

3. Environmental Program Information

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Lawrence Livermore National Laboratory (LLNL) is committed to enhancing its environmental stewardship and 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 Environment, Safety & Health (ES&H) Action Plans. 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. In Fiscal Year (FY) 2021, the Laboratory was successfully recertified for another three years to the ISO 14001:2018 standard.

3.1.1 ES&H Action Plans

ES&H Action Plans are established each year to detail the objectives and track progress toward meeting environmental goals focused on addressing identified risks and opportunities associated with significant environmental aspects. Each institutional ES&H Action Plan is championed by a senior manager who is responsible for developing objectives, assigning a process owner to successfully lead the project to meet objectives, providing adequate resources such as team members and data, holding the team accountable to goals and objectives, and presenting interim reviews to the senior management team. All ES&H Action Plans are reviewed and approved by the Laboratory Deputy Director. Organizations also have the option of implementing action plans targeted to their specific risks and opportunities. Senior managers championed seven ES&H Action Plans during FY2021. **Table 3-1** lists the four ES&H Action Plans that address environmental aspects along with progress made in FY2021 toward meeting the objectives (three other ES&H Action Plans address health & safety issues). The Action Plans in place also help to ensure that related U.S. Department of Energy (DOE) sustainability goals are addressed. LLNL's status toward meeting the DOE sustainability goals, along with planned actions (including ES&H Action Plans) to ensure continued progress toward attaining these goals can be found in the *LLNL FY2022 Site Sustainability Plan* in **Appendix C**.

Table 3-1. ES&H Action Plan Summary

Action Plan	Related DOE SSP Goal Category	Objectives	FY2021 Progress
AP-01 Meet all Site Sustainability Plan (SSP) Goals	All	In the annual SSP, goals are evaluated for high, medium, or low risk of non-attainment as follows: Low risk – high feasibility goal will be met. Medium risk – medium feasibility goal will be met. High risk – low feasibility goal will be met.	All SSP goals except energy and water intensity are attainable or trending positively in that direction.
AP-07 Operational Stewardship	Waste Management	Address safety and environmental risks associated with closed facilities and trailers and surrounding areas that may contain hazardous and/or radioactive materials and equipment, and other potential hazards.	Demolition of B175 and B280 reactor and dome were nearly completed by the end of FY2021; demolition and removal of several trailers were completed. Over 238,000 pounds of scrap metal were recycled from B175 alone.
AP-08 Management Commitment	All	Demonstrate management commitment to ES&H through various reports, communications, and activities.	Director introduced ES&H briefing; ES&H expanded processes to identify and address worker safety and environmental risks and opportunities; ES&H-related communications were distributed to employees through various media routes.
AP-10 Hazardous Waste Compliance	Waste Management	Inspect identified high-risk areas and satellite accumulation areas (SAA) on a routine basis, implement institutional SAA/waste accumulation areas (WAA) tracking software in select directorates, develop outreach tools to educate waste generators, and develop a communication strategy for ES&H and Radioactive and Hazardous Waste Management (RHWM) to provide timely feedback to Principal Directorates regarding hazardous waste compliance issues.	Progress continued on the development of the SAA/WAA tracking software; outreach tools were developed to educate hazardous waste generators; a standardized SAA/WAA inspection checklist was piloted.

3.1.2 EMS Audits and Reviews

The Laboratory successfully completed one external third-party independent audit of its ISO 14001 EMS program (May 2021) with recommendations from the auditor to continue LLNL’s ISO 14001:2015 registration through 2024. This independent audit was conducted by NSF International Strategic Registrations and validated the Laboratory’s solid commitment to environmental stewardship.

3.1.2.1 Internal Assessments and Reviews

In February-March 2021, an internal audit (Joint Functional Area Line Management Assessment [JFLMA]) was performed to assess if LLNL continued to meet the requirements of the standard.

This audit used a management assessment model to ensure objectivity and impartiality were 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 identified 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 United States Environmental Protection Agency (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. Radioactive and hazardous waste generation is tracked using RHW's HazTrack database (a system used to track all waste managed by RHW). By reviewing the information in this database, program managers and P2S Program staff can monitor and analyze waste streams managed by RHW 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 *2020 Annual Yearbook for the LLNL SW/SPEIS* (Quinly 2021).

