visit the energizer station. The energizer station saw 95 visitors and 5 were first time bike commuters. When totaled, the people who visited the energizer station logged 11,261 miles of bike commuting every month.

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