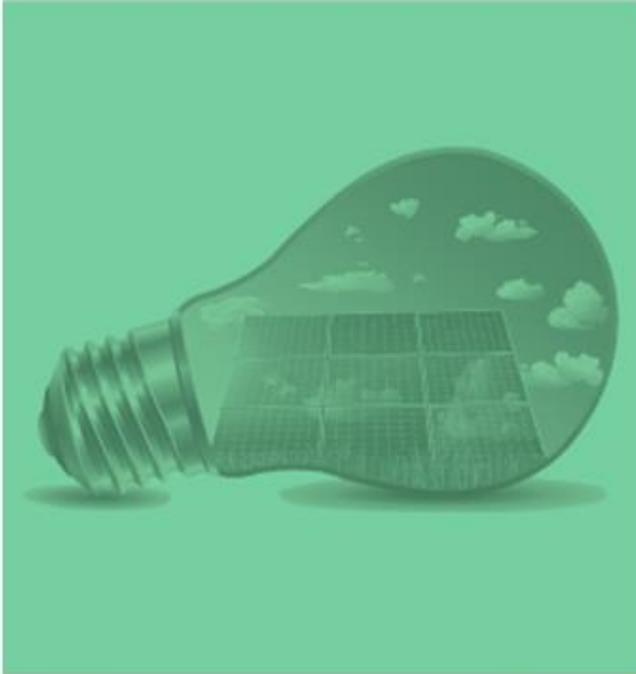


Lawrence Livermore National Laboratory

FY 2017 Site Sustainability Plan





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Lawrence Livermore National Laboratory FY 2017 Site Sustainability Plan

December 2, 2016

Approved by:



William H. Goldstein, Director
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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 Managers
CO ₂	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
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
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
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
MUSD	Maintenance and Utility Services Department
MW	megawatts
MWh	megawatt hours
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
PUE	power utilization effectiveness
P-V	photovoltaic
R&D	research and development
REC	renewable energy credits
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	DOE Strategic Sustainability Performance Plan
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 the Lawrence Livermore National Laboratory (LLNL), consistent with the guidance provided by the Department of Energy (DOE) and the supplemental guidance received on October 4, 2016, as a deliverable for the DOE Order 436.1 *Departmental Sustainability* requirement.

Overview of the 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) and occupational health and safety management (OHSAS 18001), and quality management (ISO 9001).

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 to innovate 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.

Major Planning Assumptions and Issues

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

In FY 2016, 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 2017 and renew progress on greenhouse gas, energy and water goals.

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 to achieve this goal and continually improve environmental performance. EMS is comprised of four main elements: an 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. As new facilities are constructed, they will meet the HPSB or LEED Gold requirements.

The daily site electrical and natural gas demand at Site 200 and Site 300 is significant. LLNL uses 60+ megawatts of electricity during peak times and 12,253 therms of natural gas each day. The average energy use intensity is 155 K BTU/SF, 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.

Funding Strategies

New and existing resources will be leveraged as much as possible in order to help achieve LLNL's sustainability goals. Programs such as the Facility and Infrastructure Recapitalization Program (FIRP) which sunsetted in FY 2013, funded replacement of LLNL equipment past its service life with modern, energy-efficient equipment. 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.

Also, a Cooling and Heating Asset Management Program (CHAMP) is currently being launched by NA-50 and will provide funds to upgrade equipment and systems. The B801 Direct Digital Controls (DDC) Upgrade Project is an FY 2016 CHAMP funded pilot effort to use smart controls that will yield significant reductions in energy consumption. The new DDC system will control, monitor, and optimize HVAC systems to increase the building's performance.

In FY2016, indirect funds are slated for replacing two aged cooling towers at U325. These towers are failing, inefficient and have lost 20% of their structural surface due to erosion.

Indirect funding was requested and granted to fund the Investment Grade Audit (IGA) sponsored by PG&E through its Utility Energy Services Contract (UESC) program in FY2015. The final audit report was submitted, evaluated and prioritized for senior management review in FY2016. Upon review, senior management has decided to not pursue the proposed projects in light of the huge backlog of mission-related projects in the queue and lack of resources.

Successes and Challenges

LLNL had a number of successes and challenges in FY2016. Some highlights include:

- Achieved ISO 9001 recertification and continued ISO 14001 and OHSAS 18001 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 4.3M gallons of potable water.
- Continued to lead a robust scientific and research program that advances renewable energy research, building energy efficiency, climate change research, and greenhouse gas (GHG) mitigation
- Continued a Personal Electric Vehicle (PEV) charging program to include an additional 11 charging locations (37 total), allowing more employees (currently 37) to drive and charge their personal electric vehicles while paying for electric consumption
- Recycled 1,176,600 pounds of metal removed during clean-up of a laydown yard at Site 300.
- Continued the legacy chemical reduction effort which led to the disposal of approximately 10,500 hazardous materials and the recycling of almost 1,000 gallons of paint.
- Worked with the DOE Livermore Field Office (LFO) on a 3.3MW solar renewable energy project that started commercial operation in February 2016
- Continued the Irrigation Reduction Plan to reduce turf site-wide in response to the historic California drought
- FY2016 Sustainable demo garden project to replace about 25,000 SF of browned-out turf area around B551E&W. In FY 2017, this demo garden will be irrigated with well water, estimated to save about 1.4M gallons of potable water annually
- Detailed engineering was started for a treated ground water re-use at TF-A through a Reverse Osmosis unit to supply make-up water to OS454 cooling towers, estimated to save 40 million gallons of potable water annually. In addition, a conceptual design was included in the UESC IGA for a wastewater treatment facility that would treat and recycle wastewater for make-up water at two cooling towers. A more detailed engineering and feasibility study is needed to continue to evaluate this option, estimated to save 60-80 million gallons of potable water annually
- Projects totaling more than \$16M were executed in FY 2016 to replace old HVAC systems with new energy efficient equipment, cool roof replacements and lighting with more efficient LEDs

Energy Challenges

LLNL is facing 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 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 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.

And 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.

Summary Table of Goal Targets

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
GOAL 1: Greenhouse Gas Reduction				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline (FY 2016 target: 22%)	In FY2016, LLNL achieved an overall 32.2% reduction from FY2008 baseline.	Efforts will continue to manage gas and electric consumption through energy efficiency projects.	Low
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (FY 2016 target: 7%)	In FY2016, LLNL's Scope 3 emissions were 20.3% below the FY2008 baseline.	Scope 3 emissions are likely to remain on target to maintain an overall 25% reduction from FY2008 baseline by FY2025.	Low
GOAL 2: Sustainable Buildings				
2.1	25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY 2025 from a FY 2015 baseline.	LLNL achieved 0.25% energy intensity reduction in FY2016 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.	High
2.2	EISA Section 432 energy and water evaluations.	LLNL has completed 100% of its EISA portfolio for the second round as of FYE 2016. Fourteen (14) facilities were subjected to Desk Audits in FY2016 to complete the cycle.	Investment Grade Audit proposed 4 ECMs with an estimated cost of \$2M without 3 rd party financing and LLNL support costs. Fourteen (14) facilities were subjected to Desk Audits in FY2016. Significant funding is required to execute the recommended energy conservation projects.	Medium

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
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 have been experienced). 60% of natural gas achieved.	In FY2016, the site-wide legacy electricity meter upgrade efforts were paused, as LLNL metering work was focused primarily on Computation Facilities. Additional funding is required to upgrade natural gas meters to meet the FY2015 goal requirements. Steam metering is not required. Chilled water use is captured in the building's energy use and therefore separate metering is not required.	Medium
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.	Task of assessing and certifying 17% of the number of existing occupied buildings greater than 5,000 GSF is 41% complete.	Six HPSB assessments are planned for FY 2017.	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 gross square feet 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 2017.	High