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, FY2017–2021 (Metric Tons [MT])

Waste Category	FY2017	FY2018	FY2019	FY2020	FY2021
Routine hazardous waste generated	110	167	155	111	253

Table 3-3. Routine Transuranic and Radioactive Waste at LLNL, FY2017–2021 (m³)

Waste Category	FY2017	FY2018	FY2019	FY2020	FY2021
Routine LLW generated	318	526	369	297	736
Routine mixed LLW generated	14	38	40	28	67
Routine TRU/mixed TRU waste generated	3.2	17	22	5	1

Note: See the **Acronyms and Glossary** section for acronym definitions

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 3,185 MT of routine nonhazardous solid waste in FY2021. This volume includes diverted waste (e.g., material diverted through recycling and reuse programs) and landfill waste.

Both sites combined diverted a total 2,480 MT of routine nonhazardous waste in FY2021, which represents a diversion rate of 77%. The portion of routine nonhazardous waste sent to landfill was 705 MT, see **Table 3-4**. In 2021, LLNL recycled over 4,000 computers, monitors, and laptops, which were resold or managed as universal waste. LLNL recycled 24 MT of large and small batteries, which were also managed as universal waste. Cell phones and tablets that are no longer needed by LLNL are sold to a vendor who refurbishes the items for reuse.

The comingled recycling and composting program initiated in May 2011 was continued during 2021, diverting an estimated 50 MT of comingled recycling and 79 MT of compostable material from the landfill. Recycling opportunities for plastics continues to be very limited, but where possible, LLNL looks for alternatives to disposable plastic items and works with vendors to take back plastic items such as containers and drums that can be reused or recycled.

Table 3-4. Routine Municipal Waste in FY2021, Livermore Site and Site 300 Combined

Destination	Waste Description	Amount in FY2021 (MT)
Diverted	Baled paper	50
	Corrugated cardboard	77
	Cooking grease (including grease traps)	3.4
	Mixed metals	1,045.5
	Scrap lead (Pb)	6
	Plastic	0
	Office paper	32.6
	Toner cartridges	5
	Greenwaste (chips, compost, mulch, clean wood)	1,132
	Comingled recycling	50
	Compost (food scraps, paper towels, food containers)	79
	TOTAL diverted	2,480
Landfill	Compacted (landfill)	705
		TOTAL landfill
	TOTAL routine nonhazardous waste	3,185

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 695 MT of waste related to construction and demolition activities in FY2021. The two sites combined diverted 1,510 MT of non-routine nonhazardous solid waste through reuse or recycling, which represents a diversion rate of 88% in FY2021. The 88% diversion rate was determined from waste that was self-hauled by LLNL, which is tracked separately from waste hauled by subcontractors performing construction and demolition projects. Subcontractors are required to submit municipal waste management plans including the amount, type, and disposal or recycling location of all non-hazardous materials. LLNS continues to make improvements to better streamline reporting of C&D recycling efforts between LLNS' sustainability team, construction team, and construction subcontractors. The diversion rate for a significant demolition project (B175) completed in FY2021 was 40%. 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 3-5. Construction and Demolition Waste in FY2021, Livermore Site and Site 300 Combined

Destination	Waste Description	Amount in FY2021 (MT)
Diverted	Class II cover soil (reused on-site or as landfill cover)	991
	Class II concrete (reused at the landfill for roads, pads, etc. or as cover)	509
	Scrap metals (recycled)	10
TOTAL diverted		1,510
Landfill	Construction and demolition (non-compacted landfill)	200
	TOTAL landfill	
TOTAL non-routine non-hazardous waste		1,710

3.2.3 Sustainable Acquisition

LLNL has a comprehensive Sustainable Acquisition program that includes preferential purchasing of recycled content and bio-based products. In 2021, the Sustainable Acquisition program continued to include a preference for Electronic Product Environmental Assessment Tool (EPEAT) registered computers and monitors, imaging equipment, and televisions. Over 90% of all desktop electronics, imaging equipment, television, server, and cell phone purchases in FY2021 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 (1680.1-2018; 1680.2-2012; 1680.3-2012).

Additional sustainable acquisition highlights can be found in the *LLNL FY2022 Site Sustainability Plan* in **Appendix C**.

