

Lawrence Livermore National Laboratory FY 2018 Site Sustainability Plan





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Lawrence Livermore National Laboratory

FY 2018 Site Sustainability Plan

December 7, 2017

Approved by:



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List of Acronyms

AC	air conditioner
AF	alternative fuel
AFV.....	alternative fuel vehicle
APP.....	Affirmative Procurement Program
ASC.....	Advanced Simulation and Computing Program
ASE	Alliance to Save Energy
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit
BTU.....	British thermal unit
CAC.....	Cold Aisle Containment
CBI.....	Capability-Based Infrastructure
CD	critical decision
CDD	cooling degree days
CEDR	Consolidated Energy Data Report
CEM	Certified Energy Manager
CO2.....	carbon dioxide
CRAC.....	computer room air conditioners
CVP.....	Central Valley Project
D&D Team.....	LLNL's Environmental Restoration Department Decontamination and Demolition Team
DC Pro	Data Center Energy Profiler
DDC	Direct Digital Control
DFB.....	distinguishable from background
DOE	U.S. Department of Energy
DOT	Department of Transportation
e-IWS.....	electronic Integration Worksheet System
E85	ethanol fuel
EACCS.....	East Alameda County Conservation Strategy
EDC.....	Enterprise Data Center
EFA.....	Environmental Functional Area
EISA	Energy Independence and Security Act
EMF.....	Emergency Management Facility
EMP.....	Environmental Management Plan
EMS.....	Environmental Management System
EO	Executive Order

EPA.....	U.S. Environmental Protection Agency
EPACT.....	Energy Policy Act
EPEAT.....	Electronic Product Environmental Assessment Tool
EPP.....	Environmental Affirmative Procurement Program
ES&H.....	Environment, Safety and Health
ESGF.....	Earth System Grid Federation
ESPC.....	Energy Savings Performance Contract
FEMP.....	Federal Energy Management Program
FIMS.....	Facility Information Management System
FIRP.....	Facility and Infrastructure Recapitalization Program
FMR.....	Functional Management Review
FY.....	fiscal year
GBCI.....	Green Building Certification Institute
GHG.....	greenhouse gas
GP.....	guiding principles
GPP.....	General Plant Projects
GSA.....	General Services Administration
GSF.....	gross square foot/feet
HEMSF.....	high energy mission specific facility
HDD.....	heating degree days
HPC.....	high performance computing
HPCIC.....	High Performance Computing Innovation Center
HPSB.....	high performance sustainable building
HVAC.....	heating, ventilation and air conditioning
ICPT.....	Integrated Contractor Purchasing Team
IGA.....	Investment Grade Audit
IGPP.....	Institutional General Plant Projects
ILA.....	industrial, landscaping and agricultural
IPCC.....	Intergovernmental Panel on Climate Change
ISMS.....	Integrated Safety Management System
ISO.....	International Organization for Standardization
IT.....	information technology
kgals.....	one thousand gallons
kW.....	kilowatt
kWh.....	kilowatt-hour
LBNL.....	Lawrence Berkeley National Laboratory
lbs.....	pounds

LCW	low conductivity water
LEED	Leadership in Energy and Environmental Design
LFO.....	Livermore Field Office
LLNL.....	Lawrence Livermore National Laboratory
LLNS.....	Lawrence Livermore National Security, LLC
LOS.....	lighting occupancy sensor
LVOC	Livermore Valley Open Campus
MBtu	one million British thermal units
MPS.....	Managed Print Services Program
mtCO ₂ e.....	megatons of carbon dioxide equivalent
MUSD.....	Maintenance and Utility Services Department
MW	megawatt
MWh.....	megawatt hour
NEPA	National Environmental Policy Act
NIF.....	National Ignition Facility
NNSA	National Nuclear Security Administration
NPDES.....	National Pollutant Discharge Elimination System
OHSAS.....	Occupational Health and Safety Assessment Series
P2	pollution prevention
PC	personal computer
PCMDI.....	Program for Climate Model Diagnosis and Inter-comparison
PG&E.....	Pacific Gas & Electric
PPA.....	Power Purchase Agreement
PSEG	Public Service Enterprise Group
PUE.....	power utilization effectiveness
P-V	photovoltaic
R&D	research and development
REC.....	renewable energy credit
ROI	return on investment
SC13.....	Supercomputing 2013
SCM.....	LLNL Supply Chain Management Department
SF	square foot/feet
SF ₆	sulfur hexafluoride
Site 200.....	LLNL Main Livermore Site
Site 300.....	LLNL High-Explosives Experimental Test Site
SLAC.....	Stanford Linear Accelerator Center
SP2	Sustainability Performance Program

SSP Site Sustainability Plan
SSPP Strategic Sustainability Performance Plan (DOE)
SWEIS Site-Wide Environmental Impact Statement
SWPPP Storm Water Pollution Prevention Plans
T&D transmission and distribution
TYSP Twenty-Five Year Site Plan
UESC Utility Energy Service Contract
USGBC U.S. Green Building Council
WAPA Western Area Power Administration

1.0 Executive Summary

This document is presented as the Site Sustainability Plan (SSP) for Lawrence Livermore National Laboratory (LLNL), consistent with the guidance provided by the Department of Energy (DOE) received on September 8, 2017, as a deliverable for the DOE Order 436.1 *Departmental Sustainability* requirement.

1.01 Overview of Lawrence Livermore National Laboratory

LLNL is a DOE laboratory dedicated to enhancing the United States' security through the advancement of science and technology. LLNL's mission—to advance and apply science and technology for the benefit of the nation—specifically aims to ensure the safety, security, and reliability of the U.S. nuclear deterrent; reduce or counter threats to national and global security; enhance the energy and environmental security of the nation; and strengthen the nation's economic competitiveness.

LLNL's vision, to “push the frontiers of knowledge to build the scientific and technological foundation that will be needed to address the national security issues of the future,” aligns with the nation's vision for a sustainable future. LLNL has a long history of applying science and technological solutions to the toughest and most important problems affecting national and global security and is recognized for its excellence in business and operations, as well as for its responsible stewardship of the resources entrusted to us. LLNL has long engaged in the practice of sustainability, which is integral to the Laboratory's mission, and the mission is vital to the Nation's sustainable future.

LLNL is certified in environmental management (ISO 14001), occupational health and safety management (OHSMS 18001), and quality management (ISO 9001).

1.02 Site Management Vision

LLNL's vision for site sustainability is to supply its programs with optimal conditions for success, while undergoing continual improvement to existing energy infrastructure; to collaborate with growing mission areas to identify ways of innovating towards more energy- and water-efficient solutions for energy/water intensive facilities; to pursue innovative renewable energy generation, both for on-site use and as an ongoing research area; and to incorporate energy and water efficiency improvements into the ongoing energy management and facility operations of LLNL.

1.03 Major Planning Assumptions and Issues

LLNL is planning for growth in mission-based facilities in the upcoming decade.

In FY 2017, the LLNL Operations and Business Principal Directorate, the organization that has provided most of the funding for LLNL's sustainability projects, has continued to fund the preventative maintenance program for real property assets with indirect funding. An adequately funded preventative maintenance program is essential to keeping real property and programmatic equipment in efficient operating condition, which results in energy savings.

In spite of funding constraints, LLNL has made modest progress on the sustainability goals for the Laboratory compared to the previous year, including greenhouse gas reduction, energy intensity reduction, and renewable energy goals. LLNL understands the importance of continuing to make progress towards the government's sustainability goals, and hopes to resume funding important sustainability activities in FY 2018 and renew progress on greenhouse gas, energy and water goals.

1.04 Approaches to Site Management

The Laboratory strives to be a leader in responsible environmental stewardship and sustainability and incorporates sustainability and environmental management into the planning and performance of day-to-day operations and non-routine activities. LLNL's Environmental Management System (EMS) provides a framework for integrating environmental considerations into daily work processes, based on an international standard (ISO 14001), to guide efforts toward achieving this goal and continually improving environmental performance. EMS is comprised of four main elements: environmental policy, planning, implementation, and review and improvement. LLNL's EMS Environmental Management Plans (EMPs) detail the objectives, corresponding commitments, and tracking metrics for Sustainable Acquisition, Municipal Waste Reduction, Greenhouse Gas Reduction, Energy Conservation, Water Conservation, Fossil Fuel Consumption, Hazardous Materials Use/Hazardous Waste Generation, and Ecological Resources Disturbances.

LLNL is dedicated to developing "green" buildings. Four buildings are currently Leadership in Energy and Environmental Design (LEED) certified. An additional fourteen buildings have met the guiding principles for the federal High Performance Sustainable Buildings (HPSB) guidelines. Two new facilities (AML and PFD Fitness Center) started construction in 2017 and are scheduled to be LEED Gold; as new facilities are constructed, they will meet the HPSB or LEED Gold requirements.

The daily electrical and natural gas demand at Site 200 and Site 300 is significant. LLNL uses 60+ megawatts of electricity during peak times and 12,549 therms of natural gas each day. The average energy use intensity is 152 kBtu/ft², without the excluded areas. In FY 2012, LLNL prepared a Sustainability Investment Strategy document. In that document, it was stated more than \$100M would be needed to meet all of the government's sustainability goals. It would take significantly more investment dollars than that to allow LLNL to become a "net zero energy" site.

1.05 Funding Strategies

New and existing resources will be leveraged as much as possible in order to help achieve LLNL's sustainability goals. A new National Nuclear Security Administration (NNSA) program to recapitalize and rehabilitate infrastructure funded by NA-50, the Office of Safety, Infrastructure and Operations provided life-extension projects for enduring facilities and infrastructure such as boiler and chiller improvements, and heating, ventilation, and air conditioning systems. When practical, these projects will ensure that the most energy and water efficient equipment is utilized.

The Cooling and Heating Asset Management Program (CHAMP), an asset management program funded by NA-50 and managed by LLNS, will perform heating, ventilation, and air-conditioning projects throughout the National Security complex. CHAMP projects will provide NNSA sites with HVAC replacement projects which include energy and water savings features and implement equipment level energy monitoring to demonstrate savings and concepts. The FY17 B311 chiller replacement project was executed by CHAMP and funded through LLNS site indirect funding.

In FY 2017, indirect funds were used to perform a detailed design for a Water Treatment Plant at Site 200 and a Water Filtration Plant at Site 300. These two facilities were found to be necessary to be able to use Hetch Hetchy water at both sites. A return to using Hetch Hetchy water supply will enable water savings at the cooling towers.

1.06 Successes and Challenges

LLNL had a number of successes and challenges in FY 2017. Some highlights include:

- Achieved ISO 9001, ISO 14001, and OHSMS 18001 re-certifications.

- Continued operation of the pilot project to divert treated well water effluent from the Arroyo to use as make-up water at cooling tower B133, thus saving about 6.2 million gallons of potable water.
- Continued to lead a robust scientific and research program that advances renewable energy and climate change research, builds energy efficiency, and mitigates greenhouse gases (GHG)
- Completed construction of the infrastructure for charging electric vehicles (at B611) for 10 new government-owned electric vehicles. Continued a Personal Electric Vehicle (PEV) charging program to include an additional 11 charging locations (37 total), allowing more employees to drive and charge their personal electric vehicles while paying for electric consumption.
- Continued the Irrigation Reduction Plan to reduce turf site-wide in response to the historic California drought (Gov. Brown's water irrigation reduction executive order was lifted in April 2017).
- Completed pump electrical connections at B551E&W demo garden; well water will be used for irrigation, estimated to save about 1.4M gallons of potable water annually.
- The conceptual design for a wastewater treatment facility that would treat and recycle wastewater for make-up water at two cooling towers has been studied in the recently concluded UESC IGA report. A more detailed engineering and feasibility study at an estimated cost of \$100K is needed to continue to evaluate this option, estimated to save 60-80 million gallons of potable water annually.
- Projects totaling more than \$16 million were executed in FY 2017 to replace old HVAC systems with new energy-efficient equipment, cool roof replacements and lighting with more efficient LEDs.

1.07 Energy Challenges

LLNL continues to face three ongoing energy challenges. The first is that LLNL continues to grow in mission areas that are particularly energy-intensive, such as high-performance computing (HPC) and the National Ignition Facility (NIF). This demonstrates the success of the DOE and the Lab's efforts in science and technology development. However, these programs will impact LLNL's GHG emissions and potable water intensity.

The second issue is that, while the cost of electricity to LLNL is relatively inexpensive (~\$0.05 per kWh), many energy savings opportunities that have been identified through the Energy Savings Performance Contract (ESPC) or facility audits cannot demonstrate sufficient payback (of less than 20 years) to warrant the investment.

Third is the issue of aging facilities. Approximately 75% of LLNL buildings are over 30 years old. LLNL has consistently replaced and upgraded its basic real property with the most efficient and cost-effective equipment, however, older facilities are still less energy-efficient than new construction.

1.08 Goal Category Targets

Table 1-1 summarizes the goal category targets for each DOE Strategic Sustainability Performance Plan (SSPP) goal.

Table 1-1. Summary of Goal Category Targets

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
Energy Management Category				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline	In FY 2017, LLNL achieved an overall 40.6+% reduction from FY2008 baseline.	LLNL is on target to meet the 50% target with continued aggressive management of fugitive emissions from equipment using SF ₆ , purchase of RECs, and energy efficiency projects to reduce gas and electric consumption including an FY18 EMS action plan focused on reducing energy use in laboratories through a Smart Labs Initiative.	Medium
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline	In FY 2017, LLNL's Scope 3 emissions were 16.2% below the FY2008 baseline.	Scope 3 emissions are likely to increase due to electricity use and a larger workforce, but still remain on target to significantly exceed the 25% reduction goal. Scope 3 emissions reduction through materials use reduction will be pursued through an FY18 EMS action plan to develop a Smart Labs Initiative.	Low
2.1	25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY 2025 from a FY 2015 baseline.	LLNL achieved 4.28% energy intensity reduction in FY 2017 as normalized for weather.	Energy savings through proposed ECM projects will be actively pursued; however significant funding for energy savings projects is required to meet the goal. Energy savings specifically in laboratory buildings will be pursued through an FY18 EMS action plan to develop a Smart Labs Initiative.	High
2.2	EISA Section 432 energy and water evaluations.	LLNL has completed 25% of its EISA portfolio for the third round as of FYE 2017. Ten (10) facilities were subjected to Desk Audits in FY 2017.	Significant funding is required to execute the recommended energy conservation projects.	Medium
2.3	Meter all individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate.	90% of electricity achieved (some loss of meters has been experienced). 60% of natural gas achieved.	Funding for a Metering Services Project has been requested from management in order to arrest the declining state of advanced electric meters. Additional funding is required to upgrade natural gas meters to meet the FY 2018 goal requirements.	Medium

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
Water Management Category				
4.1	36% potable water intensity (Gal per gross square foot) reduction by FY 2025 from a FY 2007 baseline.	In FY 2017, LLNL was able to reduce its water intensity by 5.9% relative to the FY2007 baseline. This is primarily due to the unavoidable switch to Zone 7 water supply in mid-July of 2016.	LLNL will aggressively continue irrigation reduction plans with focus on water wise landscaping. Further implementation of reverse osmosis technology or another source of water to replace potable water use in cooling towers and irrigation will require additional funding to meet FY 2025 goals. Additional water savings will be pursued through an FY18 EMS action plan to develop a Smart Labs Initiative.	Medium
4.2	30% reduction in water consumption (Gal) of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target: 10%)	LLNL uses potable water for ILA (non-potable water is not used for ILA).	LLNL is investigating multiple strategies for reducing potable water used for ILA, including using reclaimed water and xerophytic landscaping.	N/A
Waste Management Category				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline.	Covered in Energy Management Category	Covered in Energy Management Category	
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline.	Covered in Energy Management Category	Covered in Energy Management Category	
7.1	Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris.	LLNL consistently meets or exceeds this goal. In FY 2017, LLNL diverted 76% of nonhazardous solid waste.	An FY18 EMS action plan is in place to develop a municipal waste reduction strategy.	Low
7.2	Divert at least 50% of construction and demolition materials and debris.	LLNL consistently meets or exceeds this goal. In FY 2017, LLNL diverted 77% of construction and demolition materials and debris.	Tracking of construction and demolition materials and debris continues for FY 2018.	Low
Fleet Management Category				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline.	Covered in Energy Management Category	Covered in Energy Management Category	
5.1	30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline. (2017 target: 4%)	In FY 2017, LLNL contributed towards NNSA/DOE achieving an overall 30% reduction in fleet-wide per-mile greenhouse gas emissions reduction. The final percentage contributed will be calculated in November, in the FAST.	LLNL will continue to contribute towards NNSA/DOE achieving an overall 30% reduction in fleet-wide per-mile greenhouse gas emissions reduction.	TBD, Insufficient information, unable to assess at this time

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
5.2	20% reduction in annual petroleum consumption by FY 2020 relative to a FY 2005 baseline; maintain 20% reduction thereafter.	In FY 2017, LLNL's petroleum fuel consumption decreased 70.04% from the FY2005 baseline.	LLNL will continue to strengthen its alternative fuel infrastructure by replacing conventional fueled vehicles with AFVs and by promoting the use of alternative fuels.	Low
5.3	10% increase in annual alternative fuel consumption by FY 2015 relative to FY 2005 baseline; maintain 10% increase thereafter.	FY 2017 alternative fuel consumption decreased 5% compared to FY 2016. This decrease was due to CARB compliance standards for California. For example, the Ford Transits could not be offered in E85. Overall increase compared to the FY 2005 baseline is 390%.	LLNL will maintain its alternative fuel vehicle (AFV) fleet and continue to replace the existing conventional fueled vehicles with E85, hybrid, and plug-in electric vehicles.	Low
5.4	75% of light-duty vehicle acquisitions must consist of alternative fuel vehicles (AFV).	LLNL did not meet the required 75% replacement of fossil fuel light-duty vehicles with AFVs in FY 2017. 68% of light-duty vehicles replaced in FY 2017 were replaced with AFVs.	LLNL will continue to work toward 50% of passenger vehicle acquisitions consisting of zero emission or plug-in hybrid electric vehicles by FY 2025.	Low
5.5	50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025.	At the end of FY 2017, LLNL added 10 electric vehicles to its fleet as part of a pilot program. These vehicles will replace 10 petroleum fuel vehicles.	LLNL will continue to work toward 50% of passenger vehicle acquisitions consisting of zero-emission or plug-in hybrid electric vehicles by FY 2025.	TBD, Insufficient information, unable to assess at this time
Clean and Renewable Energy Category				
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 not be less than: 10% in FY 2017, working towards 25% by FY 2025.	FY 2017 renewable contribution was 23%, exceeding the 10% goal with the 73% allotment of renewable power generated by the 3.3MW solar plant and with the purchase of RECs through WAPA. Plans are in place to continue to meet the 25% goal.	The FY 2018 requirement will be met primarily with the 73% allotment from the renewable power generated by the 3.3 MW solar plant and through REC purchases as needed.	Low
3.2	"Renewable Electric Energy" requires that renewable electric energy account for not less than 10% of total agency electric consumption in FY 2017, working towards 30% of total agency electric consumption by FY 2025.	FY 2017 requirement was exceeded with the 73% allotment of renewable power generated by the 3.3MW solar plant and with the purchase of 100,471 MWh of renewable electric energy and 16,715 MWh of RECs through WAPA. LLNL is currently at 30.6% relative to the 30% by FY 2025 goal.	The FY 2018 requirement will be met primarily with the 73% allotment from the renewable power generated by the 3.3 MW solar plant and through REC purchases as needed.	Low

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
Green Buildings Category				
2.4	At least 17% (by building count or gross square feet) of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the revised Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter.	Assessing and certifying 17% of the existing occupied buildings greater than 5,000 GSF is 41% complete.	Additional HPSB assessments are planned, however, the recommendations are unlikely to be cost effective to implement.	High
2.5	Efforts to increase regional and local planning coordination and involvement.	LLNL continues to maintain good relationships and frequent exchanges with local community planning and government agencies, including the cities of Livermore and Tracy, as well as the counties of Alameda, Contra Costa, and San Joaquin. Interactions include meetings with City of Livermore planners to discuss the collaborative R&D initiative with a proposed Livermore Valley Open Campus, surrounding development, commuters interface with public transits, discussions with water officials in Livermore on wastewater issues, and participation in stakeholder groups to discuss environmental issues and habitat protection.		
2.6a	Net Zero Buildings: 1% of the site's existing buildings above 5,000 GSF are intended to be energy, waste, or water Net Zero buildings by FY 2025.	No existing facility has been identified for Net Zero capability.	A short list of possible candidates will be developed in 2018.	High
2.6b	Net Zero Buildings: All new buildings (over 5,000 GSF) entering the planning process designed to achieve energy Net Zero beginning in FY 2020.	LLNL has not completed any Net Zero design. Funding has not yet been identified for this work.	A short list of future facilities as viable candidates for energy Net Zero will be developed in 2018.	High
Acquisitions and Procurement Category				
6.1	Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts.	Sustainable Acquisition or Environmental Affirmative Procurement Program (EPP) clauses have been incorporated into all eligible LLNL General Provisions (GPs) for purchase orders and subcontracts except for the Standard Research GPs. The Standard Research GPs apply only to subcontracts awarded for basic or applied research services and do not offer an opportunity to procure products. As such, there is no benefit to add sustainable acquisition clauses to this GP.	LLNL will continue to include Sustainable Acquisition or Environmental Affirmative Procurement Program clauses as identified in the General Provisions in all eligible purchase orders and subcontracts. LLNL will continue to implement and periodically update Procurement Standard Practice 23.5, Environmental Affirmative Procurement and Waste Reduction Requirements as required and apply it to all LLNL procurement activities. The procedure was last updated on 3/3/17.	Low
Measures, Funding, and Training Category				
8.1	Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693.	In FY 2016, LLNL evaluated the merits of the recommended four ECMs proposed in the IGA estimated at a cost of \$2 million, not including the third-party financing cost and LLNL support costs.		