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
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.	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 Net Zero (energy) will be developed in 2017.	High
GOAL 3: Clean & Renewable Energy				
3.1	“Clean Energy” requires that the percentage of an agency’s total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-2017, working towards 25% by FY 2025.	FY 2016 renewable contribution was 27%, 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 Western Area Power (WAPA). Plans are in place to continue to meet the 25% goal.	The FY 2017 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 a total agency <u>electric</u> consumption in FY 2016-2017, working towards 30% of total agency <u>electric</u> consumption by FY 2025.	FY 2016 requirement was exceeded with the 73% allotment of renewable power generated by the 3.3MW solar plant and with the purchase of 15,407 MWh RECs and 44,162 MWh of renewable electric energy through the Western Area Power Administration (WAPA). LLNL is currently at 27% related to the 30% by FY2025 goal.	The FY 2017 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
GOAL 4: Water Use Efficiency and Management				
4.1	36% potable water intensity (Gal per gross square foot) reduction by FY 2025 from a FY 2007 baseline. (2015 target: 16%)	In FY 2016, LLNL's potable water intensity savings relative to the FY 2007 baseline was 12.77%. This is primarily due to the unavoidable switch mandated by our primary water provider (San Francisco Public Utilities Commission) to Zone 7 water supply for a total of 23 weeks for the year. If the switch was not made, LLNL would have met the 18% goal.	LLNL will aggressively continue irrigation reduction plans with focus on water wise landscaping. Further implementation of reverse osmosis technology or other technologies to replace potable water use in cooling towers will require additional funding to meet FY 2025 goal.	Medium
4.2	30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target: 10%)	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
GOAL 5: Fleet Management				
5.1	30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline. (2016 target: 3%; 2017 target: 4%)	In FY 2016, 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
5.2	20% reduction in annual petroleum consumption by FY 2020 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2016 target: 20%)	In FY 2016, LLNL's petroleum fuel consumption decreased 70.43% 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.	High
5.3	10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter.	FY 2016 alternative fuel consumption increased 10% compared to FY 2015. Overall increase compared to the FY2005 baseline is 410%.	LLNL will maintain its alternative fuel vehicle (AFV) fleet and continue to replace the existing fleet with E85, hybrid, and plug in electric vehicles.	Low

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
	(2016 target: 10%)			
5.4	75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2016 target: 75%)	LLNL met and exceeded the required 75% replacement of fossil fuel light-duty vehicles with AFVs in FY2016. 77% of light-duty vehicles replaced in FY 2016 were replaced with AFVs.	LLNL will continue replacing its fleet with AFVs as manufacturers and GSA make them available. LLNL is exploring AFV options, specifically in the area of electric vehicles.	Low
5.5	50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2016 target: 4%)	In FY 2017, LLNL will begin its electric vehicle Pilot Program by replacing 10 petroleum fuel vehicles with electric plug in 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
GOAL 6: Sustainable Acquisition				
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. As a result, LLNL is in compliance with the requirement to include sustainable acquisition clauses in all eligible contract actions.	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.	Low
GOAL 7: Pollution Prevention and Waste Reduction				
7.1	Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris.	LLNL consistently meets or exceeds this goal. In FY 2016, LLNL diverted 75% of nonhazardous solid waste.	LLNL continues to identify new potential waste streams for diversion.	Low

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
7.2	Divert at least 50% of construction and demolition materials and debris.	LLNL consistently meets or exceeds this goal. In FY2016, LLNL diverted 57% of construction and demolition materials and debris.	Tracking of construction and demolition materials and debris continues for FY 2017.	Low
GOAL 8: Energy Performance Contracts				
8.1	Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693.	In FY 2016, LLNL evaluated the merits of the recommended 4 ECMs proposed in the IGA estimated at a cost of \$2M not including the 3 rd party financing cost and LLNL support costs.		
GOAL 9: Electronic Stewardship				
9.1	Purchases – 95% of eligible acquisitions each year are EPEAT-registered products.	LLNS' achievement was 90% in FY 2016. We did not meet this goal as 2 EPEAT Gold rated monitors LLNL was purchasing in Quarters 1 and 2 were removed from the EPEAT list in Quarter 3.	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	Power management – 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	Automatic duplexing – 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

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
9.4	End of Life – 100% of 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
9.5	Data Center Efficiency. Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.	In 2015, a physical review of the 23 data centers previously reported as decommissioned (2012) was completed. It was found that 2 have been put back in service. Further review of the 2012 data center definition is required to ensure their current usage does not change their status of decommissioned. 38 data centers continue to be in service and operational.	Planned actions for 2017 include renewed focus on LLNL data center consolidation efforts. Evaluating B112 for classified computing and operating as a mixed use facility. Developing requirements for B112 hosting IT hardware from legacy data centers throughout the DOE complex. Finally, based on new DCOI guidance update the 2012 inventory of LLNL data centers.	Medium
GOAL 10: Climate Change Resilience				
10.1	Update policies to incentivize planning for, and addressing the impacts of climate change.	Through LLNL's existing environmental policy, the Lab commits to continuously improve environmental performance.	LLNL plans to follow any direction and guidance from DOE in completing a climate vulnerability assessment and adaptation plan. The assessment and plan would serve to identify existing resilient actions and areas for increasing actions to build resilience against predicted climate threats. Through this process, the Lab would also identify and update as needed policies as they relate to climate change.	Low
10.2	Update emergency response procedures and protocols to account for projected climate change, including extreme	LLNL currently incorporates into its emergency response program a broad range of hazards and environmental aspects, potential consequences, and lessons	Particular responses to extreme weather events and other longer term impacts from climate change are planned for analysis during the vulnerability assessment	Low

SSPP Goal #	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-Attainment
	weather events.	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.	process, and would be incorporated into existing emergency response procedures as needed under direction from DOE.	
10.3	Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.	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 are planned for review during the vulnerability assessment process under direction from DOE. Protocols and policies would continue to be adapted as needed to address the findings of the vulnerability assessment.	Low
10.4	Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies.	LLNL management is committed to effective communication and 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 best available current climate change 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 plans to execute the vulnerability assessment and adaptation planning process 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

SSPP Goal 1.1

50% Scope 1 & 2 GHG reduction by FY2025 from a FY2008 baseline

LLNL's GHG footprint is defined by three major scopes of GHG emissions. These are depicted in Figure 2-1. 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&2 GHG emissions are offset by the estimated annual GHG emissions avoided by purchased renewable energy credits (RECs).

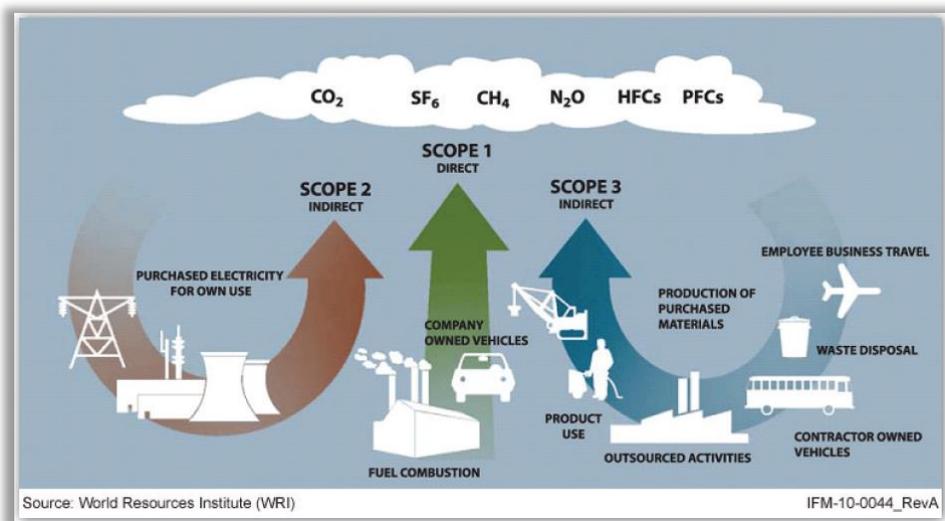


Figure 2-1. The three major scopes of GHG emissions.