3.2.4 Pollution Prevention/Sustainability Activities

3.2.4.1 Sustainability Accomplishments

LLNL's P2S Program assists the site in meeting Site Sustainability Plan goals related to municipal waste reduction, acquisition, and electronic stewardship by conducting and responding to opportunity assessments; these include direct calls from program areas as well as Green Hotline inquiries. During FY2021 the P2S Program assisted with several sustainability projects including participating in workgroups to determine a recycling pathway for unneeded excess refrigerants, refine tracking of construction and demolition wastes, install additional electric vehicle charging infrastructure, and roll out the recycling and composting program to additional buildings.

3.2.4.2 High-Performance Sustainable Buildings and Energy Conservation

Four Leadership in Energy and Environmental Design (LEED) building certifications (B142, B264, B451, and B453) were completed in 2008–2011, one LEED Gold certification (B655) was completed in 2019, two buildings are CalGreen compliant, six initial building assessments using the DOE High Performance Sustainable Building (HPSB) assessment tool were completed in

2011–2012. In FY2020, one LEED Certified certification facility (B223) and one LEED Silver certification facility (B224) were constructed in the Applied Materials and Engineering (AME) complex. At the end of FY2021, two buildings (B642 and B643) were under review by the U.S. Green Building Council for LEED Gold certification. Nine additional buildings are planned that will meet the Guiding Principles and/or LEED certification in the next 2 years.

In FY2020 a Sustainable Design facilities standard was prepared to ensure that new construction and major renovations address the HPSB requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, implement the Guiding Principles for Sustainable Federal Buildings required in DOE Order 430.1C, *Real Property Asset Management*, and support DOE Order 436.1, *Departmental Sustainability*. This standard was significantly revised in FY2021 to incorporate new guidance from the Council of Environmental Quality on the Guiding Principles for Federal Sustainable Buildings (CEQ, December 2020).

Applying best practices continues to help reduce LLNL's energy intensity and greenhouse gas (GHG) emissions. These best practices include alerting facility managers of excessive use in their facilities, updating and adapting equipment operating schedules to meet the changing requirements of occupants, providing staff with the training and tools they need, and tracking energy use and comparing against expected performance. LLNL's Livermore Site and Site 300 each have a site-wide direct digital control (DDC) system that is used to control temperatures, pressures, and humidity in many buildings. The system is state-of-the-art and as of the end of 2021 had approximately 941 high-speed, connected digital processors in 61 buildings with several more installations planned.

There was continued significant progress on installing and replacing existing site-wide lighting fixtures with LEDs. For example, one light replacement project at B581 exchanged 260, 400-watt metal halide lamps for 164-watt LED lights. In this facility, the lights are on 24-hour hours a day seven days per week, which translates to a large potential energy savings. It is estimated that the new lights will save about 540 MWh per year. Additionally, the metal halide bulbs had a life expectancy of 18,000 hours while the LED lights have a life expectancy of 50,000 light hours.

LLNL has also 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 continues to identify and decommission data centers that are no longer needed.

Additional information on energy conservation goals can be found in the *LLNL FY2022 Site Sustainability Plan* in **Appendix C**.

3.2.5 Pollution Prevention/Sustainability Employee Training and Awareness Programs

Although the P2S Program conducted awareness activities throughout the year, the COVID-19 pandemic caused many activities to be cancelled or converted to virtual platforms. P2S staff

participated in several DOE-wide forums. Additionally, P2S staff gave presentations about LLNL's sustainable acquisition efforts, the EMS program, and action plans to various groups at symposiums.

LLNL, Sandia National Laboratories (SNL/CA), and the Livermore Laboratory Employee Services Association (LLESA) (a non-profit employee services group that supports both sites) typically host a joint Bike to Work and Share Your Ride event each May. However, this event was not held in 2020 or 2021 due to COVID-19. In FY2022, LLESA plans to transition from hosting an on-site Bike to Work Day energizer station to hosting a Biking Challenge during the same month. This new format will allow employees to participate in the bike challenge regardless of their work situation as many employees will continue a work schedule that includes telecommuting. LLESA will continue to promote participation in the official Bike to Work Day event and encourage visits to other energizer stations in Livermore.

The P2S Program continued to conduct training for purchasing staff on Sustainable Acquisition requirements and support the Green Hotline to help employees with questions, suggestions, or ideas regarding LLNL's pollution prevention and waste diversion endeavors, as well as other environmental issues.