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
Travel and Commute Category				
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline.	Covered in Energy Management Category	Covered in Energy Management Category	
Fugitives and Refrigerants Category				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline.	Covered in Energy Management Category	Covered in Energy Management Category	
Electronic Stewardship Category				
9.1	95% of eligible acquisitions each year are EPEAT-registered products.	LLNL's achievement for FY17 was 82%. LLNL did not meet this goal as non-EPEAT rated monitors (34-inch curved Dell) continued to be purchased by the Laboratory to replace the use of two 24-inch monitors so employees could navigate across multiple applications. The curved monitor was EPEAT Gold-rated during the first half of FY16 but was removed from the EPEAT list during Quarter 3 of FY16. In addition, some Apple products being purchased by LLNL during the FY were archived in the EPEAT database; this also contributed to a lower achievement percentage.	Continue to receive quarterly EPEAT reports from blanket agreement suppliers (Holman's, PC Specialist [dba Technology Integration Group], and Perfect Output) to monitor performance.	Low
9.2	100% of eligible PCs, laptops, and monitors have power management enabled.	100% of eligible PCs, laptops, and monitors are implemented with power management functionality; monitors are powered off after 30 minutes idle time, PCs and laptops are put into stand-by mode after 30 minutes of idle time.	Continue desktop refresh program and desktop power management project.	Low
9.3	100% of eligible computers and imaging equipment have automatic duplexing enabled.	Multifunction devices and printers purchased under LLNL's managed print services blanket agreement possess duplex printing capabilities and this function is enabled when the contractor installs the device. LLNL has not performed an assessment to determine the percentage of devices Lab-wide with this feature enabled.	Plans are in place to revise LLNL's print management policy to increase paper and toner savings.	Low
9.4	100% of eligible (i.e., not classified) used electronics are reused or recycled using environmentally sound disposition options each year.	LLNL has a process to evaluate excess electronics for either reuse or recycling options.	Continue with program.	Low

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
9.5	<p>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> <p>Data Center Optimization Initiative (DCOI) requires the development and annual reporting on data center strategies to consolidate inefficient infrastructure, optimize existing facilities, improve security posture, achieve cost savings, and transition to more efficient infrastructure (such as cloud services and interagency shared services or co-located data centers).</p>	<p>Currently evaluating options for the consolidation and closure of 18 existing LLNL unclassified data centers by:</p> <p>Adoption of a Cloud First policy to the furthest extent practicable based on cost, security requirements and application needs.</p> <p>Migrating to inter-agency co-located data centers.</p> <p>Migrating to more optimized data centers within LLNL inventory.</p>	<p>LLNL will continue to implement and measure progress toward meeting the goals set forth in the FITARA memorandum.</p> <p>Review and report quarterly data center inventory.</p> <p>Freeze any significant expansions of existing data centers.</p> <p>Achieve and maintain a PUE of less than 1.5 for existing tiered data centers by September 30, 2018.</p> <p>Continue efforts, where feasible, to consolidate, close or re-purpose existing LLNL data centers.</p>	Medium
Organizational Resilience Category				
10.1	Update policies to incentivize planning for and addressing the impacts of extreme events due to changes in weather patterns.	Through LLNL's existing environmental policy, the Lab commits to continuously improve environmental performance.	LLNL has identified existing resilient actions and areas for increasing actions to build resilience against predicted climate threats through a baseline assessment. LLNL plans to identify, and update as needed, policies as they relate to changes in weather patterns.	Low
10.2	Update emergency response procedures and protocols to account for projected change, including extreme weather events.	LLNL currently incorporates into its emergency response program a broad range of hazards and environmental aspects, potential consequences, and lessons learned from simulated and actual emergencies. Several hazards that are already incorporated into the emergency response program overlap with immediate climate change hazards, for example risks of wild fire from extreme drought.	In accordance with ISMS practices, LLNL will continue to improve upon the emergency response program.	Low
10.3	Ensure workforce protocols and policies reflect projected human health and safety impacts.	LLNL's existing workforce protocols and policies reflect the value of each worker returning home daily in the same or better condition than when they arrived at work. This sweeping approach to health and safety allows for adaptation as needed, including for extreme weather events.	Specific impacts of projected extreme weather events and other impacts from climate change were considered during the baseline review. Protocols and policies are currently sufficient, but can be reviewed and adapted as needed to address health and safety impacts.	Low

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
10.4	Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies.	LLNL management is committed to effective communication and is supportive of all Lab policies.	LLNL management will continue to demonstrate commitment to adaptation efforts through internal communications and policies.	Low
10.5	Ensure that site/Lab climate adaptation and resilience policies and programs reflect the best available current science, updated as necessary.	LLNL works to anticipate, innovate and deliver solutions for the nation's most challenging security problems. LLNL's scientists and engineers include those working on the front lines to advance climate science. LLNL applies the best available science in all decision making.	LLNL will take an integrated approach to climate adaptation and resiliency under direction from DOE, with input from our own climate scientists, and using the latest tools available for predicting and planning the effects of climate change.	Low

2.0 Performance Review and Plan Narrative

2.01 Energy Management Category (SSPP Goals 1.1, 2.1, 2.2, and 2.3)

SSPP Goal 1.1: 50% Scope 1 and Scope 2 GHG reduction by FY 2025 from a FY 2008 baseline

LLNL's GHG footprint is defined by three major scopes of GHG emissions. These are depicted in Figure 2-1, below. LLNL quantifies emissions within each scope, as well as targets reductions according to scope-related reduction goals. LLNL owns or controls sources from all three direct GHG emissions. Scope 3 emissions are addressed under goal 1.2 in this section.

LLNL's Scope 1 emissions are the result of direct emissions associated with fuel combustion or fugitive emissions. LLNL's Scope 2 emissions are a result of indirect emissions associated with consumption of purchased or acquired electricity. All other potential Scope 2 emissions are not applicable to LLNL. Scope 1 and Scope 2 GHG emissions are offset by the estimated annual GHG emissions avoided by purchased renewable energy credits (RECs).

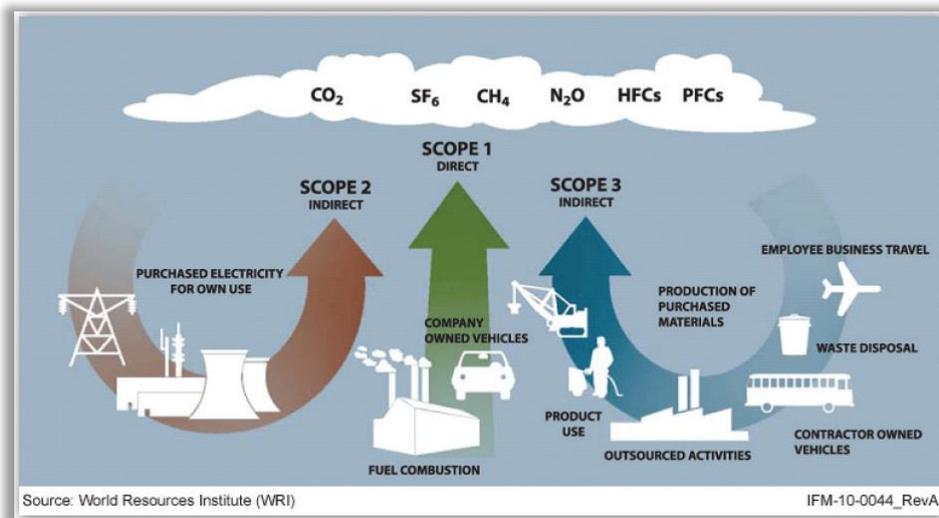


Figure 2-1. The three major scopes of GHG emissions

LLNL's Scope 1 and Scope 2 emissions include:

- Natural gas fuel combustion for the generation of electricity, heat, cooling, or steam (e.g., boilers and furnaces)
- Fuel combustion (e.g., gasoline; E85, a blend of 85% ethanol and 15% gasoline; and diesel) in mobile sources, including LLNL's GSA-leased vehicles, commercially leased, and agency-owned vehicles
- Fugitive emissions from fluorinated gases and refrigerants, including mixed refrigerants used in refrigeration and air conditioning equipment
- Operation of the sewage lagoon at Site 300
- Indirect emissions associated with electricity consumption
- Estimated indirect emissions avoided by purchased RECs (emissions offset)

LLNL continues to assist DOE in working to achieve the 50% GHG reduction goals. LLNL's Site 200 and Site 300 major sources of Scope 1 and Scope 2 GHGs are influenced primarily by the management of electricity, natural gas, fossil fuels and fugitive emissions (i.e., sulfur hexafluoride [SF₆] and others).

Factors influencing Scope 1 and Scope 2 emissions are addressed in the various activities and accomplishments described throughout this document, including:

- Energy intensity reduction
- Renewable energy consumption
- Reducing fleet fuel use
- Metering
- Cool roofs
- Pollution prevention and waste reduction
- Sustainable acquisition and electronic stewardship

Overall Reduction of Scope 1 and Scope 2 Greenhouse Gas Emissions¹

DOE's goal for Scope 1 and Scope 2 is a 50% reduction in the generation of Scope 1 and Scope 2 GHG emissions by FY 2025 from the FY 2008 baseline. LLNL's GHG reductions for Scope 1 and Scope 2 are largely driven by the plans described in this document. LLNL achieved an overall reduction of 40.6% (estimated) from FY 2008 baseline for Scope 1 and Scope 2 emissions during FY 2017. Aggressive reduction of SF₆ in programmatic equipment since 2008 coupled with the purchase of RECs has helped LLNL exceed the FY 2017 reduction goal of 25%.

Performance Status

In FY 2017, LLNL achieved a reduction of 40.6% (estimated) in Scope 1 and Scope 2 GHG emissions, relative to its FY 2008 baseline. Significant efforts, focusing on LLNL's continued management of SF₆ usage, the offsets of purchased RECs and purchased renewable electric energy from incremental hydroelectric power, and minimizing electrical energy use, have contributed to this year's reduction achievement. Also, the 3.3 MW solar farm at Site 200 contributed 4,046 MWh of energy to the Lab that resulted in avoiding over 1,000 mtCO_{2e} of GHG emissions during FY 2017. These efforts have helped LLNL exceed the Scope 1 and Scope 2 emissions reduction target of 25% for FY 2017.

Plans and Projected Performance

LLNL has already successfully reduced GHG emissions through aggressive reduction and management of fugitive emissions from equipment using SF₆. Scope 1 and Scope 2 GHG reductions for FY 2018 and beyond will largely be dependent on Laboratory management of electrical energy because this is LLNL's largest contributor to Scope 1 and Scope 2 GHG emissions (see Figure 2-2). For more information, refer to the sections that address Goal 2.1 (energy intensity reduction) and Goal 3.2 (electrical consumption from renewable energy sources).

¹ Scope 1 and Scope 2 GHG emissions and GHG emission reductions presented in this document are current estimates. Actual Scope 1 and Scope 2 GHG emissions and GHG emission reductions will be published in the final DOE Sustainability Dashboard.

Scope 1&2 GHG Emissions Breakdown			
Categories	Baseline (2008)	FY 2016	FY 2017
Facility Energy	156,687.7	130,910.9	103,093.5
Non-Fleet V&E Fuel	0.0	0.0	0.0
Fleet Fuel	1,773.0	1,153.0	1,153.0
Fugitive Emissions	34,946.7	16,225.1	22,103.3
On-site Landfills	0.0	0.0	0.0
On-site WWT	7.2	5.4	14.9
Renewables	0.0	270.4	299.4
RECs (subtracted)	0.0	-11,997.4	-11,748.8
Total (MtCO₂e)	193,414.6	136,567.4	114,915.3

Figure 2-2. Scope 1 and Scope 2 GHG emissions (MtCO₂e) by source.
 Note: Scope 1 and Scope 2 GHG emissions presented in this document are estimates. Actual Scope 1 and Scope 2 GHG emissions will be published in the final DOE Sustainability Dashboard.

The measures described in this document all have the potential to assist in GHG emission reductions, and they will be carried out if deemed economically feasible and supportive of mission. Future growth of LLNL continues to be centered on energy-intensive facilities and research, including the NIF, HPC, and other program-related areas, all of which will increase LLNL's GHG emissions. It should be noted that though LLNL has been successful with the reductions in SF₆, this is only part of the picture and does not necessarily translate into overall GHG reductions.

LLNL will continue to maintain the SF₆ Management and Capture Plan for managing SF₆ purchase, usage, and storage.

Ongoing efforts to support SF₆ regulatory reporting include maintaining documentation on R&D uses and reporting emission data from electrical utility usage.

Resources Required

The majority of resources required to reduce LLNL's overall Scope 1 and Scope 2 emissions are related to activities addressed under other goals, especially those related to energy intensity reduction and renewable energy use. LLNL is not likely to achieve any additional emissions reductions unless electrical energy consumption can be reduced.

LLNL will continue to work on documenting and tracking SF₆ uses onsite. As the LLNL SF₆ management program becomes more developed, the number of projects where alternatives to SF₆ can be used becomes smaller. However, the remaining uses, specifically those in the high-voltage applications and accelerators, are typically characterized by robust containment and transfer systems that can detect significant releases fairly quickly. While the major users of SF₆ may not be able to eliminate the use of SF₆ in the near future, program management and researchers need to continue to ensure that the gas is used in a manner that minimizes the amount released.

SSPP Goal 2.1: 25% energy intensity reduction by FY2025 from an FY2015 baseline

Performance Status

At the end of FY 2017, our contribution to the DOE energy use intensity reduction goal was 4.28%, relative to the FY 2015 baseline, normalized for weather. Without a correction for weather, the intensity would be at 2.55%. Figure 2-3 illustrates the savings using the updated baseline. No facilities were demolished in FY 2017 due to lack of funding. The Facility Information Management System (FIMS) list of facilities

excluded from the energy intensity goal is attached in the Appendices section of this plan. The Energy Usage and Cost Report is entered in the Dashboard.

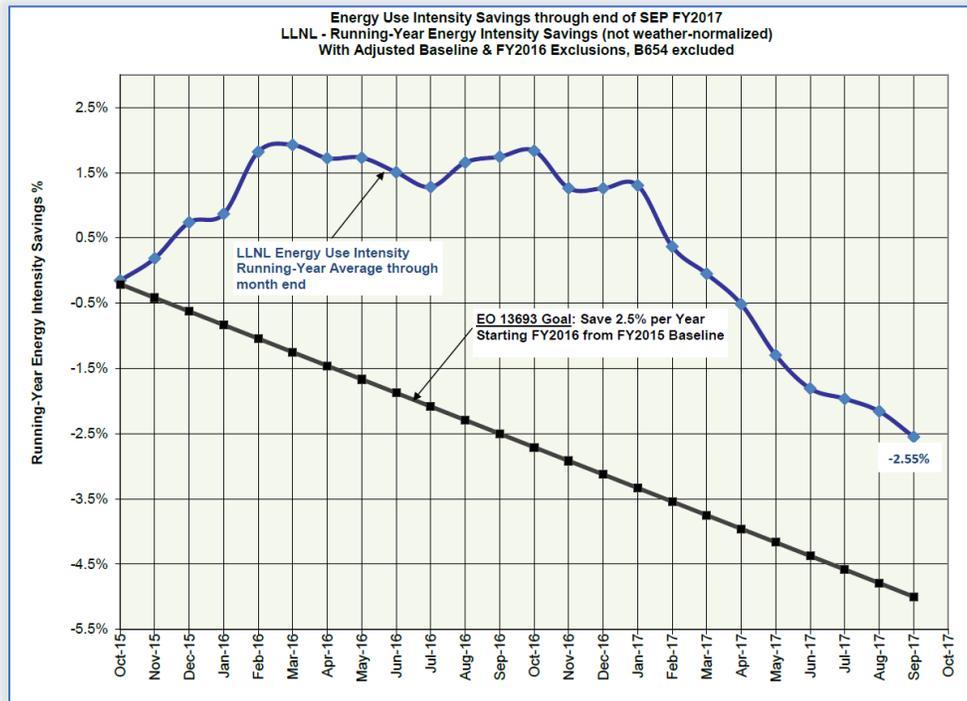


Figure 2-3. Energy-use intensity savings through end of FY 2017 (running year energy-intensity savings with FY 2016 exclusions)

LLNL continues to evaluate its energy usage to better understand how to encourage efficient energy reduction. The energy chart in Figure 2-4 estimates the sources of energy by type. The chart was updated with FY 2017 data and was created by incorporating metered data, lighting estimates, and equipment inventory. The energy consumed at LLNL is split between the Excluded facilities (55.8%) and Goal Subject facilities (44.2%).

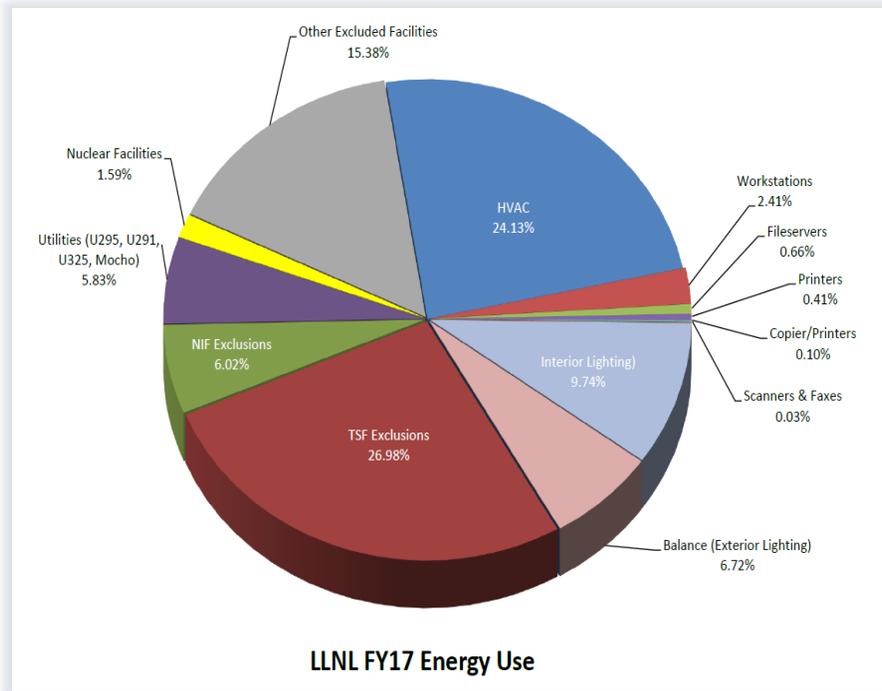


Figure 2-4. LLNL FY 2017 Energy Use

With just the Goal Subject facilities (Figure 2-5), the energy breakdown shows HVAC systems (54.58%) and lighting (37.23%) continue to be the two largest users of energy at LLNL. The breakdown helps to indicate where specific energy conservation efforts should be directed.