LLNL's Scope 1 & 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 General Services Administration (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 & 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 & 2 emissions are addressed in 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 & 2 Greenhouse Gas Emissions¹

DOE's goal for Scope 1 & 2 is a 50% reduction in the generation of Scope 1 & 2 GHG emissions by FY 2025 from the FY 2008 baseline. LLNL's GHG reductions for Scope 1 & 2 are largely driven by the plans described in this document. LLNL achieved an overall reduction of 32.2% (estimated) from FY 2008 baseline for Scope 1 & 2 emissions during FY 2016. Aggressive reduction of SF₆ in programmatic equipment since 2008 coupled with the purchase of RECs has helped LLNL exceed the FY2016 reduction goal of 22%.

Performance Status (50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline)

In FY 2016, LLNL achieved a reduction of 32.2% (estimated) in Scope 1 & 2 GHG emissions, relative to its FY 2008 baseline. Significant efforts focusing on LLNL's continued management of SF₆ usage and the offsets of purchased RECs and purchased renewable electric energy from incremental hydroelectric power along with minimizing electrical energy use have contributed to this year's reduction achievement. Also, a new 3.3 MW solar farm at the Livermore Site became operational in February 2016. It contributed 3,433 MWh of energy to the site that resulted in avoiding approximately 955 mtCO₂e of GHG emissions during FY 2016. These efforts have helped LLNL exceed the Scope 1 & 2 emissions reduction target of 22% for FY 2016.

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 to manage 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, GHG emissions related to SF₆ remain low.

Plans and Projected Performance (50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline)

LLNL has already successfully reduced GHG emissions through aggressive reduction and management of fugitive emissions from equipment using SF₆. Scope 1 & 2 GHG reductions for FY 2017 and beyond will largely be dependent on LLNL's management of electrical energy because this is LLNL's largest contributor to Scope 1 & 2 GHG emissions (See Figure 2-4a). 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 & 2 GHG emissions and GHG emission reductions presented in this document are current estimates. Actual scope 1 & 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 2015	FY 2016
Facility Energy	156,688	130,672	124,784
Non-Fleet V&E Fuel	0	0	0
Fleet Fuel	1,773	1,074	1,116
Fugitive Emissions	34,947	11,287	16,225
On-Site Landfill MSW	0	0	0
On-Site WWT	7	12	14
Renewables	0	0	270
RECs (subtracted)	NA	(20,445)	(11,200)
Total (MtCO₂e)	193,415	122,600	131,209

Figure 2-4a. Scope 1 & 2 GHG emissions (MtCO₂e) by source.

Note: Scope 1 & 2 GHG emissions presented in this document are estimates.

Actual scope 1 & 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 the electrical utility usage.

Resources Required

The majority of resources required to reduce LLNL's overall Scope 1 & 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 on-site.

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 and are contained in 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 1.2

25% Scope 3 GHG reduction by FY2025 from a FY2008 baseline

Scope 3 includes all indirect emissions not included in Scopes 1 & 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 (25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline)

In FY 2016, the Laboratory maintained an overall reduction of 20.3% in Scope 3 emissions from the FY 2008 baseline, exceeding the 7% reduction target for FY 2016. Contributing factors to this year's emissions reduction include a reduction in commute travel and T&D credits from RECs. (Note: electrical energy use also impacts Scope 3 GHG emissions through T&D losses).

Scope 3 GHG Emissions Breakdown			
Categories	Baseline (2008)	FY 2015	FY 2016
T&D Losses*	8,624	6,323	5,925
Air Travel	9,709	8,412	9,358
Ground Travel	1,276	1,470	1,431
Commute	25,708	18,468	19,224
Off-Site Landfill MSW	730	14	744
Off-Site WWT	5	538	14
Total (MtCO₂e)	46,052	35,225	36,696

Figure 2-4b. 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.

The Laboratory maintains an active Alternate Work Schedule, allowing most employees to opt in to a 9/80 or 4/10 work schedule. Approximately 2,688 employees (39percent of the workforce) have elected an alternate work schedule that reduces their commute by 10 percent (9/80s) or 20 percent (4/10s).

LLNL continued its personal electric vehicle (PEV) pilot program that was started in 2014. The program was expanded to a total of 37 charging stations during 2016. The program has 37 employee participants paying a monthly charging fee. This reduces GHG emissions by about 110 MtCO₂e annually.



Figure 2-5. Personal Vehicle charging station

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, such as LLNL, having over 50 employees 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.

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 (25% Scope 3 GHG reduction by FY2025 from a FY2008 baseline)

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 GHG emissions as 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 2.1

25% energy intensity reduction by FY2025 from an FY2015 baseline

Performance Status

At the end of FY 2016, our contribution to the DOE energy use intensity reduction goal was 0.25%, relative to the FY 2015 baseline normalized for weather. Without a correction for weather, the intensity would be at 1.64%. Figure 2-6 illustrates the savings using the updated baseline. No facilities were demolished in FY 2016 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.

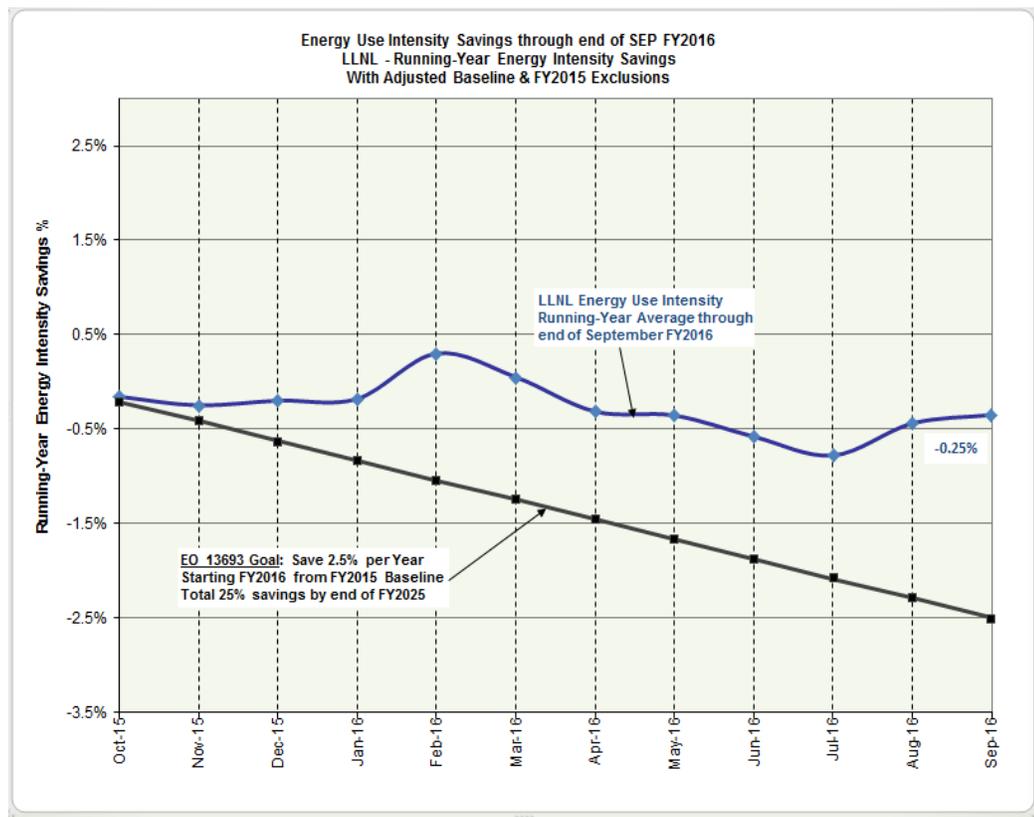


Figure 2-6. Energy Use Intensity Savings through end of FY 2016 (running year energy intensity savings with FY 2015 exclusions).