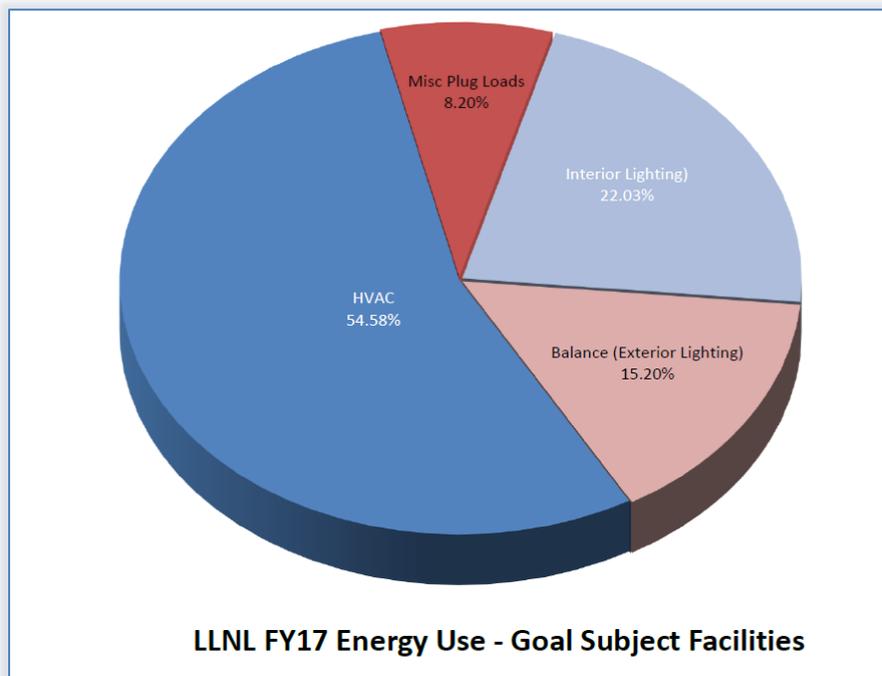


Figure 2-5. Energy use - goal subject facilities only

In FY 2017, LLNL was again challenged to meet its energy intensity reduction goal. The milder-than-normal summer was helpful in decreasing the electricity consumption in the summer months, but the colder-than-LLNL-AR-742010

normal winter was responsible for increasing our natural gas consumption in the winter months. In the summer of FY 2017, there were 16% less cooling degree days (CDD) than the summer of FY 2015 (Figure 2-6).

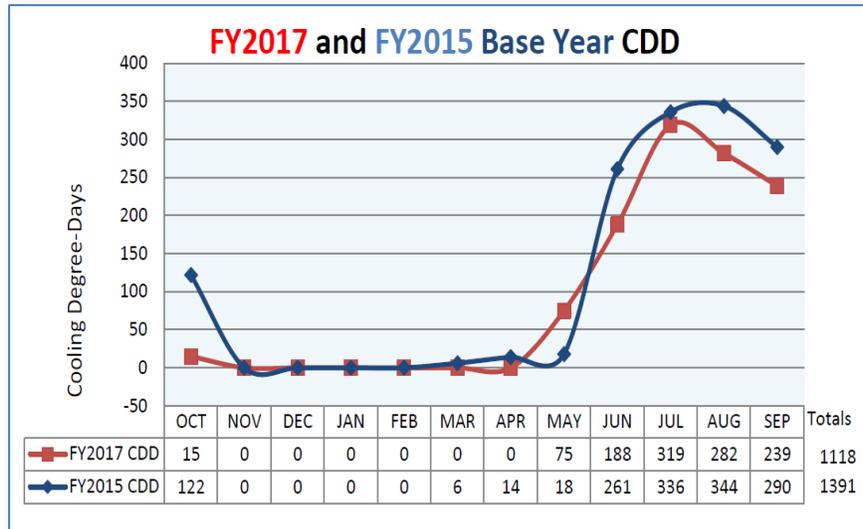


Figure 2-6. Comparison of cooling degree days (CDD)

On the negative side, FY 2017 winter was colder, compared to the base year FY 2015. There were 56% more heating degree days (HDD) than in the winter of FY 2015, increasing the burden on the boilers and heating system (Figure 2-7).

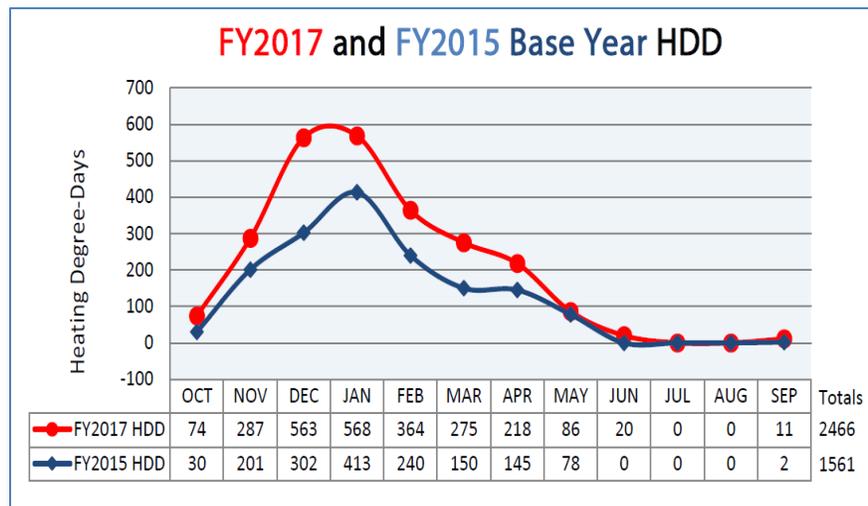


Figure 2-7. Comparison of heating degree days (HDD)

Plans and Projected Performance

LLNL has developed a comprehensive list of energy-savings projects that includes the results from the IGA report, EISA audits, compliance issues, deferred maintenance projects (that have a significant energy savings), metering evaluations, and grassroots suggestions. The list will continue to evolve and expand as

new energy-efficiency opportunities are identified. The list is prioritized by the energy savings return on investment (ROI) compared to the project costs.

LLNL has made progress in increasing HVAC funding for preventive and corrective maintenance for HVAC systems, as well as increasing staff and focusing attention on distributed elements of the HVAC system.

LLNL continues to evaluate and implement grassroots suggestions for energy-savings projects wherever possible and will implement them as funding permits. The Laboratory continues to distribute energy usage data on the metered facilities to the respective facility managers. When an increase in metered electricity is detected, the facility managers are engaged to find the cause and solutions for the increase.

Employees continue to send suggestions to our Energy Management Group through the “Sustainability at LLNL” website. LLNL’s EMS website also has a section that encourages sustainability suggestions. The ideas are evaluated and, if deemed appropriate, are added to the comprehensive list of energy-intensity savings projects.

In addition, the preventive maintenance program included in the ESPC project has added several facilities to the WebCTRL system; applying best practices will continue to help reduce LLNL’s energy intensity and GHG emissions: these 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 Site 200 and Site 300 each have a site-wide DDC (Direct Digital Control) system that is used to control temperatures, pressures, and humidity in many buildings. The system is state-of-the-art, using approximately 465 high-speed, connected digital processors in 41 buildings so far with several more installations planned. The system allows subcontractors and trained onsite AC mechanics to program complex algorithms that optimize the use of electricity and natural gas in many of our HVAC systems without compromising employee comfort and in many cases, improving it through tighter control of temperature in offices and labs. Each system uses constant monitoring and remote alarming to alert building and maintenance staff of malfunctions so that they can be repaired in time to minimize discomfort and energy usage.

In the last year, digital HVAC controls have been added to or expanded in many of the buildings. A review of building electricity usage shows about a 4% reduction in electricity consumption when compared to the usage before the controllers were added. Some of the highlights are as follows:

- B132/133: When the DDC system was upgraded in B133, we expanded it to buildings 132N and 132S and replaced defective pressure transducers. The transducers are used to control the chilled and hot water flows so that only the required minimum amount is pumped to the buildings.
- B151: We continue to optimize the large DDC system, adjusting air pressures and temperatures to satisfy the needs of the labs and offices.
- B191: A new DDC interface has been installed to replace the older, troublesome interface. This gave us a new insight into the workings of the existing DDC system in the building, revealing many sub-optimal comfort and production conditions and energy waste. Work continues to correct these issues.
- B211: Optimum start was implemented in twelve rooftop units to delay the start time of the units until needed to have the zones at a comfortable temperature at occupancy.
- B254: The pneumatically controlled AC unit and six reheat zones were replaced with DDC control. Pneumatic control offers virtually no energy-optimizing features. The DDC system has been programmed to send air downstream at the highest temperature possible without creating discomfort, saving heating and cooling energy.
- B311: A new chiller was installed with reset control, allowing us to optimize the chilled water temperature based on actual air conditioning unit demands.

- B321: Obsolete temperature controls were upgraded in fifteen AC units to our standard. In each unit, energy-saving algorithms were implemented to minimize heating and electrical usage.
- B321E: The DDC system was replaced in the central plant, providing close control and monitoring of chillers and boilers serving the complex. Temperature stability is critical, so we programmed the system to provide tight control using the least amount of energy.
- B381 Target Fab: NIF engineers and technicians worked to optimize the close tolerance conditions in the target fab high-bay by replacing and relocating old sensors. This will allow tighter control of the conditions in the high-bay.
- B381 Office Building: Work continues to replace defective Variable Frequency Drives (VFDs) that control the airflow to the office building wings. The defective drives have forced the AC mechanics to run the fans at full speed, wasting electrical and heating energy in the building. The new drives will be configured for easier maintenance and better, more economical control of airflow.
- B411: Digital controls were included with two new rooftop AC units allowing the units to avoid unnecessary heating and cooling while maintaining records storage temperature and humidity within mandated standards.
- B583: The existing VAV box controls were replaced with our standard DDC controllers, giving us the ability to completely control office airflows and temperatures and use those conditions to reset the rooftop AC unit to optimum settings.
- B663: A new chiller was installed with reset control allowing us to optimize chilled water temperature based on actual air conditioning unit demands.
- B694: Optimum start was implemented in two AC units and nineteen VAV zones to delay the start time of the units until needed to have the zones at a comfortable temperature at occupancy. This allowed us to delay the building occupancy time by up to two hours. This reduces the AC unit run time by up to 1040 hours per year, decreasing energy usage and maintenance costs and increasing the life of the units.

Based on best estimate of available resources for FY 2018, LLNL will attempt to maintain its energy intensity savings at current levels, considering the total building area of 5,874 ft². As funding becomes available, LLNL will attempt to exceed this goal.

Figure 2-8 shows the site projected electricity consumption; Figure 2-9 shows the load forecast.

Fiscal Year	2017A	2018	2019	2020	2021	2022	2023	2024	2025
Forecast Total Electricity Consumption	429	433	438	443	488	488	488	488	488
Baseline Load (x10 ⁶ kWh)	248	243	240	235	226	224	223	221	219
HEMSF Facility 1 (TSF) (x10 ⁶ kWh)	138	145	152	160	213	213	213	213	213
HEMSF Facility 2 (NIF) (x10 ⁶ kWh)	28	30	32	34	36	38	40	42	44
Estimated Load after Energy Efficiencies	414	418	424	429	474	475	475	476	476

Figure 2-8. Site projected electricity consumption with Exascale (x10⁶ kWh)

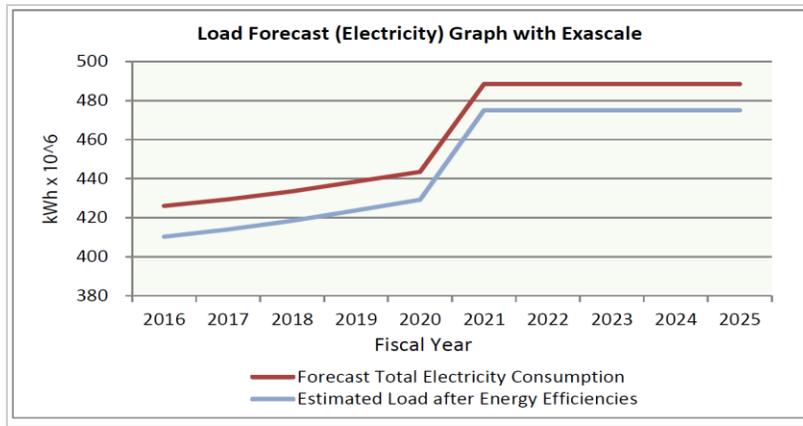


Figure 2-9. LLNL energy load forecast with Exascale

Resources Required

Funding will be required for projects that have been identified, including the installation of more DDC systems or conversion of existing pneumatic control systems, additional programmable thermostats, interior and exterior lighting upgrade projects, and other energy conservation-related projects. LLNL is continuing to develop a strategy to justify energy conservation projects in comparison to its low cost of electricity.

Plans to reduce deferred maintenance, while at the same time increasing energy efficiency, will be implemented as funds become available. When replacing aging equipment identified in the master deferred maintenance list, new equipment will be the latest, most energy-efficient type available.

Resources have been requested for energy-intensity reduction measures for FY 2018.

Figure 2-10 lists projects that, if funded and implemented, would allow LLNL to meet its energy-intensity reduction goals.

Project	Project Cost (\$M)	Annual Savings (\$M)	Simple Payback (Yrs)	FY18 (\$M)	FY19 (\$M)	FY20 (\$M)	FY21 (\$M)
Building Automation Systems/EMCS	5	0.9	5.6	0.5	1.5	2	1
Electric Motors and Drives, Variable Speed Motors and Drives	2	0.54	3.7	0.5	0.5	0.5	0.5
Site-wide Lighting Improvements, Exterior	3	0.4	7.5	0.5	1	1	0.5
Site-wide Lighting Improvements, Interior	5	3.8	1.3	0.5	1.5	1.5	1.5

Figure 2-10. Proposed projects in support of SSPP Goal 2.1

SSPP Goal 2.2: EISA Section 432 energy and water evaluations

In FY 2017, ten facilities were subjected to internal Desk Audits. These audited facilities made up the first 25% for the third round of audits.

Energy audits to meet EISA Section 432 and efforts to increase efficiency (e.g. combining energy audits with condition assessment surveys), along with recommissioning/retro-commissioning, are continually being evaluated. Meetings with managers of facilities identified with an increase in electricity are being held to discuss the recent energy audit recommendations to plan a path forward, beginning with those recommendations that offer the most energy savings opportunities.

There are two qualified Certified Energy Managers (CEM) working for LLNL. As funds become available, LLNL hopes to increase the number of CEMs as some Facility Managers or Facility Points of Contact are being encouraged to enroll in the program.

Significant funding is required to execute the recommended energy conservation projects identified by previous audits.

SSPP Goal 2.3: Meter all individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate

Performance Status

The Metering Plan will continue to be updated to align with the November 2014 Federal Building Metering Guidance document. LLNL's commitment to support the DOE Strategic Sustainability Performance Plan (SSPP) and comply with the Energy Policy Act (EPACT) 2005 and EISA 2007 regulations is exemplified in this latest issue of the Metering Plan. LLNL is committed to monitoring and reducing its energy usage and finding innovative ways to lead the complex while at the same time meeting its mission goals. This updated metering plan not only outlines the plan to continue the repair of meters, but highlights LLNL's new goal to upgrade existing legacy meters before they fail.

LLNL's metering portfolio, as of October 1, 2016, is shown in Figure 2-11. LLNL is currently developing a complete water meter deployment plan. Due to the low water use, a measurement plan for water use at Site 300 has not been in place since 2007.

	Number of Meters	Number of Buildings
Electricity		
Advanced Individual	114	116
Advanced Shared	134	247
Standard	58	27
No Meter	0	21
Total	308	411
Natural Gas		
Equipment Meters	18	14
Building Meters	18	14
No Meter	0	0
Total	36	28
Water		
Advanced	14	0
Standard	13	1
Total	27	1

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Figure 2-11. LLNL's current metering portfolio.

Plans and Projected Performance

Below is a summary of how LLNL's performance compared to the SSPP goals.

SSPP Metering Stretch Goals	FY 2017 Performance Status	Planned Actions and Key Issues
Meter all individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate	90% achieved as of the end of FY 2017.	The LLNL plan to repair failed legacy electricity metering was continued in FY 2017, but only at Computation Facilities. The effort to perform complete meter upgrades throughout the site will be continued when funding becomes available. Funding for a Metering Services Project estimated at \$500K was requested from management in order to arrest the declining state of advanced electric meters. Additional funding is required to upgrade natural gas and water meters to meet the FY 2018 goal requirements.

In FY 2015, modem-based electricity meters were taken out of production. As a result, LLNL shifted its strategy from repairing existing modem-based meters to complete meter upgrades in order to maintain compliance with its metering goals. Due to funding source limitations, electricity meter upgrades were only completed at Computation facilities during FY 2017. As a result, the remainder of the LLNL site continued to experience legacy electricity meter failures both in communication and overall function.

No audits were performed in FY 2017, due to lack of resources and funding.

Additional funding and staffing resources are needed to continue audits, replacement and upgrades of failed and existing legacy electricity meters, as well as exploration of more effective and innovative metering methods.

Resources Required

Funding has been requested from management for a Metering Services Project in order to arrest the declining state of advanced electrical meters. Figure 2-12 lists projects that, if funded, will ensure that appropriate LLNL facilities meet SSPP Goal 2.3 for electricity, natural gas, and potable water metering. These projects are intended to help change behaviors and improve operations to achieve energy efficiencies.

Project	Project Cost (\$M)	Savings (\$M)	Simple Payback (Yrs)	FY17 (\$M)	FY18 (\$M)	FY19 (\$M)	FY20 (\$M)
Electricity Metering	4.2	N/A	N/A	0	0.5	1.0	1.0
Natural Gas Metering	3.6	0.065	54	0	0.5	0.8	1.0
Potable Water Metering	1.5	0.025	59	0	0.25	0.25	0.5

Figure 2-12. Proposed projects in support of SSPP Goal 2.3

2.02 Water Management Category (SSPP Goals 4.1, and 4.2)

SSPP Goals 4.1: 36% potable water intensity (Gal per gross square foot) reduction by FY2025 from a FY2007 baseline

Performance Status

In FY 2018, LLNL’s contribution to the DOE potable water intensity savings goal was 5.92% (Figure 2-13). LLNL’s drop in potable water intensity savings from the previous year was primarily due to the following factors:

An unavoidable switch to the secondary water supplier (Zone 7) after mid-July 2016. Prior savings were attained with the primary water supplier Hetch Hetchy water.

Continued growth and activity in FY 2018 has increased the domestic water demand at the site.

The water consumption and cost data report is entered in the Dashboard.

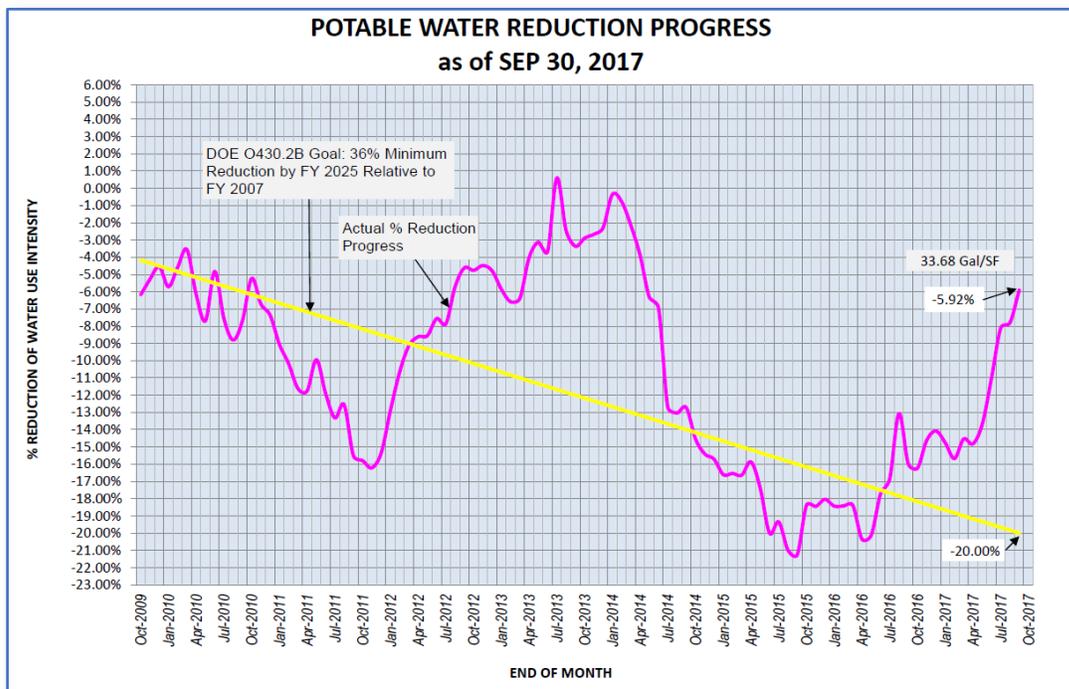


Figure 2-13. Potable water use intensity savings through end of FY 2017

Potable water use at LLNL’s cooling towers increased nearly 3% (3,388 kgal) from FY 2015. FY 2017 was not as warm as FY 2015, but had 258 cooling degree days (CDDs) more than base year FY 2007, equating directly into higher cooling demand. As the chillers and air conditioning units respond to the demand, more make-up water is required at the cooling towers. The R.O. Treated Groundwater Pilot Project at B133 Cooling Tower (where treated well water is run through a reverse osmosis unit to produce near Hetch Hetchy-quality water, then recycled to the tower as make-up) saved about 6.2 million gallons of potable water for FY 2017. This project is expected to save about 7 million gallons annually.