LLNL continues to evaluate its energy usage to better understand how to effect efficient energy reduction. The energy chart in Figure 2-7 estimates the sources of energy by type. The energy chart was updated with FY 2016 data and was created by incorporating metered data, lighting estimates and equipment inventory. The energy consumed at LLNL is almost equally split between the Excluded facilities (50.08%) and Goal Subject facilities (49.92%).

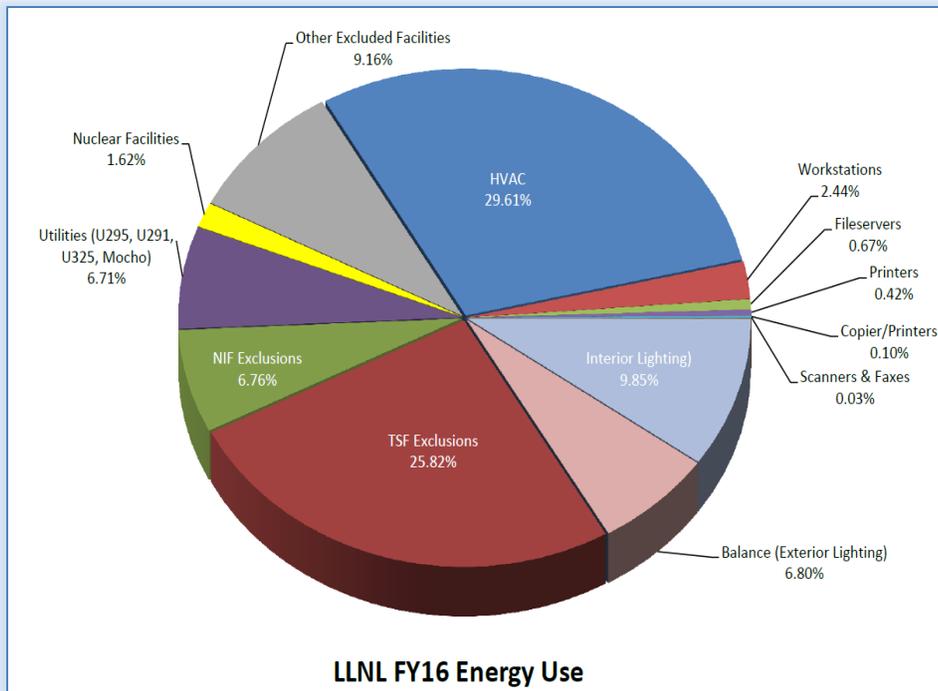


Figure 2-7. LLNL FY 2016 Energy Use

With just the Goal Subject facilities (Figure 2-7a), the energy breakdown shows HVAC systems (59.32%) and lighting (33.34%) continue to be the two largest users of energy at LLNL. The breakdown helps to indicate where specific energy conservation efforts should be directed.

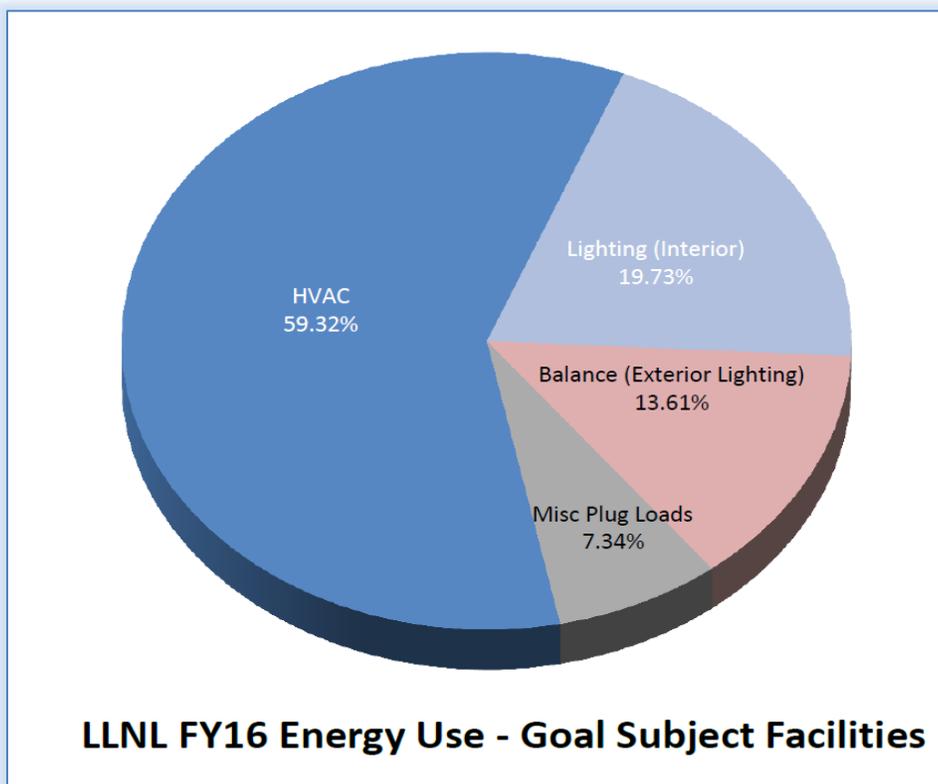


Figure 2-7a. Energy Use – Goal Subject Facilities only

LLNL continues to implement cost-effective energy conservation projects, as funding permits. In FY 2016, no funding was available for ECMs; however, the PG&E sponsored UESC Investment Grade Audit (IGA) was completed and evaluated.

In FY 2016, 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-normal winter was responsible for increasing our natural gas consumption in the winter months. In the summer of FY 2016, there were 23% less cooling degree days (CDD) than the summer of FY 2015 (Figure 2-8).