California Governor Jerry Brown lifted his executive order of mandatory water reductions for potable water use and irrigation in April 2017, after five years of unprecedented drought in the state. By the end of September 2017, our estimated irrigation savings was about 5 million gallons for the year. Our total

irrigation reduction to date is about 57% and about 11% on potable water use with respect to the 2013 baseline.

The Laboratory applies various intensity level of landscaping as appropriate to the contextual environment, ranging from special-use to transitional and natural settings. As stated in the 2011 Sustainable Landscape Concept Plan, one of the site landscaping goals is to reduce the amount of irrigation water-intensive lawn. The use of turf would be limited to only certain special aesthetic and recreational applications; other lawn areas with no specific functional requirements would be converted to drought tolerant/Livermore Valley-compatible planting.

LLNL will continue to do incremental landscape and irrigation modifications to reduce water use as funding allows, reducing lawn areas and optimizing irrigation efficiency with alternate sustainable landscaping.

A breakdown of LLNL potable water consumption is illustrated in Figure 2-14. The cooling tower make-up component is our highest user at 50.56%, with Irrigation Use second at 19% and Facility Process use third at 15.37%.

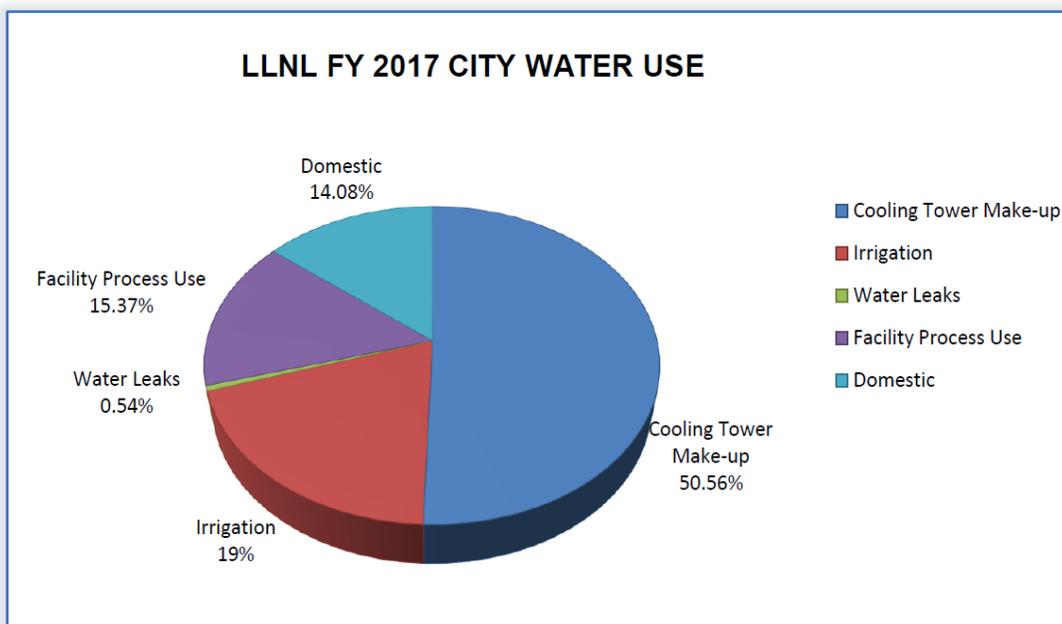


Figure 2-14. LLNL FY2017 potable water use breakdown

Current LLNL practice is to meter areas or zones of greatest water use, such as the cooling towers and irrigation zones, rather than at individual buildings as it would be prohibitively expensive. All five cooling tower make-up water systems at LLNL are furnished with standard water meters. LLNL plans to upgrade all water meters to advanced water meters, pending funding. This will allow a more timely and accurate accounting of the total cooling tower make-up water load.

Plans and Projected Performance

There are several factors that will make it difficult to meet the FY 2025 goal without additional resources to execute the needed water savings projects. Some challenges in the future include:

- In FY 2017, LLNL was using the secondary water supplier, Zone 7 due to chlorine issues with the primary supplier Hetch Hetchy water. This unavoidable switch to Zone 7 has imposed an insurmountable burden to the biggest user: the cooling tower make-up system.
- Continued Livermore Computing mission growth requires additional cooling tower make-up. Unlike energy-intensity calculations, there are no exclusions for mission growth for water reduction.

- As noted in the Performance Status, continued growth and activity in FY17 has increased the domestic water demand at the site.

There are several water infrastructure projects underway, or being planned, that will assist the Laboratory in meeting the federal water-reduction goal.

- The Site 200 Water Treatment Design Project includes an engineering technical report and design of a water chlorination facility at the Sandia water tanks area, which will treat the Hetch Hetchy water to make it compliant with the required potable-water drinking standards. The engineering report is a requirement for a water supply application permit. A return to Hetch Hetchy water will allow the cooling tower make-up system to reduce consumption.
- The Site 300 Water Filtration Project involves the engineering, design and installation of a filtration facility using granulated activated carbon (GAC) at Site 300. This project will allow the use of Hetch Hetchy water instead of ground water.
- The site-wide Mechanical Utilities Valve and Water Distribution Piping Replacement Project will strategically replace failed isolation valves and affected water piping in the utility systems, including potable water in order to better serve the mission and efficiently mitigate line breaks.
- The recently submitted UESC Investment Grade Audit (IGA) included a proposal for three water ECMs; Well Water Cooling Tower make-up for U325, Wastewater Reclamation for Cooling Tower make-up at U291 and OS454 Livermore Computing (formerly the Terascale Facility), and Xeriscaping at B170.
- The Water Testbed Project continues to harvest rooftop rainwater at Building 471 for irrigation use in the area. Other candidate areas are being identified as funding becomes available.
- In keeping with its high standard of environmental stewardship and commitment to meeting DOE's water intensity reduction goals, LLNL continues to evaluate ways to identify, monitor, and mitigate inefficiencies in its water-distribution systems. This will have an additional benefit of reducing electrical energy expended in water distribution across the site.
- LLNL's search for the most advanced and efficient leak detection technologies has created an opportunity to collaborate with industry leaders who employ the latest technological and environmentally sound methods to detect, locate, and correct leaks. Additional resources are required to pursue the currently available improved leak-detection strategies. However, with the low cost of water, LLNL is sensitive to investing funds in long payback projects that may not consistently yield the desired results.

DOE's FY 2018 water intensity reduction goal is 22%. Based on LLNL's best estimate of available resources for FY 2018, and recognizing the primary water supplier (Hetch Hetchy) is not back in service, LLNL will strive to maintain its current savings.

LLNL Uses Treated Well Water

...in cooling towers

In FY2013, LLNL initiated a pilot project to demineralize treated well water for use as make-up water in its cooling towers. The well water now goes through an additional treatment that includes running it through a reverse osmosis unit to eliminate the possibility of the water doing harm to the cooling towers. Until recently, treated well water was discharged to the arroyo.

As the percentage of water use is greatest at the cooling towers, a conversion to treated water now assists LLNL in meeting its water reduction goals. Using recycled treated well water as make-up water is estimated to save at least 5,500 kgals annually. The pilot project was completed FYE2013 and is expected to be fully deployed by the end of the calendar year. A photo of the reverse osmosis unit is shown at right.



...for irrigation

Another plan to evaluate the use of recycled and treated well water for irrigation is being considered. Treated well water is diverted to the reverse osmosis system where it is purified for use in the cooling tower. The treated well water will be blended with potable water to ensure a nondeleterious effect to the landscaping. Resources are needed to fully evaluate this plan.



Resources Required

For FY 2018, LLNL has requested funding to complete the water infrastructure projects that would allow a return to the Hetch Hetchy water system. Water saving projects identified in previous audits can also assist in intensity-reduction measures and are shown in Figure 2-15. These projects, if funded and implemented, would better allow LLNL to meet its water intensity reduction goal.

Project	Project Cost (\$M)	Annual Savings (\$M)	Simple Payback (Yrs)	FY18 (\$M)	FY19 (\$M)	FY20 (\$M)
Use RO Treated Wellwater at U325	4.9	0.23	21.6	0.5	0.5	1
Use RO Treated Wellwater at U291	3.5	0.17	20.2	0.5	1	1
Use RO Treated Wellwater at NIF	3.5	0.17	20.2	0.5	1	1
Use Reclaimed Wastewater at U291 and TSF	13	0.61	21.3	3	3	4

Figure 2-15. Proposed projects in support of SSPP Goal 4.1

SSPP Goal 4.2: 30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY2025 from a FY2010 baseline

Performance Status

LLNL uses potable water for industrial (i.e., cooling tower make-up) and landscape irrigation at Site 200. At Site 300, potable well water is used for all purposes. A planned cutover from well water to Hetch Hetchy water is near completion and could be started up in 2018, pending the completion of the Site 300 Water Filtration (GAC) project.

The new 30% water consumption reduction of ILA water goal does not strictly apply to LLNL since, by definition, ILA is non-potable water. However, LLNL is committed to reducing industrial use of potable water at the cooling towers and for landscape irrigation. As a subset of the water reduction savings, the portion attributable to ILA can also be tracked.

Storm-Water Management

The management and control of storm-water runoff quantity, timing, and water quality have become important considerations in low-impact development and sustainability. Storm-water management is a component of LLNL's EMS through various environmental aspects, including groundwater discharges, inadvertent releases, water use, and land resource use. LLNL also considers storm-water management an element in water conservation and green building.

LLNL's storm-water program has been designed to address regulatory requirements and DOE Orders. Storm-water discharges at both Site 200 and Site 300 are regulated by the State of California under the authority of the Clean Water Act, using industrial and construction storm water National Pollutant Discharge Elimination System (NPDES) permits. The State also regulates storm-water discharges under the Porter-Cologne Water Quality Control Act, using Waste Discharge Requirements. LLNL's storm-water programs must also comply with DOE orders, as specified in Contract DE-AC52-07NA27344. LLNL implements the storm-water programs through its ES&H Manual and Storm Water Pollution Prevention Plans (SWPPP).

In December 2007, Congress enacted EISA, which established storm-water runoff requirements for development and redevelopment projects. Section 438 of this Act requires all projects at federal facilities adding more than 5,000 square feet of new development or redevelopment to restore the predevelopment hydrology to the maximum extent feasible. LLNL has begun to use site planning, design, construction, and maintenance strategies 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. This ensures that no adverse impacts to the site hydrology occur as a result of construction activities. In December 2009, the U.S. EPA published the "Technical Guidance on Implementing the Storm Water Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act"

(EPA Guidance), which provides recommendations for implementing low-impact development strategies for runoff control.

In addition, the state-wide Storm Water General Permit for Construction Activities 2009-0009-DWQ (Construction General Permit) was reissued by the State of California in July 2010. This permit revision added additional water balance and runoff requirements for construction designs at sites of one acre or more to protect storm water quality. Construction SWPPPs are prepared for each individual project and specify all best management practices required by the Construction General Permit.

Storm-Water Management Performance Status

New construction at LLNL will include storm-water controls consistent with EISA 438 and EPA Guidance, to the maximum extent technically feasible.

Storm-Water Management Planned Actions

LLNL continues to identify other water-conservation activities, including additional rainwater-harvesting projects. Consistent with EISA 438 and low-impact development, LLNL is including water-balance considerations into designs for the East Campus Site Improvement project. This project will include many low-impact development designs to meet or exceed a 95th percentile storm, consistent with the EPA guidance.

The State of California has revised the Industrial General Storm Water Permit. LLNL applied for coverage and received the revised permit in July 2015.

Storm-Water Management Resources Required

As LLNL develops and redevelops areas of the site, storm-water runoff management will be integrated into the planning process. This may incur a 15-30% increase in landscape and runoff management costs. As significant construction or renovation is scheduled for FY 2018, the additional resources required will be identified during the design phase.

2.03 Waste Management Category (SSPP Goals 1.1, 1.2, 7.1, and 7.2)

SSPP Goals 1.2: 25% Scope 3 GHG reduction by FY2025 from a FY2008 baseline

Scope 3 includes all indirect emissions not included in Scopes 1 and 2. Employee commuting and business air travel, along with transmission and distribution (T&D) losses associated with electricity use, continue to account for the majority of Scope 3 emissions. LLNL's Scope 3 emissions are offset by the estimated annual GHG emissions associated with T&D losses that were avoided by purchased RECs.

LLNL Scope 3 GHG emissions include:

- Employee commuting
- Employee business travel
 - Air travel
 - Rental or privately-owned vehicle mileage
- Off-site (contracted) domestic wastewater treatment
- Off-site municipal solid waste disposal
- Electrical T&D losses
- Estimated avoided T&D losses associated with purchased RECs (emissions offset)

Performance Status

In FY 2017, the Laboratory maintained an overall reduction of 16.2% in Scope 3 emissions from the FY 2008 baseline, exceeding the 9% reduction target for FY 2017. Contributing factors to this year's emissions reduction include a reduction in commute and air travel, off-site municipal solid waste and T&D losses.

Scope 3 GHG Emissions Breakdown			
Categories	Baseline (2008)	FY 2016	FY 2017
T&D Losses	8,624.1	9,980.2	7,185.9
Air Travel	9,709.0	9,358.0	9,156.3
Ground Travel	1,217.7	1,364.0	1,400.7
Commute	25,708.0	19,210.6	20,113.8
Off-site MSW	729.8	743.8	674.6
Off-Site WWT	5.4	14.2	14.9
Total (MtCO₂e)	45,994.0	40,670.8	38,546.2

Figure 2-16. Scope 3 GHG emissions (MtCO₂e) by source. Note: Scope 3 GHG emissions presented in this document are estimates. Actual Scope 3 GHG emissions will be published in the final DOE Sustainability Dashboard.

LLNL continued its personal electric vehicle (PEV) pilot program that was started in 2014. The program was expanded to a total of thirty-seven charging stations during 2016. The program has thirty-seven employee participants paying a monthly charging fee. This reduces GHG emissions by about 110 MtCO₂e annually. In FY 2017, LLNL completed construction of the infrastructure for charging electric vehicles (at B611) for ten new government-owned electric vehicles.



Photo 2-1. Personal vehicle charging station

LLNL has a well-established recycling program that consistently exceeds the 50% goals for diversion of municipal waste from landfill. Everything from aluminum soda cans to tires and toner cartridges are included in LLNL's recycling program. In addition, compostable materials are collected in both onsite cafeterias and many high-occupancy office buildings. Composting and recycling programs that divert waste from landfill are discussed in detail under their respective SSP Goals.

Plans and Projected Performance

LLNL Scope 3 emissions reductions will continue to focus on opportunities to reduce employee commuting and business travel. Any efforts related to Scope 3 emissions reductions will also be impacted by electrical energy use. Annual GHG emissions due to T&D losses associated with electrical energy use are roughly as much as GHG emissions from business air travel.

Tasks associated with the greenhouse gas environmental management plan include identifying opportunities for employee telecommuting and encouraging video-conferencing and webinar/online training instead of travel when these options are available.

Resources Required

Normal business processes are in place for this goal.

SSPP Goal 7.1: Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris

SSPP Goal 7.2: Divert at least 50% of construction and demolition materials and debris

LLNL's pollution prevention (P2) efforts have been guided by federal Executive Orders (EO), and are firmly entrenched in many of its management practices. Many of the goals have been in place at LLNL and have been exceeded. Pollution prevention is a key component of LLNL's Environmental Management System, which includes training for all employees. DOE's SSPP P2 goals and a summary of LLNL's status and plans are listed below.

Goal: Divert at least 50% of routine non-hazardous solid waste from landfill by the end of FY 2017.

LLNL status: LLNL consistently meets or exceeds this goal. In FY 2017, LLNL diverted 76%.

Goal: Divert at least 50% of construction and demolition materials and debris by the end of FY 2017.

LLNL status: LLNL consistently meets or exceeds this goal. In FY 2017, LLNL diverted 77%.

Performance Status

Paper Use

LLNL continues to focus on reducing printing paper and to purchase uncoated paper containing at least 30% post-consumer fiber, in accordance with EO 13693 goals. Figure 2-17 highlights LLNL's progress in reducing paper usage. The Laboratory is identifying opportunities to go paperless wherever possible.

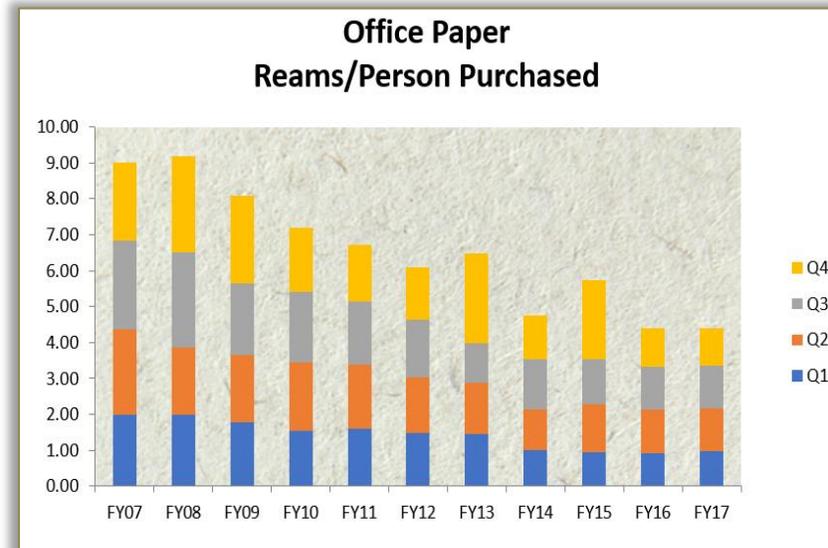


Figure 2-17. LLNL progress in reducing white office-paper usage

The Managed Print Services Program (MPS) is an effort to manage business machines (i.e. copiers, printers, fax machines, and scanners) to increase operational efficiency and reduce LLNL's environmental footprint. Equipment selections include environmental benefits such as double-sided (duplex) printing and scanning capabilities to reduce paper usage, and use solid ink technology instead of traditional toner cartridges. MPS has been implemented in the Operations and Business Principal Directorate, the Computations Directorate, and the Director's Office.

In FY 2017, LLNL was one of five Bay Area federal facilities recognized for improving efficiency, saving resources and reducing costs as part of the [Federal Green Challenge](#) (FGC). LLNL has participated in the FGC since its inception in 2011, achieving reductions in municipal waste, sustainable purchasing, sustainable electronics, and transportation categories. This is the first year that LLNL has been recognized at the regional level, for outstanding achievements in sustainable purchasing. LLNL has made steady incremental reductions in office paper usage since FY 2009 through initiatives such as managed print services, double-sided printing, and moving to online and email for approvals and report submittals. This results in significant savings, and an overall reduction in paper purchases of over 40 percent.

In addition to the savings associated with purchasing less paper (over 22,300 reams, or 56 tons), there are even bigger savings associated with the ink and toner cartridges used for printing (see Figure 2-18).

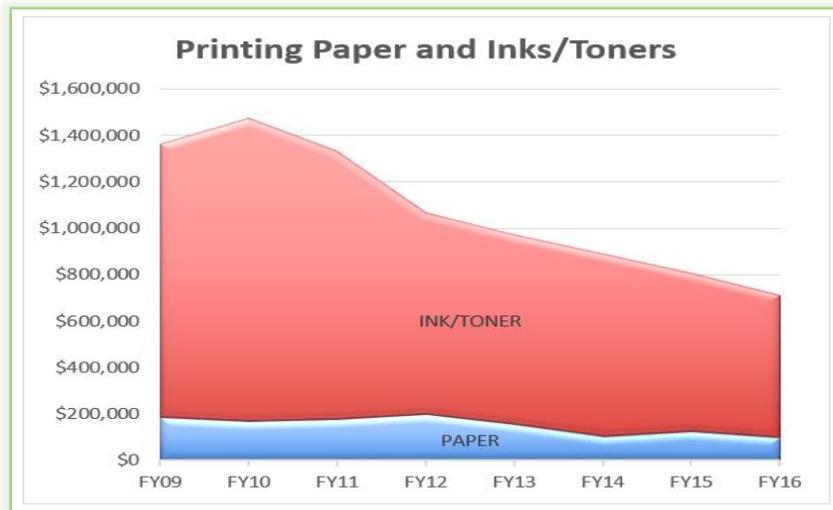


Figure 2-18. Reduction in paper and inks/toners

Waste Minimization and Recycling

LLNL regularly exceeds the EO 13693 goal that specifies that federal agencies divert at least 50% of routine non-hazardous solid waste, including food and compostable material but not construction and demolition debris. LLNL continues its comingled recycling and composting program in thirteen buildings (housing about 30% of LLNL's population) and in both onsite cafeterias. During FY 2017, sixty-eight metric tons of compostable waste and forty-five metric tons of comingled recycling were collected under this program.

Waste collection areas in both LLNL onsite cafeterias have designated waste-collection areas with detailed graphics, signs, and bins to encourage better separation of recyclable, compostable, and trash items. To make separation easier for employees and decrease the amount of waste sent to landfill, the cafeterias switched all disposable foodservice ware to compostable products in 2015.

Other accomplishments in waste management include the following:

- Raising awareness through awards, outreach, and numerous Laboratory events
- Encouraging reducing consumption and reusing items when feasible
- Performing reuse and recycling opportunity assessments in specific areas
- Promoting green meetings and events

LLNL does not anticipate any changes in site population in FY 2018 that could impact waste generation.

Toxic Chemical Reduction

Using a priority-based approach, LLNL addressed the chemical usage-reduction requirements of EO 13514 that focused on toxic, hazardous, and GHG-contributing chemical emissions. Twenty-seven chemicals were selected as "priority" chemicals in 2008 and continue to be tracked and reported regularly (Figure 2-19).

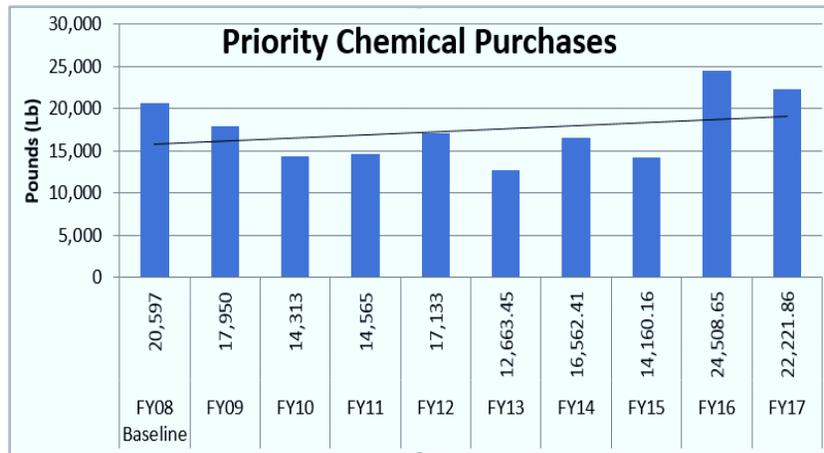


Figure 2-19. Priority chemical purchases

Plans and Projected Performance

LLNL plans to continue to reduce pollution and increase recycling during FY 2018 by:

- LLNL has incorporated a Municipal Waste Reduction Strategy Action Plan under the EMS program that aims to estimate potential recycling and compost collection across selected buildings and, if determined feasible, expand the program to additional buildings to achieve an additional waste diversion of 37,500 lbs.
- Raising awareness through awards, outreach, and Laboratory events
- Continuing to reduce high-risk chemical inventory for chemicals that do not have a foreseeable mission use

Resources Required

Normal business processes are in place for LLNL to meet this goal.

2.04 Fleet Management Category (SSPP Goals 5.1, 5.2, 5.3, 5.4, and 5.5)

SSPP Goal 5.1: 30% reduction in fleet-wide, per-mile greenhouse-gas emissions by FY 2025 from FY 2014 baseline (2017 target: 4%)

Performance Status

Executive Order 13693 was issued in March 2015. DOE Federal Energy Management Program guidance related to greenhouse gas emissions calculations is pending. In FY 2017, LLNL contributed towards the NNSA/DOE achieving an overall 30% reduction in fleet-wide, per-mile greenhouse gas emissions reduction. The final percentage contributed towards this goal will be calculated in the Dashboard in November, when the LLNL usage data is inputted from FAST. LLNL is evaluating the best alternatives to impact greenhouse-gas emissions from vehicles. Alternatives may include alternate vehicle-procurement channels.

Plans and Projected Performance

LLNL will continue to rely on E85, and has incorporated ten electric vehicles into its fleet as part of the 2017 target. In addition, LLNL will seek alternate procurement channels where practical and required to support achievement of the target. The Laboratory is dependent on sources such as CAFÉ standards and the OEMs which are outside of our sphere of influence, resulting in insufficient information to fully assess the projected performance at this time.

Government-Owned Electric Vehicle Pilot Program

In 2015, the LLNL's Asset Management Department participated in a conference call between the DOE and other federal sites to discuss fleet-related matters such as leveling, exchanges, training, and sustainability. During the discussion, the DOE representative mentioned the department's desire to have one of its sites volunteer for a pilot program to acquire fully electric vehicles (EVs). It was at that time that LLNL's Fleet Management volunteered to initiate such a pilot program.

LLNL proved to be a perfect choice for EVs due to its flat, one-square-mile layout and the fact that it already had a robust personal EV program in place. In order for the DOE to accept LLNL as a pilot site, it had to be willing to take ten EVs the first year, and expand its charging infrastructure to include Level II charging stations.



Photo 2-2. A fully electric Ford Focus at LLNL

In FY 2016, the LLNL EV committee began to strategically evaluate the future of its EV program while the DOE placed the order for the ten electric sedans. In the summer of 2016, LLNL utilized its Summer Student Program to hire a recent college graduate who was assigned the task of researching vendors who could

enhance the LLNL EV program (both electric and solar options were researched). One company contacted for information was ChargePoint Inc., based in Campbell, California. ChargePoint was identified as one of the leaders in the field of electric vehicle chargers. Conversely, another company contacted for information was Envision Solar International Inc., based in San Diego, who had cutting-edge technology on portable solar vehicle chargers.

In early 2017, the EV Committee identified, reviewed, and later approved a location for the first Level II electric charging station (Building 611). The construction project plan ensured the charging station would be completed on or before the ten EVs arrived by the end of the fiscal year.

In April 2017, two managers from Asset Management participated in the NNSA Fleet Working Group's quarterly meeting, held at the Nevada National Security Site. During that trip, the participants were shown an Envision Solar - EV ARC. LLNL representatives were impressed by the unit, and asked for a demo unit to be provided to LLNL. Once the unit was delivered to LLNL, EV owners fully utilized it and provided positive feedback.

In late FY 2017, LLNL completed the installation of one Level II electric charging unit (with two charging receptacles), and purchased two Level II portable solar charging units. The solar units were strategically placed in high-volume, high-visibility locations onsite (Photo 2-3).



Photo 2-3. An Envision Solar Arc in use at LLNL

On October 23, 2017, a special ceremony (Photo 2-4 and Photo 2-5) was held onsite to highlight the accomplishments of the EV program. In attendance were representatives from the DOE vehicle program, ChargePoint, Envision Solar, senior LLNL management, Sandia Livermore, Lawrence Berkeley Lab, and the Livermore mayor's office.



Photo 2-4. LLNL Deputy Director Tom Gioconda at the EV ceremony



Photo 2-5. Ribbon-cutting of the Envision Solar Arc at LLNL

In November 2017, Fleet Management began deployment of the ten EVs out into the programs. Programs were contacted to schedule exchanges and training sessions. In all, ten petroleum-fueled sedans were replaced by electric vehicles. LLNL intends to increase its overall electric vehicle fleet to sixty over the next several years. With the addition of the one Level II electric charging unit (with two charging receptacles), and the two Level II solar units, LLNL now has a total of forty-one charging stations, with more Level II stations planned.

It should be noted that LLNL will continue with its primary E85 alternative fuel and electric vehicle strategy. Additionally, LLNL will seek alternate procurement channels where practical and required to support achievement of the target.

SSPP Goal 5.2: 20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter (2017 target: 20%)

Performance Status

In FY2017, LLNL decreased its petroleum fuel consumption by 70.04% relative to the FY2005 baseline, but increased 1.3% from FY 2016. This increase was a direct result of more vehicles being assigned to LLNL's Site 300, in Tracy, California. The fueling station at Site 300 does not have E85 fuel, and therefore must use regular unleaded fuel. LLNL will continue to replace petroleum-use vehicles with AF and electric vehicles at its main site in Livermore. The Laboratory will also continue to promote the reduction of petroleum fuel by acquiring more electric vehicles and by advertising and leveraging taxi services. Figure 2-20 shows the increase of the overall petroleum consumption.

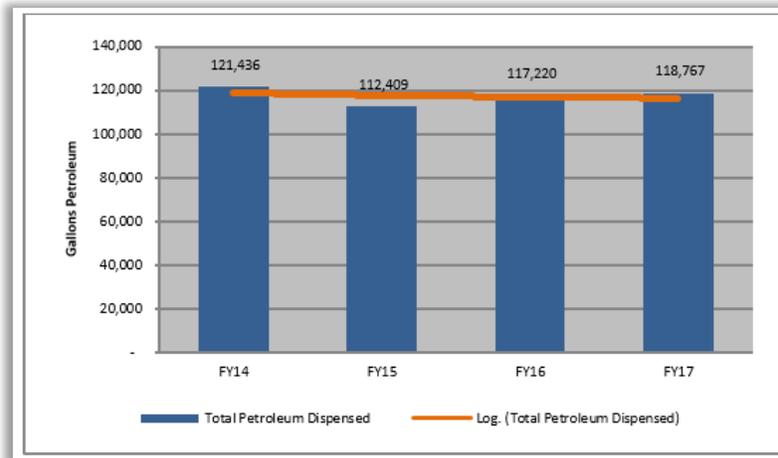


Figure 2-20. LLNL Petroleum Consumption Reduction

Plans and Projected Performance

LLNL will continue to strengthen its alternative fuel infrastructure by replacing conventional fueled vehicles with AFVs and by promoting the use of alternative fuels.

SSPP Goal 5.3: 10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter. (2017 target: 10%)

Performance Status

LLNL continues to focus its alternative-fuel strategy primarily with the use of ethanol fuel (E85) as its fuel of choice. In 2007, LLNL built an ethanol fuel station with a 12,000-gallon underground tank at a cost of \$1.3 million. Subsequently, LLNL restructured its fleet strategy to be composed of E85-compatible vehicles. In FY 2017, LLNL's use of alternative fuels (AF) decreased 5% relative to the previous year's consumption. This decrease was due in large to CARB compliance standards for the state of California. For example, E85 Ford Transits could not be offered in California. The overall increase compared to the FY 2005 baseline is 390%. As shown in Figure 2-21, LLNL has entered the maturity stage on AF consumption and year-over-year increases are anticipated to level off. LLNL has recently received ten electric vehicles (sedans) and is supporting these vehicles with enhanced charging infrastructure. LLNL anticipates receiving more electric vehicles in subsequent years.

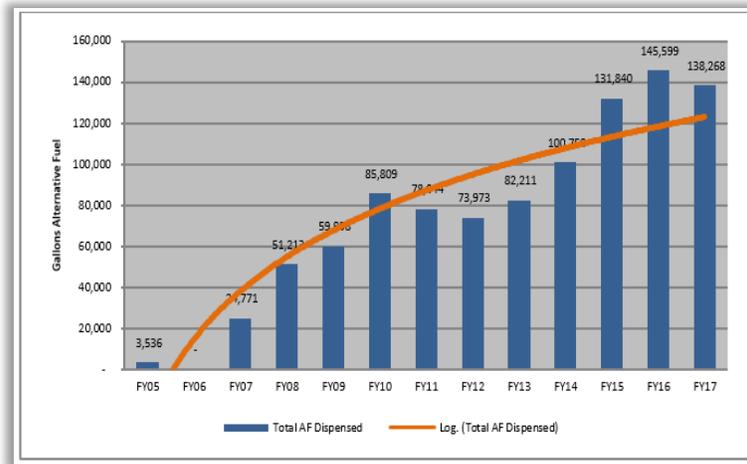


Figure 2-21. Total alternative fuel dispensed

Plans and Projected Performance

LLNL plans to increase its overall electric vehicle fleet to greater than fifty vehicles in a few years.

SSPP Goal 5.4: 75% of light-duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2017 target: 75%)

Performance Status

In FY 2017, LLNL did not meet the required 75% replacement of fossil-fuel, light-duty vehicles with AFVs. LLNL replaced 68% of the light-duty vehicles scheduled for exchange with AFVs. LLNL's current alternative-fuel fleet accounts for 79% of its total light-duty vehicles.

Plans and Projected Performance

LLNL will continue replacing its fleet with AFVs as manufacturers make them CARB-compliant for the state of California, and are available. LLNL will also explore different alternative-fueled vehicle options. LLNL replaced ten petroleum-fueled sedans with electric vehicles. The Laboratory also plans to increase its overall electric vehicle fleet to greater than fifty in a few years. In the meantime, LLNL will continue with its primary E85 alternative fuel vehicle fleet strategy.

In accordance with E.O. 13693, the Laboratory launched a personal vehicle charging program in FY 2014. The program is designed to allow employees to charge their personal vehicles using existing Livermore site-designated charging locations for a monthly fee. Employees who choose to participate in the program are asked to sign an end-user agreement that provides details and terms of the program requirements. End-users pay a monthly fee which provides them with access to charging stations. Initially, LLNL had thirty-seven charging stations available under the program. In FY 2017, LLNL added one Level II electric charging station (with two charging receptacles), and two Level II solar units, bringing its total to forty-one charging stations. All charging stations are based on a first-come, first-served basis. Currently, there are approximately 50-plus employees enrolled in the program (and more are being added, which is an increase of 13 from the total in FY 2016). This program is in response to employee requests and in support of NNSA/DOE and the Lab's site sustainability efforts.

DOE Fleet Management Information System

Plans and Projected Performance

NNSA HQ-Fleet will submit one NNSA fleet management plan that incorporates each site's accomplishment. LLNL will report status on the goals to the collective NNSA/DOE fleet goal.

LLNL has reviewed the current reporting requirements for the implementation of the DOE Fleet Management Information System (Fed FMS) as it relates to DOE-owned vehicles. Metadata for each owned vehicle will be validated and updated. Monthly summaries of fuel costs and mileage will be entered beginning in December (with November data). A unique fuel card has been issued to each vehicle to facilitate proper accounting. Odometer readings are collected using field transaction data gathered during fueling and vehicle representative data collection.

SSPP Goal 5.5: 50% of passenger vehicle acquisitions consist of zero-emission or plug-in hybrid electric vehicles by FY 2025. (2017 target: 4%)

Performance Status

LLNL is evaluating the best alternatives to impact greenhouse gas (GHG) emissions from vehicles. Alternatives may include alternate vehicle procurement channels.

Plans and Projected Performance

FY 2017, LLNL evaluated the charging infrastructure required to support an electric vehicle fleet that meets the 2025 goal. LLNL replaced ten petroleum-fueled sedans with ten electric vehicles, and plan to increase its overall electric vehicle fleet to greater than fifty in the next several years. In the meantime, LLNL added one Level II electric charging unit (with two hoses), and two Level II solar units, bringing its total to forty-one charging stations. LLNL will continue with its primary E85 alternative fuel and electric vehicle strategy. The Laboratory will also seek alternate procurement channels where practical and required to support achievement of the target. LLNL is dependent on sources such as CAFÉ standards and the OEMs, which are outside of our sphere of influence resulting in insufficient information to fully assess the projected performance at this time.

2.05 Clean and Renewable Energy Category (SSPP Goals 3.1 and 3.2)

SSPP Goal 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 FY2017, working towards 25% by FY 2025

Performance Status

LLNL’s energy consumption comes from electricity and natural gas. The “Clean Energy” goal was met by the purchase of Renewable Energy Credits (RECs) in addition to the 73% allotment from the 3.3MW PSEG Lawrence Livermore Solar Center (see Photo 2-6).

Plans and Projected Performance

LLNL will continue with the purchase of RECs in addition to the use of the renewable electrical energy output of the P-V solar facility.



Photo 2-6. 3.3 MW P-V solar plant at LLNL

The P-V solar plant located at the northwest buffer zone started commercial operations in February 2016. This renewable energy plant generated a total of 5,559 MWh in FY 2018. LLNL’s share of this renewable energy was 4,046 MWh. That is the equivalent energy used by 1.33 million homes for one hour or GHG emissions of about 601 vehicles for a year. It is anticipated that this renewable energy plant will produce about 6M kWh annually and contribute to the renewable energy goal for DOE.

SSPP Goal 3.2: “Renewable Electric Energy” requires that renewable electric energy account for not less than 10% of a total agency electric consumption in FY17, working towards 30% of total agency electric consumption by FY 2025

Performance Status

Due to the low cost of purchased power, installing renewable energy at LLNL has been a challenge. LLNL is a member of the Northern California Sites Electric Power Consortium (the Consortium). The Consortium includes LLNL, Lawrence Berkeley National Laboratory (LBNL), and Stanford Linear Accelerator Center (SLAC). The Consortium currently utilizes two sources of power to meet its annual energy requirements: the Central Valley Project (CVP) Base Resource allocation of hydropower and wholesale market power

purchases. WAPA is the Consortium's procurement agent, and makes any required wholesale purchases on the Consortium's behalf.

The wholesale power rates are considerably less expensive when compared to local public utilities such as PG&E. These low rates have also made renewable energy development incur a longer ROI relative to projects with standard utility rates. The 10% renewable energy consumption requirement was exceeded at 27% through the purchase of RECs and Renewable Electric Energy in FY 2017. LLNL purchased 16,715 MWh of RECs, 100,471 MWh of Renewable Electric Energy from incremental hydropower plus 4,046 MWh of Renewable Electric Energy from the onsite solar plant.

LLNL was also awarded a recent grant to balance the use of solar power at the building scale. This project will entail using a solar array at the Livermore Valley Open Campus (LVOC) and coordinating building energy management with a nearby building. This project will not result in any additional renewable credits for the LLNL site, but will aid in the knowledge of how renewable power can be used for individual buildings.

LLNL is currently exploring the use of Site 300 for renewable energy research purposes. The goal of this effort would be to provide a test bed for existing renewable technology (solar and wind), to improve the multi-scale modeling of renewable resource availability and variability using high-dimensional models in concert with deployed sensors, and to examine avian interactions with renewable energy systems to reduce fatalities.

LLNL has deployed solar energy at a smaller scale, including a number of pathway and parking lot lights, and environmental sensors. In FY 2012, LLNL discussed renewable energy options (including fuel cell purchases) with renewable energy providers, yet the relatively high cost of these projects prohibited their actualization.

Details of the REC purchases can be found in the Dashboard under Renewables.

Plans and Projected Performance

For FY 2018, LLNL will purchase RECs to comply with the renewable energy requirement. The amount of RECs purchased can decrease substantially due to the contribution of the P-V solar plant at LLNL. LLNL will continue to explore research opportunities for renewable power generation at Site 300; if these projects come to fruition, LLNL will use that power as well. Additionally, the Site 200 renewable energy goals would contribute to DOE's goals.