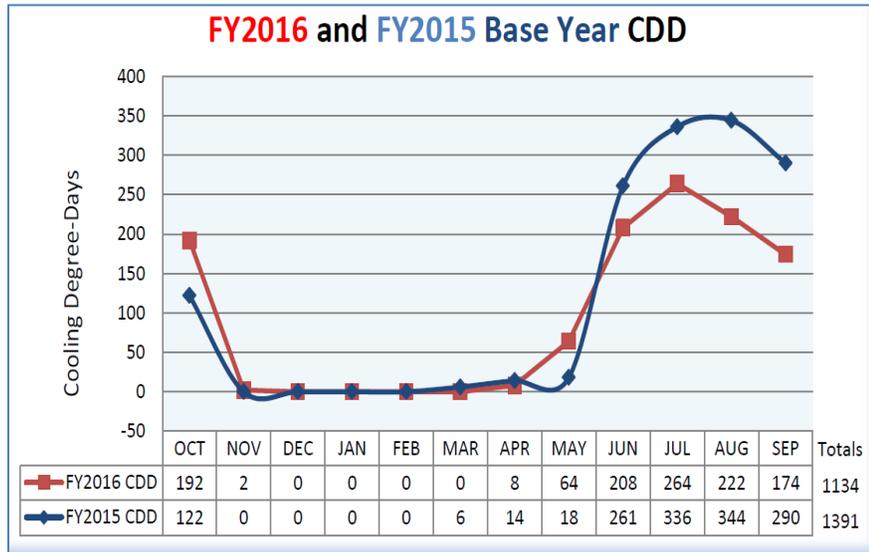


Figure 2-8. Comparison of Cooling Degree Days (CDD)

On the negative side, FY 2016 winter was colder, compared to the base year FY 2015. There were 42% more heating degree days (HDD) than in the winter of FY 2015, increasing the burden on the boilers and heating system (Figure 2-8a).

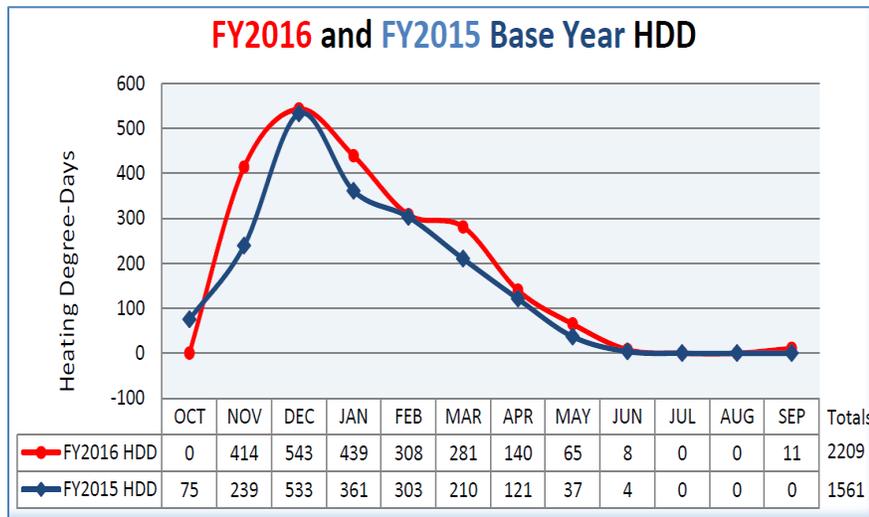


Figure 2-8a. Comparison of Heating Degree Days (HDD)

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. In FY 2016, LLNL evaluated the IGA report and prioritized the ECMs for submittal to senior management.

A Functional Management Review (FMR) was conducted in FY 2013 to evaluate LLNL's electrical and mechanical maintenance programs. LLNL requested funding to address the various recommendations listed in the FMR report. All initiatives have not been fully funded. LLNL has made progress in increasing HVAC staffing and funding for preventive and corrective maintenance for HVAC systems, 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. LLNL 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.

One of the DOE/IG-0869 audit recommendations was to "Implement best practices related to billing for electricity usage to the maximum extent practicable." This was LLNL's practice prior to the contract transition, but stopped to simplify internal accounting in compliance with internal cost accounting standards.

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, update and adapt 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.

Based on LLNL's best estimate of available resources for FY 2017, it is estimated that energy intensity savings will be 1% with an energy use of 900 BBTU for the year, considering the total building area of 5,874 SF. As funding becomes available, LLNL will attempt to exceed this goal.

The Site Actual and Projected Electricity Consumption Table is shown in Figure 2-9; the Load Forecast Chart is shown in Figure 2-10.

Fiscal Year	2015A	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Forecast Total Electricity Consumption	424	426	429	433	438	443	448	453	458	464	469
HEMSF Facility 1 (TSF) (x10 ⁶ kWh)	137	144	151	159	167	175	184	193	202	213	223
HEMSF Facility 2 (NIF) (x10 ⁶ kWh)	25	26	28	30	32	34	36	38	40	42	44
Estimated Load after Energy Efficiencies	408	410	414	418	424	429	434	440	445	452	457

Figure 2-9 Site Actual and Projected Electricity Consumption (x 10⁶ kWh)

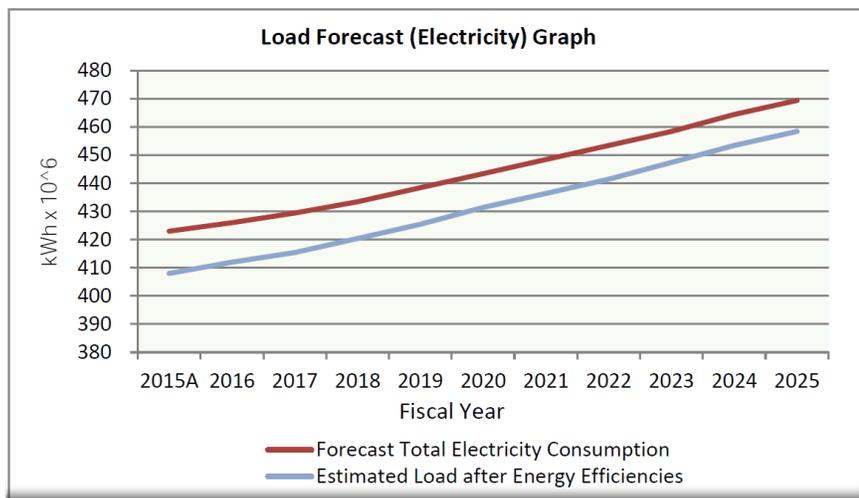


Figure 2-10. LLNL energy load forecast

Resources Required

Funding will be required for projects that have been identified, including the installation of 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 2017.

Figure 2-11 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)	FY17 (\$M)	FY18 (\$M)	FY19 (\$M)	FY20 (\$M)
Building Automation Systems/EMCS	5	0.9	5.6	1	1.5	1.5	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	1	1	1	0
Site-wide Lighting Improvements, Interior	5	3.8	1.3	0.5	1.5	2	1

Figure 2-11. Proposed projects in support of SSPP Goal 2.1

SSPP Goal 2.2

EISA Section 432 energy and water evaluations

In FY 2016, fourteen (14) facilities were subjected to internal Desk Audits. These audited facilities made up the remaining 28% for the second round of audits. Our EISA portfolio is 100% complete for the second 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 four 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. A proposed UESC project was evaluated in FY 2016 (see SSPP Goal 8.1 for more details).

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 Energy Policy Act (EPACT) 2005 and EISA 2007 regulations is exemplified in this latest issue of the Metering Plan. LLNL is committed to monitor and reduce its energy usage and find 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 metering before they fail.

LLNL's metering portfolio, as of October 1, 2016, is shown in Figure 2-12.

	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

Figure 2-12. 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.

Plans and Projected Performance

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

SSPP Metering Stretch Goals	FY2015 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 2012.	<p>The LLNL plan to repair failed legacy electricity metering was continued in FY 2016, but only at Computation Facilities. The effort to perform complete meter upgrades throughout the site will be continued when funding becomes available.</p> <p>Additional funding is required to upgrade natural gas and water meters to meet the FY 2017 goal requirements.</p> <p>Steam metering is not required.</p> <p>Chilled water use is captured in the building’s energy use and therefore separate metering is not required.</p>

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 2016. As a result, the remainder of the LLNL site continued to experience legacy electricity meter failures both in communication and overall function.