Even with a 3.3 MW P-V array, LLNL will still need to purchase additional RECs; renewable energy projects are capital-intensive. In general terms, a 6 MW solar array would be required to meet the renewable energy goals for LLNL; this would require an approximate \$24 million investment. A 6 MW solar array would also greatly contribute to LLNL's energy reduction goals. The high cost of onsite renewable power indicates an ROI that would exceed the projected 20-year useful life of the equipment. When compared to WAPA rates, renewable energy only becomes economically feasible when the producer is a private entity eligible for tax credits, tax exemptions, depreciation, and other assorted incentives.

For the next fiscal year, LLNL will accomplish the following:

- Continue exploring scientific opportunities in renewable energy.
- Continue discussions with renewable energy providers on innovative opportunities in renewable energy for LLNL.
- Continue collaboration in the Northern California DOE Laboratory Consortium.

2.06 Green Buildings Category (SSPP Goals 2.4, 2.5, 2.6a, and 2.6b)

SSPP Goal 2.4: At least 17% (by building count or gross square feet) of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the revised Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter

Performance Status

Four LEED building certifications (B142, B264, B451, and B453) were completed in 2008-2011 and six initial building assessments using the DOE HPSB Assessment Tool were completed in 2011-2012. Assessments for eight additional buildings stand at 95% completion, awaiting funding for the purchase and installation of occupancy-sensing lighting controls. These eighteen buildings have met (or will meet) the requirements of the five HPSB Guiding Principles: Integrated Design, Energy Performance, Water Use Reduction, Indoor Environmental Quality, and Materials Conservation, either through the use of the HPSB Assessment Tool or the LEED Existing Building: Operations and Maintenance rating system.

Candidate buildings continue to be identified so that HPSB Assessments may proceed after funding has been identified for the effort. The current number of occupied buildings over 5,000 square feet in the enduring inventory is 131 with a total square footage of 5,615,671; seventeen percent of this is twenty-three buildings with a total square footage of 954,664. As of FY2014, ten buildings had been assessed using the LEED system or the HPSB Assessment Tool (43% complete), with a total square footage of 395,775 (41% complete). An additional thirteen assessments based on building count and an additional 558,889 square feet based on square footage need to be assessed to achieve the 17% goal.

Plans and Projected Performance

Building 311 is scheduled for U.S. Green Building Council (USGBC) LEED submittal in FY2017/FY2018. The estimated cost of development of the submittal packages of this building is estimated at \$60,000, which includes staff time for researching building history, building assessments, completion of USGBC LEED templates, and providing all required support documentation. An initial survey of the lighting and HVAC systems identified and implemented opportunities for lower-cost improvements that had a positive effect on the building's overall energy savings; currently, additional funding is being sought to make the remaining changes. A small portion of the funding is set aside for the registration and review fees charged by USGBC/Green Building Certification Institute (GBCI). Existing campus-wide documentation, primarily based on LLNL's EMPs, will continue to be utilized in the building-assessment documentation process. Funding has been requested for this effort.

Pending funding availability in FY 2018, Buildings 211, 272, 531 and 691 are scheduled for DOE HPSB assessments which are embedded in the EPA Portfolio Manager benchmarking website. The facilities will be assessed and all relevant information will be reported using the HPSB Assessment Tool. This includes tracking all energy usage, building ventilation and overall systems' performance, irrigation studies for possible water savings, and demonstrating that green cleaning, integrated pest management, and low-emitting materials are in-use.

Resources Required

The overall scope of this project is anticipated to require a multi-year effort, and scheduling of upcoming projects is based primarily on staff availability; there is no dedicated HPSB staff at this time. Funding needed to complete the long-range tasks will be requested in future fiscal years.

The estimated cost of development of the submittal packages for Building 311 is estimated at \$60,000. The estimated cost of development of the HPSB submittal packages of ten buildings is estimated at \$6,000 each.

Pending funding, additional staff may be hired and/or current staff will be trained to aid in completing more USGBC LEED/HPSB assessment templates and providing all required support documentation.

Funding has been requested to complete the remaining scope required for LLNL to meet its HPSB goal in each of the 27 remaining buildings, listed in Figure 2-22.

Building Name	GSF	Remaining Scope	Target Year	Estimated Cost (\$)
B211	14,122	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	20,000
B272	10,124	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	19,000
B531	12,381	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	20,000
B691	18,437	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	22,000
B155	21,742	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	28,000
B161	6,105	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	12,000
T2727	5,000	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	12,000
T2775	9,875	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	18,000
T2825	59,875	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	12,000
T4525	5,736	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	12,000
T4726	9,384	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	18,000
T4728	6,762	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	12,000
B694	10,590	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	19,000
B694	10,590	All HPSB documentation	FY2018	6,000
		Lighting occupancy sensor design, procurement and installation	FY2019	19,000
B140	66,660	All HPSB documentation	FY2018	25,000
		Lighting occupancy sensor design, procurement and installation	FY2019	85,000
B571	41,407	All HPSB documentation	FY2018	20,000
		Lighting occupancy sensor design, procurement and installation	FY2019	65,000
B671	41,476	All HPSB documentation	FY2018	20,000
		Lighting occupancy sensor design, procurement and installation	FY2019	65,000
B551E	40,889	All HPSB documentation	FY2018	20,000
		Lighting occupancy sensor design, procurement and installation	FY2019	65,000
B311	40,951	LEED Certification package needed	FY2018	60,000
T1677	28,576	Lighting occupancy sensor design, procurement and installation	FY2019	36,000
T1739	5,646	Lighting occupancy sensor design, procurement and installation	FY2019	12,000
T1889	16,821	Lighting occupancy sensor design, procurement and installation	FY2019	22,000
T3724	19,810	Lighting occupancy sensor design, procurement and installation	FY2019	26,000
T3725	19,867	Lighting occupancy sensor design, procurement and installation	FY2019	26,000
T3726	19,824	Lighting occupancy sensor design, procurement and installation	FY2019	26,000
T4675	11,142	Lighting occupancy sensor design, procurement and installation	FY2019	19,000
T6925	5,873	Lighting occupancy sensor design, procurement and installation	FY2019	12,000
Total	559,665			931,000

Figure 2-22. HPSB goal project list. List of projects that, if funded and implemented, would allow LLNL to meet its HPSB goal

SSPP Goal 2.5: Regional and local planning

Executive Order 13693 Planning for Federal Sustainability in the Next Decade, issued on March 19, 2015, instructs federal agencies including DOE to maintain Federal leadership in sustainability and greenhouse gas emission reductions as follows:

- Participate in regional transportation planning, recognition of existing community transportation infrastructure, and incorporation of such efforts into site policy and guidance documents.
- Ensure planning for new federal facilities or new leases includes consideration of sites that are pedestrian friendly, are near existing employment centers, are accessible to public transit, emphasize existing central cities and, in rural communities, existing or planned town centers.

- Identify and analyze impacts from energy usage and alternative energy sources in all Environmental Impact Statements and Environmental Assessments for proposals for new or expanded federal facilities under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.).
- Coordinate with regional programs for federal, state, tribal, and local ecosystem, watershed, and environmental management.
- Identify regional transportation planning, ecosystem, watershed, and environmental management initiatives affecting sites and opportunities to work with local authorities to align energy policies and siting of renewable energy infrastructure.

Transportation

The Laboratory recognizes the existing community transportation infrastructure and works with multiple local and state agencies on transportation planning, providing input on the selection of future Livermore stations served by regional Bay Area Rapid Transit (BART), and promoting public transit commuting ridership. Such collaborative planning allows LLNL to develop anticipated needs of providing appropriate internal means for Laboratory commuters to connect easily with public transit. The Laboratory's on-site shuttle schedule aligns with the local transit service (Wheels) during commute hours, connecting the route to the Livermore downtown transit center, the ACE Train Station, and the Dublin BART station.

The bicycle remains a popular seasonal method of commuting, with increasing awareness of personal fitness, energy conservation, and housing developments close to LLNL. Local bike lanes lead directly onto the Laboratory site; the Bay Area weather and the relatively flat site terrain also contribute to bicycling and walking as major modes of internal travel onsite.

As a major employer in the community, LLNL is committed to promoting energy conservation and supports commuters by providing certain onsite conveniences to those who use alternate modes of transportation rather than the single-occupant vehicle:

- Maintaining a database to facilitate rideshare and vanpool matching.
- Permitting vanpools to route through "Limited" security areas.
- Providing preferential parking spaces for vanpool vehicles.
- Offering free bicycle safety helmets to on-site riders and bicycle commuters.
- Providing power charging stations as a pilot program for personal electric vehicles.
- Providing on-site taxi shuttle service and a site-use bicycle program.

Plans and Projected Performance

All buildings and ancillary facilities are located within the established Laboratory site boundaries; with approximately 6,900 GSF of leased facility in the local vicinity. Site planning for new facilities is coordinated with architectural and civil design for orientation, energy efficiency, and incorporation of environmental management system considerations (including bioswale soft-shoulder for roadways and sustainable landscaping for open grounds).

Sustainable site development encompasses an integrated approach to the planning of future onsite facilities and infrastructure consistent with the LLNL Ten Year Site Plan (TYSP), striving to enhance site stewardship in coordination with the surrounding community. The Laboratory encourages walking and bicycling as a means of travel within the site; long-range site development envisions continuous improvement of a bicycle- and pedestrian-friendly environment:

- Future facilities development will be physically scaled and organized to maximize the potential of walking and bicycling on-site: quick trips on foot typically measure about one quarter mile, while the typical bicycling distance is about one-half mile.
- Sidewalks and landscaped pathways will provide safe and direct travel for pedestrians segregated from motor vehicles wherever feasible. Bicycle travel is accommodated by a mix of road sharing and pedestrian/bike shared-use pathways.

- LLNL supplies and maintains approximately 600 unassigned bicycles for employees' use on-site. Riders leave bicycles at destinations; bicycles are redistributed daily around the site. Sixty (60) bikes were replaced in FY2015 with new ones to ensure having sound equipment for the program.
- LLNL operates an on-call on-site taxi shuttle service, with additional kiosks locations within a quarter mile radius from major on-site destinations.
- LLNL continues to pursue civil improvement projects to expand the site-wide integrated pathway network for pedestrians and bicycles, providing landscaped linkages between major destinations.

LLNL's approach to landscaping is to strive for a campus-like environment and be responsive to a sustainable design appropriate for the location and function, utilizing drought-tolerant and native planting, hardscape, and smart irrigation control systems. The objective is to reduce irrigation water usage and optimize plant growth and maintenance efforts. LLNL has further fine-tuned watering of existing turf areas in FY2015, with approximately 32,600 ft² converted to drought-tolerant planting or xeriscape; the converted areas can expect a 50% reduction in irrigation water usage after the new plantings have been established.

Local Planning Coordination

LLNL continues to maintain good relationships with local community planning and government agencies, including the cities of Livermore and Tracy, as well as the counties of Alameda, Contra Costa, and San Joaquin. The planned expansion of Livermore Valley Open Campus (LVOC) would foster a community of collaboration amongst laboratories, academia, the private sector, and outside agencies on research and development in green transportation, energy, advanced technologies, and high-performance computing. Sustainable practices would be incorporated into the LVOC plan as practicable.

Energy

LLNL continues to review all ongoing operations, new or modified projects, or modifications in site operations for impacts on utilities and energy use. Cumulative impacts on energy use and meeting energy goals will continue to be considered in long-range planning.

Environmental Planning

DOE/NNSA's National Environmental Policy Act (NEPA) process is the foundation for all major federal actions, and is an important component to LLNL's planning. The LLNL Environmental Functional Area addresses environmental compliance for LLNL/DOE through various programs, including the Environmental Management Systems (EMS). The EMS addresses significant environmental aspects, including water conservation, greenhouse-gas reductions, waste reductions and sustainable acquisition Lab-wide. LLNL supported DOE/NNSA in preparing a Supplement Analysis under the National Environmental Policy Act (NEPA) for the five-year review of the Site-Wide Environmental Impact Statement for Continued Operations of LLNL in 2011. DOE/NNSA continues to review proposed projects and plan site developments and modifications in accordance with NEPA.

Large-Flowered Fiddleneck Restoration

The large-flowered fiddleneck is a federally listed endangered species with an extremely limited distribution (Photo 2-7). Only two native populations of this species are known to occur; one population is located at LLNL's Site 300, and the second is located on nearby private land. Two introduced experimental populations (one at Site 300 and a second on property owned by the East Bay Regional Parks) are also maintained by occasional seed bank enhancement. LLNL participates in regional large-flowered fiddleneck recovery efforts, including efforts to maintain the experimental populations and research on the effects of fire frequency on large-flowered fiddleneck abundance. A member of the LLNL staff also serves on the large-flowered fiddleneck recovery team.



Photo 2-7. The large-flowered fiddleneck (*Amsinckia grandiflora*) is a wildflower endemic to California, and occurs at LLNL's Site 300 in the large-flowered fiddleneck reserve.

Renewable Energy

Land use onsite will continue to evolve with opportunities to implement sustainability projects at the Livermore site and Site 300. Construction on the 10-acre, 3.3MW ground-mounted photovoltaic solar array in the northwest security buffer of the Livermore site was completed in 2016. LLNL will continue to consider renewable energy use at the Livermore site and Site 300, in accordance with goals and long-range plans.

SSPP Goal 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 FY 2025

Performance Status

No existing facility above 5,000 GSF has been identified for Net Zero capability in FY 2017.

Plans and Projected Performance

Due to the expected exponential increase in costs, upgrade of an existing facility to Net Zero is not easily achievable or practicable. A short list of existing facilities that may be viable as candidates for Net Zero (energy) will be developed in 2018.

Resources Required

To achieve LEED Gold certification, construction upgrade costs are generally 10% higher than usual. A significant funding investment to upgrade an existing facility to Net Zero is expected. The availability of that additional funding is unknown at this time.

SSPP Goal 2.6b: Net Zero Buildings: All new buildings (>5,000 GSF) entering the planning process designed to achieve energy Net Zero beginning in FY 2020

Performance Status

All new construction greater than 5,000 GSF will comply with the GPs (e.g., HPSB, LEED, etc.). No future facility exceeding 5,000 GSF has been identified for Net Zero capability in FY 2017.

Plans and Projected Performance

A short list of future facilities that may be viable as candidates for Net Zero (energy) will be developed in 2018.

Resources Required

Line-item funding is being requested for construction of the new Emergency Operations Center (EOC) in FY 2018. LLNL has begun to use Institutional General Plant Projects (IGPP) as well as direct General Plant Project (GPP) funding to construct new buildings (Figure 2-23).

New buildings will be constructed to meet either LEED Gold or achieve HPSB certification. To achieve LEED Gold certification, construction costs are generally 10% higher than usual. While the new construction projects have the potential to be candidate Net Zero facilities, the upcharge for Net Zero facilities and the availability of additional funding is unknown at this time.

Project	Project Cost (\$M)	Annual Savings (\$M)	Simple Payback (Yrs)	FY17 (\$M)	FY18 (\$M)	FY19 (\$M)
Advanced Manufacturing Laboratory	9.8	N/A	N/A	0.2	4.7	4.9
Protective Force Fitness Center	4.8	N/A	N/A	2.8	2	0
IGPP Funded Generic Office Building	9.8	N/A	N/A	0	4.9	4.9
Emergency Operations Center (line item funded)	22.5	N/A	N/A	0	22.5	0

Figure 2-23. Proposed new construction projects

2.07 Acquisitions and Procurement Category (SSPP Goal 6.1)

SSPP Goal 6.1: Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts

According to LLNL policy, LLNL shall ensure 95% of new contract actions, including task orders under new contracts and existing contracts, require to the extent possible, the supply or use of products and services that are energy-efficient (ENERGY STAR or Federal Energy Management Program [FEMP]-designated), water-efficient, bio-based environmentally preferable (including Electronic Product Environmental Assessment Tool [EPEAT]-registered products), non-ozone depleting, contain recycled content, or are non-toxic or less toxic alternatives; and LLNL shall update affirmative procurement plans (also known as green purchasing plans or environmentally preferable purchasing plans), policies, and programs to ensure that all federally mandated designated products and services are included in all relevant acquisitions.

Performance Status

LLNL has an Affirmative Procurement Program (APP) which ensures environmentally preferable products and services, recycled-content products, and bio-based products are purchased to the maximum extent practicable and are consistent with federal law and related procurement requirements, including EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management, and the DOE Affirmative Procurement Program Guidance. Sustainable Acquisition or Environmental Affirmative Procurement Program (EPP) clauses requiring subcontractors to utilize environmentally preferable products/services and recovered or recycled content have been incorporated into all LLNL General Provisions (GPs) for purchase orders and subcontracts, except for the Standard Research GPs. The Standard Research GPs apply only to subcontracts awarded for basic or applied research services and do not offer an opportunity to procure products. As such, there is no benefit to add sustainable acquisition clauses to this GP. As a result, LLNL is 100% compliant with the requirement to include sustainable acquisition clauses in eligible contract actions.

LLNL continues to implement Procurement Standard Practice 23.5, Environmental Affirmative Procurement and Waste Reduction Requirements. This Standard Practice describes the requirements for acquiring environmentally preferable products and services, products with recycled content, and bio-based products, to promote cost-effective waste reduction in Laboratory subcontracts. It is reviewed periodically by the Environmental Functional Area (EFA) in order to ensure all regulatory revisions, updates, and changes have been incorporated. The Standard Practice was last updated on March 3, 2017.

Sustainable Acquisition Highlights

- EPEAT: 82 % of all computers, monitors, imaging equipment, and televisions purchased during FY2017 successfully met the EPEAT criteria.
- LLNL continues to manage sustainable Integrated Contractor Purchasing Team (ICPT) agreements with Fisher Scientific, Grainger Industrial Supply, and VWR International Scientific Products. These agreements offer special promotional pricing discounts off of GSA pricing.
- Blanket agreements with Holman's and The Office City have requirements to include EPEAT ratings by product on their electronic ordering system and to provide quarterly EPEAT reports.
- LLNL continues to award subcontracts to suppliers who offer DOT-critical carbon steel drums made out of 15% recycled content material. During FY 2017, 33 Purchase Orders were awarded to Skolnik Industries totaling \$718,630. One UniCard order was also placed with Skolnik for 16-gallon open head carbon steel drums, totaling \$2,065.
- Six subcontracts with a totaling \$162,760 were awarded to Stockton Tri-Industries, Inc. to manufacture metal waste boxes containing 22% recycled content material.
- LLNL computer subcontractors maintain an EPEAT-rated description field on their websites.
- LLNL's Supply Chain Management Department (SCM) continues to require the major suppliers of desktops, laptops, computer monitors, imaging equipment, and televisions to issue EPEAT reports on

a quarterly basis directly to the Sustainability Performance Program Manager and the Contract Analyst. Receiving detailed reports more frequently throughout the fiscal year assists the Environmental Functional Area (EFA) in analyzing and projecting the total EPEAT buys for the year.

- The Office City manages a punch-out list that identifies recycled content items offered to its customers. The catalog allows LLNL's Technical Release Representatives (TRRs) to see and search for recycled products.
- The current Blanket Agreement with Perfect Output (H100477) for the purchase of multi-function devices (copiers/printers) has a requirement to produce and submit reports detailing their progress in reducing energy consumption, solid waste, and greenhouse gas emissions over the life of the subcontract. This agreement has quarterly EPEAT reporting requirements in the statement of work and they are encouraged to promote EPEAT-qualified equipment in their quotes.
- The Controlled Items/Services List (CISL) identifies the items and services requiring guidance, notification or approval from a specific LLNL organization prior to their acquisition by a TRR. It lists the types of approvals that are required to be obtained from an Environmental Function Area Subject Matter Expert when the purchase of non-EPEAT-rated desktops, notebook workstations or computer monitors are requested on a requisition.

Plans and Projected Performance

LLNL will continue to support the purchase of environmentally preferable products and services, recycled content products, and bio-based products, to the maximum extent practicable, by ensuring the clauses identified in the General Provisions are included in all purchase orders and subcontracts.

LLNL will also continue to revise Standard Practice 23.5 as required and have each revision reviewed by an appropriate member of the LLNS Environmental Functional Area (EFA). This will ensure all regulatory revisions, updates, and changes have been incorporated and that the SP is in compliance with LLNL's prime contract requirements.

Resources Required

Business processes are in place for LLNL to meet this goal. Resources from the Supply Chain Management Department are required to ensure green-related clauses/articles are incorporated into purchase order and subcontract pro-forma documents and to update Standard Practices, as required.

Federal Green Challenge Award

During FY 2017, LLNL was one of five Bay Area federal facilities to be recognized for meeting and exceeding its green goals as a part of EPA's Federal Green Challenge (FGC) program. In September, the Environmental Protection Agency, Region 9, presented LLNL with the 2017 Federal Green Challenge Region Award for significantly reducing its paper usage by almost half over the past seven years (**Error! Reference source not found.**). LLNL was also recognized for its reduction in the use of printer components such as toners and ink cartridges.



Photo 2-8. The 2017 Federal Green Challenge Regional Award identifies achievements in sustainable procurement. Catharine Baker, California assemblywoman for LLNL's district, commented on LLNL's receipt of the award, saying that the Lab's "commitment to improving efficiency, saving resources, and reducing costs while working toward solutions to the nation's most challenging security problems make [LLNL] most deserving of this recognition."

NNSA 2017 Best-in-Class Award for Waste Reduction and Pollution Prevention

LLNL received a NNSA 2017 Best-in-Class award in the Waste Reduction and Pollution Prevention category for a newly installed three-dimensional printer system that uses significantly fewer resources and generates less waste than the previous electronics prototyping process (see Photo 2-10). The new Optomec Aerosol Jet 500 (AJ-500) system, which became operational in January 2016, is capable of printing circuits with a broad range of nanomaterials, allowing engineers to manufacture conductors, semiconductors and microcircuits with an intricacy and flexibility not possible with the Lab's previous technology. Circuit board manufacturers and companies in the medical, weapons and aerospace industries have already shown interest in what can be done with the new technology. Equally significant, the new system is safer, uses less space and equipment, uses fewer raw materials, requires less electricity and water, and results in a fraction of the volume of waste previously generated. To be able to print 3D electronic components is a fundamental game-changer, but to do this with fewer risks, fewer hazardous chemicals, fewer resources, and while generating less waste, is a true sustainability victory.

A brief comparison of the new process versus the old process is shown below (Photo 2-9).

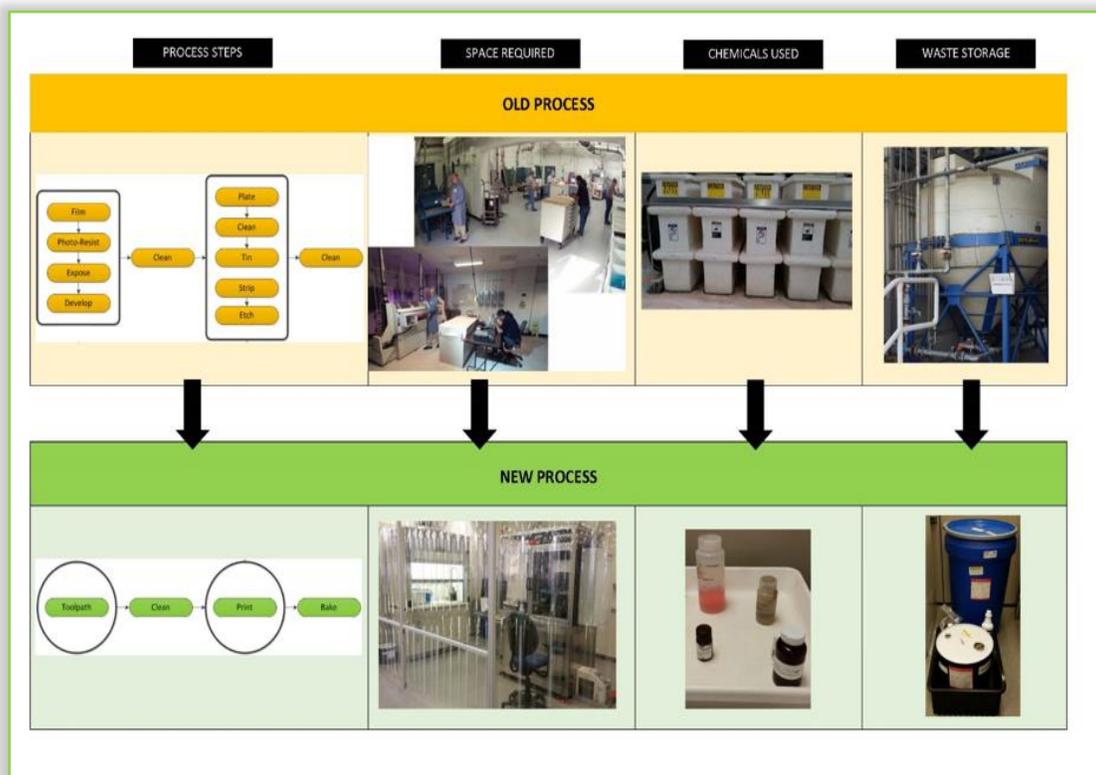


Photo 2-9. A new 3D-printing process reduced waste generation and storage, chemical use, and space utilized.



Photo 2-10. James McConnell (pictured center), Associate Administrator for Safety, Infrastructure and Operations (NA-50), was at LLNL on November 14, 2017 to personally present the NNSA Best In Class Sustainability Award in the Waste Reduction and Pollution Prevention

Lawrence Livermore Solar Center

In January 2015, DOE/NNSA finalized the license agreement with Whitethorn Solar, a wholly owned subsidiary of Juwi Solar Inc. (Juwi), for a solar electrical generation system onsite at Lawrence Livermore National Laboratory (LLNL). The power generated by this system represents the DOE/NNSA's largest purchase of solar power from an onsite facility and the first in the western region. Juwi designed, engineered, and installed, a 3.3 megawatt fixed-tilt solar photovoltaic array at the Laboratory's Livermore site. Juwi also operates and maintains the ground-mounted solar energy system and PSEG, Solar Source (NJ) is the owner. The facility has been operating for almost two years and during the first year actual generation was 6,241 megawatt hours. At peak power the Solar Center provides about 5% of the laboratory's electrical demand and is enough electricity to power more than 600 homes. The bundled renewable power generated from this system is sold to the Western Area Power Administration through a 20-year purchase power contract and the DOE/NNSA purchases the renewable power under its current power agreement with Western for LLNL, LBNL, and SNL-CA. The solar power purchase supports federal climate change and renewable energy goals. Construction was complete in three months despite weekly rain events. Commercial operations began in February 2016 and the facility has been producing power and meeting expected generation goals for the past twenty-one months!



Photo 2-11. Lawrence Livermore Solar Center

2.08 Measures, Funding, and Training Category (SSPP Goal 8.1)

SSPP Goal 8.1: Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693

LLNL has engaged in Energy Performance Contracts, most recently an ESPC, wherein new HVAC controls and WebCTRL software were installed in twenty-four facilities as part of ECM3.1 and seventy-nine advanced electric meters and Energy Management software (EEM Suite) were installed as part of ECM3.2.

As stated in the Energy Management category, digital (DDC) HVAC controls were added to or expanded in about seventeen additional buildings to control temperatures, pressures and humidity. Each system uses constant monitoring and remote alarming to alert building and maintenance staff of malfunctions so that they can be repaired in time to minimize discomfort and energy usage. In reviewing the building energy usage, a 4% reduction in electricity consumption was realized when comparing the usage to before the controllers were added.

LLNL attempted a Utility Energy Services Contract (UESC) with the local utility, PG&E. An Investment Grade Audit (IGA) was completed and the proposal was submitted in FY 2016. The final report proposed four energy conservation measures (ECMs) with an estimated cost of \$2 million, not including third-party financing costs and LLNL support costs. At this time, senior management has decided to not pursue the proposed project due to the backlog of mission-related and infrastructure projects that are in the queue and the lack of resources. The ECMs will be prioritized in the master list for future projects as funding becomes available.

The 3.3 MW photovoltaic solar plant project on 10 acres in the northwest buffer zone started generating renewable electricity in February 2016. This is a Power Purchase Agreement (PPA) between PSEG Solar and WAPA. LLNL uses most of the produced renewable power with LBNL using 20% and SNL/CA using 7%. The plant is estimated to generate about 6M kWh of renewable electricity for LLNL annually and removes the equivalent GHG emissions of about 890 automobiles a year.

Challenges to Use of Energy Performance Contracts

LLNL's low cost of power and water has traditionally been an obstacle to justifying the payback on projects. This hurdle is expected to continue. Small investments upfront can buy down the project and lifecycle cost analysis can assist with improving the project's payback and will be applied as appropriate.

2.09 Travel and Commute Category (SSPP Goal 1.2)

SSPP Goal 1.2: 25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline.

The Laboratory maintains an active Alternate Work Schedule, allowing most employees to opt in to a 9/80 or 4/10 work schedule. Approximately 2,831 employees (40% of the workforce) have elected an alternate work schedule that reduces their commute by 10% (9/80s) or 20% (4/10s).

Bay Area Air Quality Management District (BAAQMD) Regulation 14, Rule 1 was adopted in March 2014. Regulation 14 addresses mobile source emissions reduction measures, and Rule 1 implements the Bay Area Commuter Benefits Program. Employers having over fifty employees, such as LLNL, are required to offer at least one of three commuter benefit options to all covered employees. LLNL had previously already established a pre-tax option program, allowing employees to pay for transit passes or vanpool charges from pre-tax wages. This existing LLNL program meets Option 1 of the Commuter Benefit Options requirement.

GHG emission estimates due to LLNL employee commuting were computed using the most recently available annual U.S. DOT Transportation Statistics for California (Table 4-1 - Commuting to Work: 2013). This table is used to apportion the LLNL employee population by commuting category. Note that the “Worked at home” category is merged with the “Car, truck or van drove alone” category to more closely reflect the LLNL employee population.

Many webinars and other online conferencing options are increasingly available and can be used in lieu of business travel. LLNL’s Information & Communications Services organization provides a WebEx Meeting Center for audio-visual communications with other locations, as well as support for audio and video conferencing, including Voice over IP (VoIP). A travel-authorization process ensures that employee business travel is necessary and appropriate. Opting for teleconferencing and webinars instead of travel has had the additional incentive of reduced business costs over traditional travel.

These efforts have helped LLNL reduce its GHG emissions due to air and ground travel by 3.4% from baseline 2008 levels and BY 1.5% from FY 2016 levels. LLNL’s FY 2017 GHG emissions due to employees commuting are 22% less than baseline 2008 levels. However, these emissions have increased 4.7% from FY 2016 levels due to a larger workforce in FY 2017. LLNL’s travel- (air and ground) and commute-related GHG emissions for FY 2017 are shown in Figure 2-2 under the Waste Management category.

2.10 Fugitives and Refrigerants Category (SSPP Goal 1.1)

SSPP Goal 1.1: 50% Scope 1 and Scope 2 GHG reduction by FY 2025 from FY 2008 baseline

The LLNL SF₆ Management and Capture Plan (LLNL-AR-483031-REV-1) documents ongoing SF₆ use, describes current and future efforts to minimize emissions to the extent practical, and provides the basic framework for how LLNL plans and manages SF₆ operations with reduction goals in mind.

Since 2010, LLNL has significantly raised the awareness on environmental issues with the continued use of SF₆, and as a result, FY 2017 SF₆ emissions have been reduced nearly 42% from baseline 2008 emissions. However, SF₆ emissions in FY 2017 increased 33% from FY 2016 levels, due to increased programmatic activity and a plumbing issue to a flash x-ray system, which has been identified and corrected.

LLNL technicians who maintain, service repair and dispose of equipment containing refrigerants are certified as required by EPA Regulations found in 40 Code of Federal Regulation Part 82, Subpart F. The purpose of these regulations is to reduce refrigerant emissions. Refrigerants and other fugitives contributed approximately 2.5% of LLNL's Scope 1 and Scope 2 total GHG emissions in FY 2017.

2.11 Electronic Stewardship Category (SSPP Goals 9.1 through 9.5)

SSPP Goal 9.1: 95% of eligible acquisitions each year are EPEAT-registered products

Performance Status

Each fiscal year, LLNL is tasked to meet the goal that 95% of all eligible acquisitions be EPEAT-registered products. In order to monitor our success against this goal, LLNL's Supply Chain Management Department (SCM) requires the major suppliers of desktops, laptops, computer monitors, imaging equipment and televisions to issue EPEAT reports on a quarterly basis directly to the Environmental Functional Area (EFA) representative and the Contract Analyst. Receipt of these detailed reports assists EFA in analyzing and projecting the total EPEAT buys throughout the fiscal year.

During FY 2017, the overall percentage of EPEAT desktop electronics, imaging equipment, and television buys totaled 82% for the year, as identified in the chart below (Table 2-1. FY 2017 EPEAT Totals. The overall percentage of EPEAT desktop electronics, imaging equipment, and television buys for the year). LLNL did not meet this goal for the following reasons:

- LLNL continued to purchase non-EPEAT-rated monitors (i.e., 32- and 34-inch curved Dell). These monitors are being used to replace dual-monitor setups throughout the Laboratory as they greatly reduce power consumption when in use and make it easier for the user to navigate across multiple applications. These monitors also have ergonomic benefits as they reduce neck strain by keeping the neck in one position, without requiring the user to rotate their neck from one side to the other while looking at the monitor. For these reasons, and the fact that there are no similar-sized EPEAT monitors available, LLNL has completed an exemption justification so we can continue to procure the Dell 32-inch monitor.
- During FY 2017, the EPEAT database archived Apple products that LLNL was procuring, which were previously EPEAT-rated.

Table 2-1. FY 2017 EPEAT Totals. The overall percentage of EPEAT desktop electronics, imaging equipment, and television buys for the year

EPEAT Total FY17			
Category	EPEAT	non-EPEAT	% EPEAT
Desktop electronics	5580	1129	83.2%
Imaging equipment	228	28	89.1%
Televisions	1	85	1.2%
Overall for all three categories	5809	1242	82%

Plans and Projected Performance

LLNL will continue to review requisitions to see where EPEAT-related products can be substituted for non-EPEAT requirements. LLNL will also continue to mandate that blanket agreement suppliers Holman's, The Office City, and Perfect Output submit quarterly reports that identify all EPEAT equipment acquisitions placed under these agreements. This data will be used to monitor performance and allow LLNL to make adjustments where necessary to assist in meeting the goal.

SSPP Goal 9.2: 100% of eligible PCs, laptops, and monitors have power management enabled

Performance Status

LLNL continues to make progress in automating the electronic stewardship of its personal computing environment. Power management is actively managed on all eligible PCs, laptops, and monitors. All new standard PCs, laptops, and monitors adhere to ENERGY STAR and EPEAT Gold requirements.

Plans and Projected Performance

LLNL will continue its power management on all eligible PCs, laptops, and monitors. As computers are replaced, new systems will continue to be automatically included in the power management program. LLNL will pilot a new program this year that will increase the power management scope to incorporate a more standard configuration that should yield even more efficiencies.

SSPP Goal 9.3: 100% of eligible computers and imaging equipment have automatic duplexing enabled

Performance Status

The Statement of Work for LLNL's Managed Print Services (MPS) blanket agreement states that at a minimum, all multifunction devices and printers purchased under the Agreement shall possess duplex printing capabilities. The MPS vendor does not install all devices; however, when they do the installation, they are directed to configure the device to default to duplex printing.

As part of LLNL's EMS, the Environmental, Safety and Health (ES&H) organization made progress in migrating to the lab's Managed Print Services and eliminating desktop printing. The Weapons and Complex Integration (WCI) directorate launched a pilot MPS in public areas. Several other groups worked to eliminate all non-essential printers from individual offices and reduce paper use by distributing agendas and other media electronically.

LLNL won a 2017 Federal Green Challenge Regional Award for reducing paper usage by almost half over the past seven years and also significantly reducing printer components such as toners and ink cartridges (Photo 2-12).



Photo 2-12. 2017 Federal Green Challenge Regional Award. Representatives from EPA Region 9, including Associate Director Kathy Taylor, attended the SNL/LLNL farmers' market to present the 2017 Federal Green Challenge Regional Award

Plans and Projected Performance

In FY 2018, Operations and Business will reevaluate its contract with the current MPS provider to determine if the contract will be extended.

SSPP Goal 9.4: 100% of used electronics are reused or recycled using environmentally sound disposition options each year

Performance Status

LLNL manages electronic assets through the Donation, Utilization, and Sales (DUS) Group within the Property Management Division. DUS receives excess electronics and either donates, sells for reuse, or sends them to a certified recycling facility. DUS maintains a database that tracks the disposition of electronic devices sent off-site for reuse or recycling. Some electronic devices and storage media that contain sensitive information are handled by individual project areas and must first be purged of the information and then destroyed (e.g., shredded). All residual material is handled appropriately according to universal or hazardous waste regulations.

LLNL continually looks for new opportunities to reuse or recycle electronics. DUS maintains a store, the Second Time Around Store (STARS), where new and used items are made available to employees free of charge for use on-site. In FY 2016, DUS moved the store to a new location and did extensive product organization and promotional outreach to increase use of the store. Outreach efforts included development of a marketing plan, an intranet article, tabletop advertisement tents in the cafes, a revised newsletter layout, distribution of posters to bulletin boards across the lab and pamphlets to the training centers, outreach at lab events, and email campaigns.

Continued promotion of the Second Time Around Store has shown an increase in reuse as demonstrated by the reutilization dollars estimated from the items taken from the store (Figure 2-24). In addition to estimating the value of items, the Second Time Around Store also refined the tracking system to count items in different miscellaneous categories (Table 2-2).

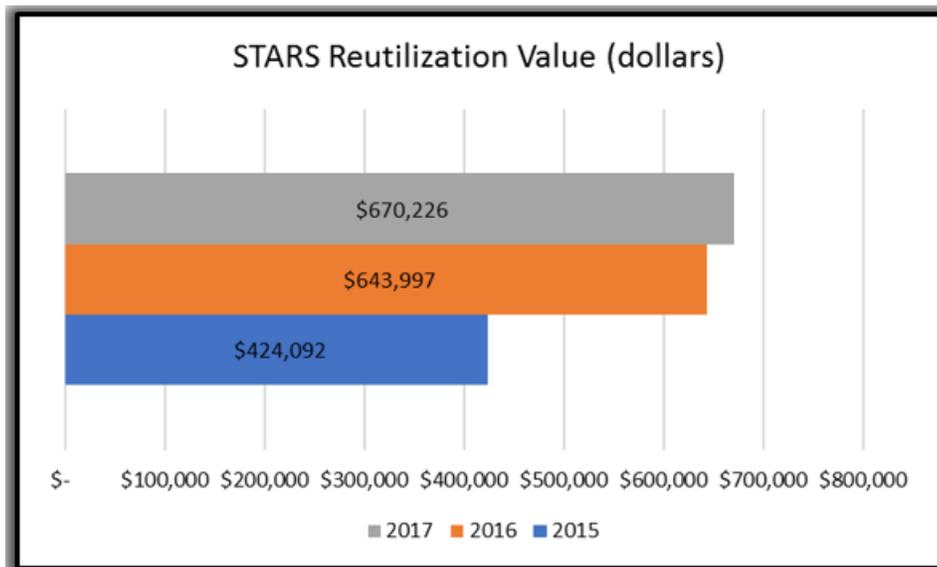


Figure 2-24. STARS reutilization value. Increase in Estimated Value of Items Taken from the Second Time Around Store for Reuse

Items Taken for Reuse from STARS – September 2017		
Misc. Computer Supplies	235	\$7,625
Misc. Furniture	89	\$27,090
Misc. Hardware	454	\$19,153
Misc. Lab Equipment	94	\$12,410
Misc. Office Supplies	712	\$6,134
Misc. Specialty	5	\$1,076
Misc. Toner	18	\$1,750
Misc. Tools	574	\$8,140
Grand Total	2,181	\$83,378

Table 2-2. Second Time Around Store Totals. STARS tracking system upgraded in September 2017 to track items.

Plans and Projected Performance

LLNL will continue to track reuse and recycling of electronic devices, and encourage reuse through online mechanisms and the lab's Second Time Around Store.

SSPP Goal 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

Performance Status

DOE Data Center Optimization Initiative (DCOI)

In 2016, the DOE established a Data Center Working Group (DCWG) to review data center facilities across the complex. This working group has amended the definition of a data center for reporting purposes, established reporting metrics and LLNL has since completed a comprehensive data center inventory based on this new criteria. LLNL is currently evaluating options for the consolidation and closure of eighteen existing unclassified data centers by adoption of a Cloud First policy and migrating hardware to more optimized data centers within the LLNL inventory.