Electricity meter audits were continued in FY 2016. If funding allows, the audits will continue into FY 2017. Audits collect vital information necessary to plan and schedule meter replacements and upgrades.

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.



The Itron VT-2 meter is an example of LLNL’s legacy electricity metering. Access to a meter of this type poses a safety hazard due to its proximity to exposed live terminal blocks. The metering plan addresses the goal to replace these meters as part of the site-wide meter upgrade effort.



Example of a meter upgrade at Computation Facility, B453. Upgrades typically require high voltage transformer outages. The old modem based meter is removed and replaced with a new Ethernet meter. Phone lines are removed and replaced with CATV cable. Ethernet connections not only provide increased electric usage data reliability and accuracy, but they introduce additional remote metering diagnostic and troubleshooting capabilities.

Resources Required

LLNL has requested funding for additional metering projects in FY 2016. Figure 2-13 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)	FY16 (\$M)	FY17 (\$M)	FY18 (\$M)	FY19 (\$M)	FY20 (\$M)	FY21 (\$M)
Electricity Metering	4.2	N/A	N/A	0	1	0.8	0.8	0.8	0.8
Natural Gas Metering	3.6	0.065	54	0	0.25	0.5	1.5	1	0.35
Potable Water Metering	1.5	0.025	59	0	0.25	0.25	0.5	0.25	0.25

Figure 2-13 proposed projects in support of SSPP Goal 2.3

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 23 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 (Figure 2-17).

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 \$60K, 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 2017, Buildings 211, 272, 423, 515, 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 \$60K. The estimated cost of development of the HPSB submittal packages of ten buildings is estimated at \$6K 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 2-16.

Building Name	GSF	Remaining Scope	Target Year	Estimated Cost (\$)
B155	21,742	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	28,000
B161	6,105	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	12,000
B211	14,122	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	20,000
T2727	5,000	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	12,000
T2775	9,875	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	18,000
T2825	59,875	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	12,000
T4525	5,736	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	12,000
T4726	9,384	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	18,000
T4728	6,762	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	12,000
B694	10,590	All HPSB documentation	FY2017	6,000
		Lighting occupancy sensor design, procurement and installation	FY2018	19,000
B311	40,951	LEED Certification package needed	FY2018	60,000
T1677	28,576	Lighting occupancy sensor design, procurement and installation	FY2018	36,000
T1739	5,646	Lighting occupancy sensor design, procurement and installation	FY2018	12,000
T1889	16,821	Lighting occupancy sensor design, procurement and installation	FY2018	22,000
T3724	19,810	Lighting occupancy sensor design, procurement and installation	FY2018	26,000
T3725	19,867	Lighting occupancy sensor design, procurement and installation	FY2018	26,000
T3726	19,824	Lighting occupancy sensor design, procurement and installation	FY2018	26,000
T4675	11,142	Lighting occupancy sensor design, procurement and installation	FY2018	19,000
T6925	5,873	Lighting occupancy sensor design, procurement and installation	FY2018	12,000
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
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
Total	559,665			931,000

Figure 2-16. 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 136932 Planning for Federal Sustainability in the Next Decade, that was issued on March 19, 2015 instructs federal agencies including DOE to maintain Federal leadership in sustainability and greenhouse gas emission reductions.

- 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 and 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 on-site.

As a major employer in the community, LLNL is committed to promoting energy conservation and supports commuters by providing certain on-site 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 on-site 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 sq. ft. converted to drought tolerate 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. With the recent annexation of 1,022 acres east of the Laboratory to the City of Livermore, interactions include meetings with City of Livermore to discuss the collaborative R&D initiative LVOC proposal, discussions with water officials in Livermore to discuss wastewater issues, and participation in stakeholder groups to discuss environmental issues.

Under a collaboration initiative with the Laboratory, academia, private sector and outside agencies on R&D in green transportation, energy and high performance computing, the planned Livermore Valley Open Campus (LVOC) would foster creation of a significant number of additional jobs and have a positive economic effect in the region over the next five years, during the initial phase of LVOC's 30-year build-out. Future urban growth is expected to enhance a sustainable community.

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

Many aspects of Site planning at the Laboratory are coordinated with DOE/NNSA's National Environmental Policy Act (NEPA) process and LEED project guidelines. 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 (SWEIS) for Continued Operations of LLNL in 2011. DOE/NNSA recently communicated plans to prepare a Site-wide review under NEPA for continued operations.

Large-Flowered Fiddleneck Restoration

The large-flowered fiddleneck is a federally-listed endangered species with an extremely limited distribution (photo below). 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. LLNL staff also serves as member of the large-flowered fiddleneck Recovery team.



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 on-site 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 2016.

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 2017.

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 2016.

Plans and Projected Performance

A short list of future facilities that may be viable as candidates for Net Zero (energy) will be developed in 2017.

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 2-18).

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)	FY14 (\$M)	FY15 (\$M)	FY16 (\$M)	FY17 (\$M)	FY18 (\$M)	FY18 (\$M)
IGPP Advanced Manufacturing Laboratory	9.8	N/A	N/A	0	0	0	0.2	4.7	4.9
IGPP Funded Generic Office Building	9.8	N/A	N/A	0	0	0	0	4.9	4.9
B654 Livermore Computing (ASC funded)	9.9	N/A	N/A	0	0.5	9.325	0.075	0	0
Emergency Operations Center (line item funded)	22.5	N/A	N/A	0	0	0	0	22.5	0

Figure 2-18. Proposed new construction projects

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 FY 2016-2017, 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 Fig. 3-1 below).

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.



Figure 3-1 3.3MW 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 4,715 MWh in FY 2016. LLNL’s share of this renewable energy was 3,433 MWh.

That is the equivalent energy used by 1.13 million homes for one hour or GHG emissions of about 510 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 FY16-17, 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: 1) the Central Valley Project (CVP) Base Resource allocation of hydropower; and 2) 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 Renewable Energy Credits (RECs) and Renewable Electric Energy in FY 2016. LLNL purchased 14,735 MWh of biomass RECs, 672 MWh of wind RECs, 44,162 MWh of Renewable Electric Energy from incremental hydropower plus 3,433 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 2017, 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 Solar P-V 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 \$24M investment. A 6 MW solar array would also greatly contribute to LLNL’s energy reduction goals. The high cost of on-site 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.

Current plans for a new computing facility have incorporated air cooling for its needs, as opposed to using traditional water cooling, and the corresponding energy needed for cooling. The new computing facility will be HPSB compliant. This innovative design will not increase LLNL's water use, and will require less electrical demand than a traditional design.

Solar water heating has not been incorporated into LLNL new buildings plans. Hot water heating is a relatively low energy use, relative to the impact of electricity used for cooling and computation. New building designs that increase the electric efficiency of computation will help off-set LLNL's increasing need for power to support expanding mission.

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.

SSPP Goal 4.1

36% potable water intensity (Gal per gross square foot) reduction by FY2025 from a FY2007 baseline. (2016 target: 18%)

Performance Status

In FY 2016, LLNL's contribution to the DOE potable water intensity savings goal was 12.77% (Fig. 4-1a). LLNL's slight 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) since mid-July to the end of the year and for a total of 23 weeks for the entire fiscal year. Prior savings were attained with the primary water supplier Hetch Hetchy water.
- Unprecedented growth and activity in FY 2016 has increased the domestic water demand at the site.

If the switchover did not occur, LLNL would have met the DOE goal of 18%. The water consumption and cost data report is entered in the Dashboard.