Plans and Projected Performance

In line with the DOE Data Center Optimization Initiative (DCOI) and the DOE Data Center Working Group (DCWG), LLNL will continue to look for opportunities to evaluate reductions in the data center inventory through consolidation and closure of existing tiered and non-tiered data centers. For 2018, there are identified opportunities to consolidate and close three data centers. In addition, it is anticipated that through the DCWG, LLNL will support the migration of inter-agency co-located data centers into the Enterprise Data Center.

LLNL will continue to optimize the efficiency of HPC with the Sequoia platform and the new Vulcan platform. A combination of liquid-cooling and air-cooling techniques will be utilized for installation of Sequoia, with over 90% of the machine being liquid-cooled.

In addition to Sequoia and Vulcan, LLNL continues to optimize the efficiency of HPC with the Sierra, Cascade, Cab and Topaz platforms. They are a combination of liquid-cooling and air-cooling techniques, with over 75% to 90% of the machines being liquid-cooled.

LLNL is heavily involved in the Energy Efficiency HPC Working Group, which participates in many HPC events. One such event is the DOE HPC Power Management Best Practices Workshop, where HPC challenges and best practices are identified. The Working Group meets monthly and is comprised of nearly 100 contributing members from the HPC industry, including national laboratories, universities, and vendors. This

working group is also working with the Green Top 500 list to develop the required metering to attain standardized energy levels during Linpack runs.

Because HPC computational efficiency is an ongoing contribution to mission excellence, LLNL will continue to research and develop techniques to improve the energy efficiency of the highly energy-intensive HPC. LLNL is involved in a number of efforts that not only aim to reduce the energy use of HPC, but promote new standards of quantifying efficiency gains beyond gross energy use. It aims to drive the DOE complex to adopt the approach to use computational efficiency as a viable alternative to measuring advances in HPC sustainable stewardship.

Lawrence Livermore National Laboratory dedicates new supercomputer facility (Photo 2-13).



Photo 2-13. LLNL's new supercomputer facility

The \$9.8 million modular and sustainable facility provides LLNL flexibility to accommodate future advances in computer technology and meet a rapidly growing demand for unclassified HPC. In-house modeling and simulation expertise in energy-efficient building design was used in drawing up the specifications for the facility; heating, ventilation and air conditioning systems were designed to meet federal sustainable design requirements to promote energy conservation. The flexible design will accommodate future liquid cooling solutions for HPC systems. The building is able to scale to 7.5 MW of electric power to support future platforms and was designed so that power and mechanical resources can be added as HPC technologies evolve.

Supercomputers at Lawrence Livermore National Laboratory (LLNL) will be retrofitted with liquid cooling systems under a California Energy Commission (CEC) grant to assess potential energy savings. The selected systems for the first phase of the project, all currently air-cooled, will be retrofitted with Asetek's all-in-one liquid cooling technology. The liquid cooling technology is used to reduce power and greenhouse gas emissions.

Resources Required

Normal business processes are in place for LLNL to continue server consolidation efforts. Funding will be requested for optimization efforts required to bring enduring data centers to performance targets.

2.12 Organizational Resilience Category (SSPP Goals 10.1 through 10.5)

SSPP Goal 10.1: Update policies to incentivize planning for, and addressing the impacts of extreme events due to changes in weather patterns

LLNL is committed to being a leader in responsible environmental stewardship and so incorporates pollution prevention, resource conservation and sustainable acquisitions into our planning and decision-making processes. We comply with all applicable environmental requirements and ensure that interactions with our regulators, DOE, and our community are based upon integrity, openness, and adherence to national security requirements. Through LLNL's existing environmental policy, the Lab commits to continuously improve environmental performance.



Photo 2-14. Wildfire damage at Site 300. Wildfire risk is an annual reality for LLNL's Site 300, which sits in the California grassland's fire-prone ecosystem. A 2017 wildfire scorched grass and trees, but did not impact facilities due to the competent response from emergency management and fire crews. In accordance with ISMS practices, LLNL takes an integrated approach to continuous improvement procedures and policies, ensuring the Lab's resiliency to the impacts of climate change. (Photo Credit: Lisa Paterson/LLNL)

Performance Status

The Lab has begun to consider the immediate impacts on mission, workers, and physical property projected to result from sea-level rise, increased precipitation, extreme temperatures, flooding, drought, and extreme storm events. According to the National Climate Assessment, the Southwest region is projected to experience an increase in the number of extreme heat days, a reduction in snowpack, and an increase in wildfire risks as a result of climate change. These risks in particular have an apparent and immediate potential to impact LLNL operations and mission (Photo 2-14).

The number of extreme heat days and the number of cooling degree days experienced at LLNL are also anticipated to increase due to climate change. While this has not yet had a substantial or lasting impact on operations, increases in the number of extreme heat days and changes in the number of cooling days would likely, over the long-term, increase cooling needs in facilities at both sites. Increases in cooling needs would result in increasing costs onsite, and create a greater potential for blackouts or brownouts of the electrical grid. LLNL continues to maintain and replace HVAC systems as practicable, thus improving energy usage and system reliability. LLNL's emergency preparedness actions include practicing for the potential for extreme heat to impact workers. LLNL conducts training for workers that includes strategies for the prevention of heat illness including work-rest regimens.

Climate change impacts are anticipated to include more frequent and severe droughts, and a reduction in snowpack. In April 2017, Gov. Jerry Brown officially stated that California's record-breaking drought was over. Despite this, LLNL continues to track water usage and to plan for water security of the Hetch Hetchy water supply that relies primarily on Sierra Nevada snowmelt. Current plans for maintenance and upgrades to the aging LLNL utility system would support reducing unnecessary water consumption that results from leaks and breaks and increase the reliability of the water supply for both sites. Modifications planned for Site 300 and the Livermore site drinking-water systems would also increase the reliability of LLNL's supply. LLNL continues to explore ways to adapt to long-term water shortages, including using treated wastewater for make-up water at certain cooling towers, treated-ground water for cooling tower make-up and strategically replacing turf-grass with drought tolerant and native landscaping.

Plans and Projected Performance

LLNL's existing emergency management and response-planning considers a breadth of situations, including those that may result from near-term climate impacts. A comprehensive approach to considering the long-term risks from climate change as they relate to physical property, mission, and workers may be taken as funding and resources allow. In accordance with underlying ISMS procedures for continual improvement, LLNL will continue to identify existing resilient actions and areas for increasing actions to build resilience against predicted climate threats. As needed, LLNL may also identify and update policies as they relate to climate change.

SSPP Goal 10.2: Update emergency response procedures and protocols to account for projected change, including extreme weather events

LLNL currently incorporates into its emergency response program a broad range of hazards and environmental aspects, potential consequences, and lessons learned from simulated and actual emergencies. Simulated emergencies are practiced under varying conditions at both the Livermore site and Site 300 to address the broad range of hazards. Additionally, through the general security policy and the security-risk management policy, LLNL will follow DOE directives and federal law to protect DOE/NNSA interests against a broad range of threats.

Performance Status

In some cases, proactive ongoing activities at LLNL already serve to address risks from potential climate hazards. For example, the Site 300 annual prescribed burn minimizes risks to assets from wildfires. As climate models predict more extreme droughts that persist for longer than normal periods of time, the risks from wildfires to Site 300 and Livermore site assets may increase beyond those experienced in previous years.

Changes in the earth's climate patterns promise lasting, impactful changes to LLNL operations. While the Lab has not yet completed a full vulnerability assessment, LLNL has identified that any projected climate hazard could impact circumstances surrounding emergency situations, the manner in which the Lab responds to emergencies or the extent of the emergency. The frequency with which the Lab may need to address emergency situations that are associated with droughts and heat waves may increase as the impacts from climate hazards increase.

Plans and Projected Performance

Near-term impacts on mission accomplishment from climate-related threats are already considered and incorporated into existing emergency response procedures. As needed, LLNL may also evaluate current activities that, while not initiated explicitly due to climate change impacts, would contribute to building resiliency into operations and assets and long-range impacts from ongoing climate risks.

SSPP Goal 10.3: Ensure workforce protocols and policies reflect projected human health and safety impacts

LLNL's existing workforce protocols and policies reflect the value of each worker returning home daily in the same or better condition than when they arrived at work. This sweeping approach to health and safety allows for adaptation as needed, including for extreme weather events and other projected impacts of climate change (Photo 2-15).



Photo 2-15. Workers review project requirements before starting work (Photo Credit Paul Hara/LLNL)

Performance Status

Through the Occupational Health and Safety Management System (OHSMS), LLNL has committed to protecting workers and the public. The Lab's ES&H requirements and safe work practices maintain compliance with federal, state, and local regulations. LLNL is dedicated to improving health and safety performance and to creating a workplace that is safe, healthy, and injury-free. Though not initiated with the intent of addressing climate change impacts, the Lab's existing protocols and policies fully support addressing projected human health and safety impacts of climate change.

Plans and Projected Performance

LLNL continues to consider impacts on worker's safety and health from weather-related risks. As extreme weather events become more likely and new climate patterns emerge, LLNL may need to consider the long-term projections and implications of climate change on worker health at work and outside of work. Currently, resources and funds are not allocated to complete this analysis.

SSPP Goal 10.4: Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies

The Lab has demonstrated its commitment to environmental stewardship and to protecting workers and the public, through its existing environmental policy and its existing health and safety policy, respectively. Through our Environmental Management System (EMS) and Occupational Health and Safety Management System (OHSMS), LLNL's management demonstrates a strong commitment to the policies, and consistently communicates internally to the Lab.

Performance Status

Existing LLNL policies were not initiated due to climate-change hazards and impacts, but have established a culture of demonstrating management's commitment to environment, health and safety. The LLNL Director

introduces the annual ES&H briefing for all employees. All Environmental Management Plans (EMPs) and Safety Management Plans (SMPs) are reviewed and approved by the LLNL Deputy Director.

Plans and Projected Performance

LLNL management will continue to demonstrate commitment to environmental stewardship and worker safety and health (Photo 2-16). As needed, LLNL management may consider issuing internal communications or updating policies relating to adaptation efforts.



Photo 2-16. The LLNL Site 300 work release meeting enables management and workers to discuss activities each morning and ensures safe work conditions. (Photo Credit Paul Hara/LLNL)

SSPP Goal 10.5: Ensure that site/Lab climate adaptation and resilience policies and programs reflect best available current science, updated as necessary

LLNL works to anticipate, innovate and deliver solutions for the nation's most challenging security problems including those that relate to energy and environmental security. LLNL's scientists and engineers include those working on the front lines to advance climate science (Photo 2-17).



Photo 2-17. An LLNL worker sets up equipment as part of research on carbon capture. (Photo credit: Jackie McBride/LLNL)

Performance Status

LLNL applies the best available science in all decision making. LLNL's Program for Climate Model Diagnosis and Intercomparison (PCMDI) develops improved methods and tools for the diagnosis and comparison of general circulation models that simulate the global climate. PCMDI also supports modeling studies initiated by the World Climate Research Programme (WCRP). PCMDI contributed to the work for which the Intergovernmental Panel on Climate Change (IPCC), who reports on scientific conclusions from climate-change modeling, was awarded the Nobel Peace Prize in 2007.

Plans and Projected Performance

LLNL's resources are currently focused on the research relating to climate modeling and other energy-related R&D efforts. Funding and resources are not allocated for an integrated effort that specifically addresses risks from climate-change impacts. However, should LLNL pursue this integrated effort, then LLNL's scientists and experts would advise on the use of the latest tools and science available for predicting and planning the effects of climate change. LLNL would also contribute research on the application of climate projections appropriate to Livermore's regional climate. The Laboratory will continue to apply the best-available science in all decision making, including decisions relating to climate change adaptation and resilience.

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Attachments

DOE Building Exclusion Self-Certification Form

Energy Consuming Excluded Facilities List

DOE Sustainability Dashboard Data Self-Certification Form

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DOE BUILDING EXCLUSION
SELF-CERTIFICATION FORM
FY 2017

FROM: Lawrence Livermore National Laboratory
Program Office Landlord: NNSA

TO: Sustainability Performance Office

DATE: November 15, 2017

SUBJECT: SELF CERTIFICATION FORM FOR THE ENERGY INTENSITY GOAL OF EISA 2007

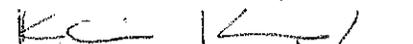
Each buildings or group of buildings that are to be excluded under the criteria for a Part G or Part H exclusion is/are metered for energy consumption and their consumption is reported annually.

If any building has been excluded under the criteria for Part H for impracticability then all practicable energy and water conservation measures with a payback of less than 10 years have been installed. A justification statement that explains why process-dedicated energy in the facility may impact the ability to meet the goal has been provided in the Dashboard Energy Exclusions Report.

I certify that the buildings listed on the Excluded Buildings List produced by FIMS as Report 063 for Lawrence Livermore National Laboratory (page 1 of 1 attached) and the Other Structures listed in Part J (attached) meet the exclusion criteria in *Guidelines Establishing Criteria for Excluding Buildings* published by FEMP on January 27, 2006.

Karin King

DOE/NNSA Site Office Official – printed name



DOE/NNSA Site Office Official – signature

11/20/17
Date

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Definitions of Exclusions PART B through PART H

PART B

— Building or group of buildings is privately owned and privately occupied but happen to be co-located on Federal lands or military installations. (Privately owned buildings listed in FIMS will not be excluded in this Part.)

PART C

— Building or group of buildings has Fully-Serviced Leases.

PART D

— Building or group of buildings is/are essentially structures such as outside parking garages which consume essentially only lighting energy, yet are classified or categorized as buildings.

PART E

— Building or group of buildings has energy usage that is skewed significantly due to reasons such as: buildings entering or leaving the inventory during the year, buildings down-scaled operationally to prepare for decontamination, decommissioning and disposal, and buildings undergoing major renovation and/or major asbestos removal.

PART F

— Building or group of buildings is/are leased space where the Government may pay for some energy but not all, the space comprises only part of a building, or the expiration date of the lease limits the ability to undertake energy conservation measures.

PART G

(BOTH statements in this part must be met for exclusion)
Building or group of buildings is/are separately-metered energy-intensive loads that are driven by mission and operational requirements, not necessarily buildings, and not influenced by conventional building energy conservation measures.

AND

Building or group of buildings is/are metered for energy consumption and their consumption will be reported annually.

PART H (BOTH statements in this part must be met for exclusion)

— Building or group of buildings can demonstrate four critical findings at the excluded building(s): 1) Energy requirements are impracticable; 2) All Federally required energy management reports have been completed and submitted; 3) Has achieved compliance with all energy efficiency requirements; and 4) Implementation of all practicable, life cycle cost-effective projects.

AND

— Building or group of buildings is/are metered for energy consumption and their consumption will be reported annually.

**U.S. Department of Energy
DOE Sustainability Dashboard
Energy Consuming Excluded Facilities List in Accordance with
Section 543(c)(3) of the National Energy Conservation Policy Act as amended by the Energy Policy Act of 2005**

Fiscal Year: 2017

Property Program Office	Property Name	Property ID	Real Property Unique ID	Property Type	Ownership	Gross SqFt	Excluded Facilities SqFt	Exclusion Part	Exclusion Justification
NNSA	Computer Center	115	89549	Building	DOE Owned (O)	17140	17140	G - Separately Metered Intensive Load(s)	The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy
NNSA	Computer Center	112	203771	Building	DOE Owned (O)	45512	45511	G - Separately Metered Intensive Load(s)	The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy.
NNSA	EPD/RHWM Liquid Waste Processing	695	140676	Building	DOE Owned (O)	46504	46503	G - Separately Metered Intensive Load(s)	The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.
NNSA	EPD/RHWM Waste Storage	693	90044	Building	DOE Owned (O)	12000	11999	G - Separately Metered Intensive Load(s)	The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.
NNSA	GS / Central Plant /DPRF/NTTC	133	89563	Building	DOE Owned (O)	5631	5630	G - Separately Metered Intensive Load(s)	The building is a central utility station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.
NNSA	HETB	334	89803	Building	DOE Owned (O)	10668	10667	G - Separately Metered Intensive Load(s)	The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.
NNSA	LCW Control Support	U325	90078	Building	DOE Owned (O)	5072	5071	G - Separately Metered Intensive Load(s)	The building is a central utility station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.
NNSA	LCW Station	U291	90074	Building	DOE Owned (O)	8631	8631	G - Separately Metered Intensive Load(s)	The building is a central utility station that is driven by mission and

									operational requirements, not necessarily buildings and not influenced by conventional building.
NNSA	LLNL National Security Computing Center	117	89551	Building	DOE Owned (O)	11370	11369	G - Separately Metered Intensive Load(s)	The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy.
NNSA	Mocho Potable Pumping Station (HH)	U6042	136630	Building	DOE Owned (O)	354	353	G - Separately Metered Intensive Load(s)	The building is a central pumping station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.
NNSA	Optics Assembly Facility	681	137350	Building	DOE Owned (O)	46818	46818	G - Separately Metered Intensive Load(s)	Electric power and natural gas consumption by these facilities is excluded, placed into the Metered Process category for these facilities. The building areas have also been placed into the Metered Process category as lighting and HVAC energy use are not
NNSA	Plutonium Facility	332	89802	Building	DOE Owned (O)	104787	104786	G - Separately Metered Intensive Load(s)	The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.
NNSA	Regional Dispatch Center	313	89770	Building	DOE Owned (O)	4352	4351	G - Separately Metered Intensive Load(s)	The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.
NNSA	Restroom Trailer	3304	143411	Trailer	DOE Owned (O)	128	128	H - Impracticability	the toilet trailer is shutdown pending D&D
NNSA	RHWM TRU Waste Storage	696	135831	Building	DOE Owned (O)	21381	21380	G - Separately Metered Intensive Load(s)	The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.
NNSA	Support Facility	335	89804	Building	DOE Owned (O)	11988	11987	G - Separately Metered Intensive Load(s)	The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.
NNSA	Telecom Node #1	256	89727	Building	DOE Owned (O)	5937	5936	G - Separately Metered Intensive Load(s)	The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.
NNSA	The National Ignition Facility	581	140320	Building	DOE Owned (O)	700907	697111	G - Separately Metered	Electric power and natural gas

								Intensive Load(s)	consumption by these facilities is excluded, placed into the Metered Process category for these facilities. The building areas have also been placed into the Metered Process category as lighting and HVAC energy use are not
NNSA	Tritium Facility	331	89801	Building	DOE Owned (O)	30484	30483	G - Separately Metered Intensive Load(s)	The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.
NNSA	WCI Livermore Computing Facility	451	89922	Building	DOE Owned (O)	51398	22221	G - Separately Metered Intensive Load(s)	Electric metered data has been identified via review of 1-line diagrams and coordination with the facility management team and reports from dedicated electric meter reports prepared by PE / Site Utilities Division / Electric Utilities Group using the MV-9
NNSA	WCI Livermore Computing Facility	439	89908	Building	DOE Owned (O)	12055	12054	G - Separately Metered Intensive Load(s)	The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy.
NNSA	WCI Livermore Computing Facility	453	200806	Building	DOE Owned (O)	240598	48000	G - Separately Metered Intensive Load(s)	TSF facilities include B453 and OS 454. Electric metered data has been identified via review of 1-line diagrams and coordination with dedicated electric meter reports prepared by PE / Site Utilities Division / Electric Utilities Group using the MV-90 dat

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DOE SUSTAINABILITY DASHBOARD DATA
SELF-CERTIFICATION FORM
FY 2017

FROM: Lawrence Livermore National Laboratory
Program Office Landlord: NNSA

TO: Sustainability Performance Office

DATE: November 15, 2017

SUBJECT: SELF CERTIFICATION FORM FOR DASHBOARD DATA ACCURACY VERIFICATION

The Department of Energy (DOE) annually reports the agency's greenhouse gas emissions, energy and water use, fleet optimization, green buildings, and renewable energy to comply with the sustainability goals mandated in E.O. 13693 and DOE Order 436.1 *Departmental Sustainability Directive*.

To fulfill the Department's sustainability reporting requirements, data was previously collected through the Consolidated Energy Data Report (CEDR) and verified by a Site's manager or Program Office through the SSP submission process. The CEDR has been retired and a new system for data collection, the DOE Sustainability Dashboard (Dashboard), has been created as the official DOE sustainability reporting tool.

I certify that the data submitted for FY 2017 through the Dashboard as of November 15, 2017 for Lawrence Livermore National Laboratory (LLNL) has been accurately entered and completed to the best of my knowledge and expertise.

Bill Howing



LLNL Sustainability Lead - signature

Karin King



DOE Site Office Official - signature

Date

11/28/2017

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