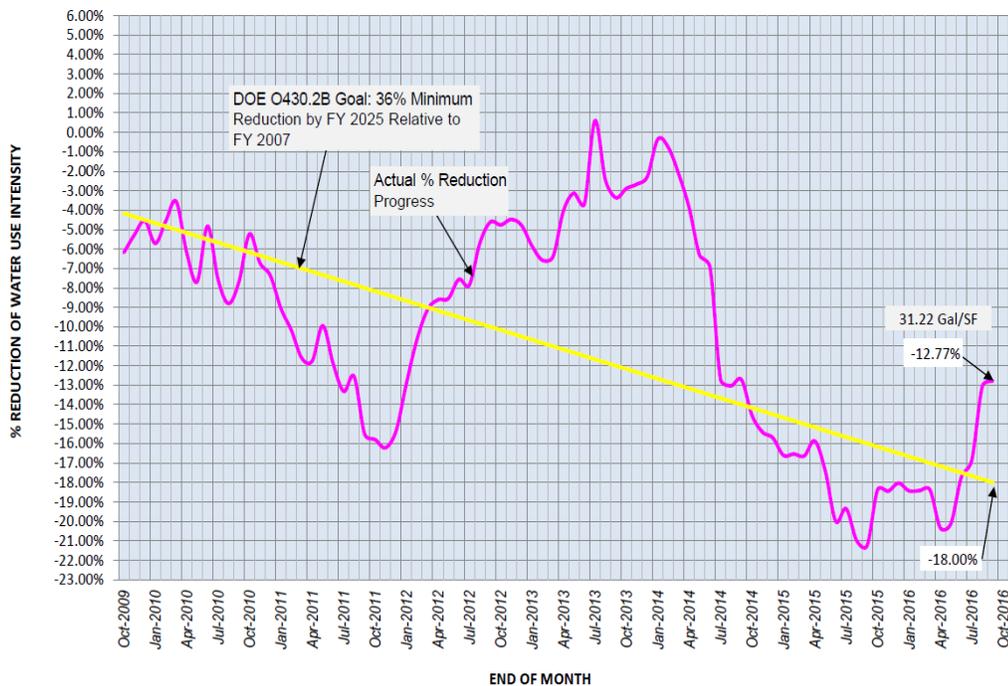


Figure 4-1a Potable Water Use Intensity Savings through end of FY2016

Potable water use at LLNL's cooling towers increased nearly 3% (3,388 kgals) from FY 2015. FY 2016 was not as warm as FY 2015, but had 351 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 4.3M gallons of potable water for FY 2016. This project is expected to save about 7M gallons annually.

In FY2016, a Sustainable Demo Garden project to replace about 25,000 SF of browned-out turf area around B551E&W was started (see photo below). In FY 2017, this demo garden will be irrigated with pump-and-treat water, estimated to save about 1,400,000 gallons of potable water annually.



Conversion of existing turf to more sustainable landscaping at B551 E & W

California is experiencing a severe, unprecedented drought and 2016 marks the fifth year. In April 2015, California Gov. Jerry Brown issued an executive order mandating up to 25% water reduction for irrigation from a 2013 baseline. San Francisco Public Utilities Commission (SFPUC) which runs Hetch Hetchy water supply requested a 10% potable water reduction and a mandatory 25% irrigation reduction. LLNL responded with a tighter fine-tuning of the irrigation controllers and schedule and more aggressive response to discovered leaks and maintenance repair. By the end of September 2016, the estimated irrigation savings was about 5M gallons. This is equivalent to a 57% irrigation reduction to date from the 2013 baseline. Overall, LLNL saved 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 4-1b. The cooling tower make-up component is our highest user at 53.99%, with Domestic use second at 15.24% and Facility Process use third at 17.32%. Irrigation component is down to 12%.

LLNL FY2016 CITY WATER USE

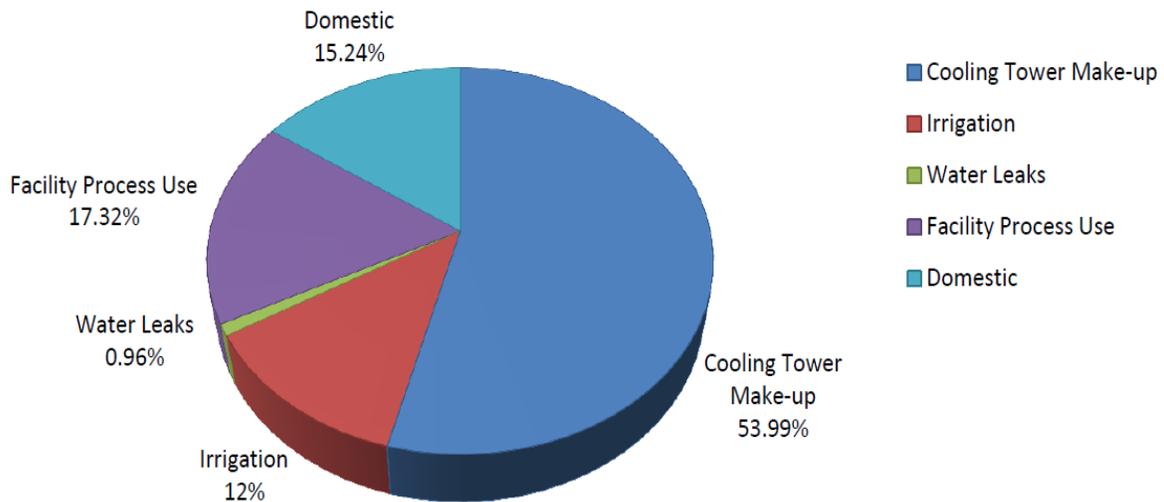


Figure 4-1b. LLNL FY2016 potable water use breakdown.

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:

- The main supplier of LLNL potable water (Hetch Hetchy) has an annual shutdown (January to February 2016) for maintenance which directly impacts the amount of water LLNL must use as make-up water accepted in its cooling towers. At least 1% of LLNL's total annual consumption will be needed because the alternate supplier's (Zone 7) water quality has less desirable attributes and allows for only a few cycles before needing to be replaced at the cooling towers. In addition, this imposes an added burden to LLNL's sewer system, as the extra blowdown from the cooling towers is discharged to the sanitary sewer system. In FY 2016, in addition to the annual shutdown, Hetch Hetchy requested a 30-day shutdown for mid-October to mid-November 2015 in order to perform drought contingency plans. And then again in mid-July 2016, due to chlorine issues with Hetch Hetchy water, an unavoidable switch to Zone 7 has imposed an insurmountable burden to 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, unprecedented growth and activity in FY16 has increased the domestic water demand at the site.

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

- 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 TeraScale Facility) and Xeriscaping at B170. The final recommendations will be prioritized for resource funding.

- LLNL has been in close communication with San Francisco Public Utilities Commission (SFPUC) who manages Hetch Hetchy water as far as opportunities for water conservation. In meetings with SFPUC, LLNL has been notified that it qualifies for non-potable incentive programs. LLNL will pursue these programs with the continued assistance of SFPUC. A similar R.O. Treated Groundwater Project is being planned for deployment at the OS454 as well as at NIF. Another SFPUC program that LLNL is looking into involves sustainable landscaping and low-flow toilets and urinals.
- 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 improved leak detection strategies currently available. 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.
- LLNL has proactively identified the benefit of adding continuous leak detection systems, such as geophonic data-loggers, that will be integrated into future water meter projects. These devices will be integrated into the meters' communication system to remotely monitor the water distribution infrastructure and provide graphical data that will alert system operators to any leaks. Major resources are needed to further advance a continuous leak detection system initiative.

Potential projects to meet LLNL's water intensity reduction goal are shown in the "Potable Water Savings Approaches to Meet Goal" highlight in this section.

DOE's FY 2017 water intensity reduction goal is 20%. Based on LLNL's best estimate of available resources for FY 2017, and assuming the primary water supplier (Hetch Hetchy) is back in service, LLNL will strive to recapture its lost savings and get back on track. California's historic, continuing drought is a major driver for LLNL to strive to exceed the federal water reduction goal. If additional drought emergency measures are required, LLNL will evaluate how best to meet the emerging needs.

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.



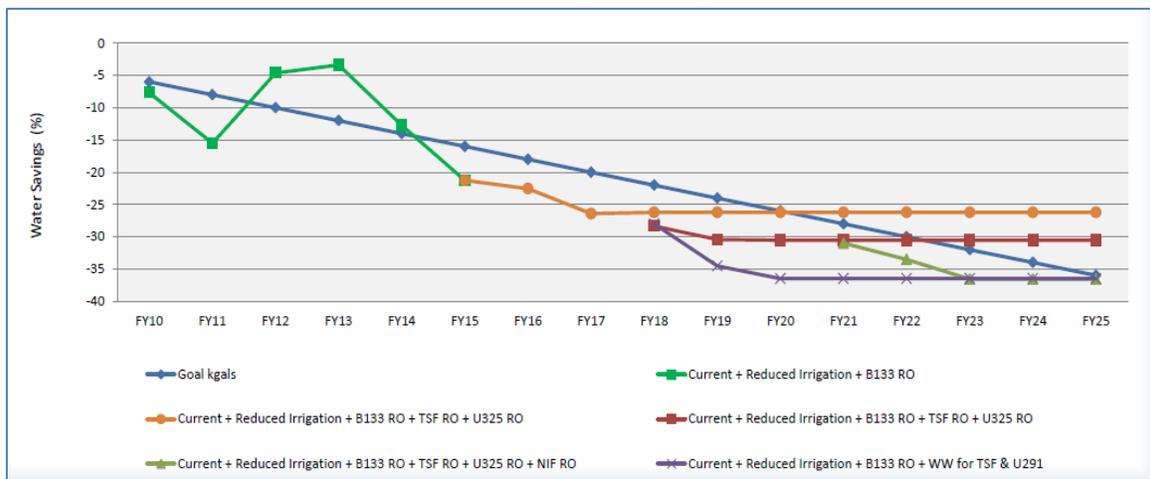
Resources Required

In FY 2017, LLNL will request funding to complete the water intensity reduction measures shown in Figure 4-1c. These projects, if funded and implemented, would allow LLNL to meet its water intensity reduction goal.

Project	Project Cost (\$M)	Annual Savings (\$M)	Simple Payback (Yrs)	FY17 (\$M)	FY18 (\$M)	FY19 (\$M)	FY20 (\$M)
Use RO Treated Wellwater at TSF	4.5	0.35	13.0	2	2.5		
Use RO Treated Wellwater at U325	4.9	0.23	21.6	2	2.9		
Use RO Treated Wellwater at U291	3.5	0.17	20.2		1	2.5	
Use RO Treated Wellwater at NIF	3.5	0.17	20.2			1	2.5
Use Reclaimed Wastewater at U291 and TSF	9.9	0.61	16.2	3	3	3.9	

Figure 4-1c. Proposed projects in support of SSPP Goal 4.1.

Chart below illustrates the effect of the estimated savings on the goal.



Potable Water Savings Approaches to Meet Goal

SSPP Goal 4.2

30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY2025 from a FY2010 baseline (2016 target: 12%)

Performance Status

LLNL uses potable water for industrial (i.e., cooling tower make-up) and landscaping 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 2017, pending operational readiness.

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 ground water 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 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 of 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 a number of low impact development designs to meet or exceed the 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 FY2016, additional resources required will be identified during the design phase.

SSPP Goal 5.1

30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline. (2016 target: 3%; 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 2016, LLNL contributed towards the 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 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 plan to incorporate ten (10) electric vehicles into its fleet as part of the 2017 target. LLNL will 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.

SSPP Goal 5.2

20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2016 target: 20%)

Performance Status (20% reduction in annual petroleum consumption by FY 2016 relative to a FY 2005 baseline; maintain 20% reduction thereafter.)

In FY2016, LLNL decreased its petroleum fuel consumption by 70.43% relative to the FY2005 baseline. This decrease was a direct result of more vehicles being assigned to LLNL's Site 300 in Tracy, CA. 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, CA. LLNL will continue to promote the reduction of miles driven by advertising and leveraging taxi services. Figure 5-2 shows the increase of the overall petroleum consumption.

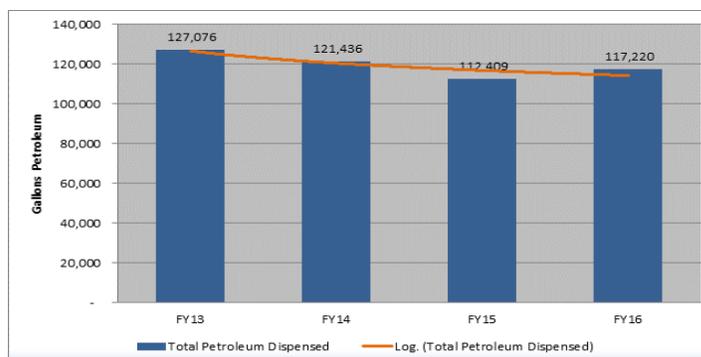


Figure 5-2. LLNL Petroleum Consumption Reduction.

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. (2016 target: 10%)

Performance Status

LLNL continues to focus its alternative-fuel strategy primarily on 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 to be composed of E85-compatible vehicles. In FY 2016, LLNL's use of alternative fuels (AF) increased 10% relative to the previous year's consumption. As shown in Figure 5-3 below, LLNL has entered the maturity stage on AF consumption and year-over-year increases are anticipated to level off. We are working with GSA to initiate an electric vehicle Pilot Program. In FY 2017, LLNL plans to replace ten (10) sedans with electric vehicles.

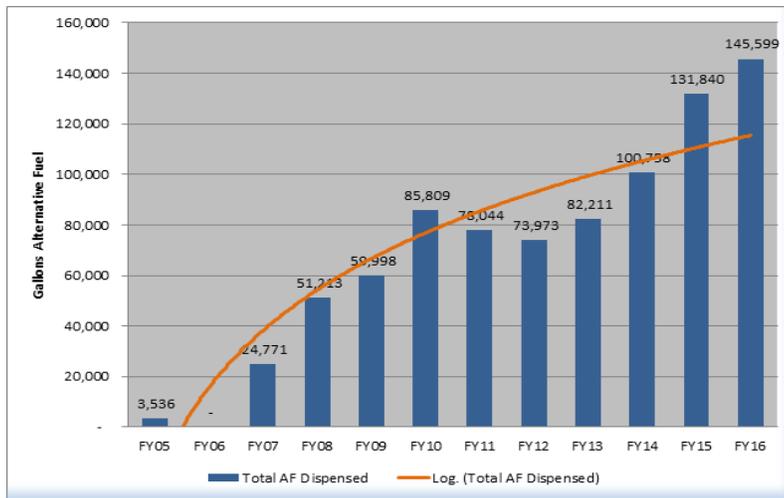


Figure 5-3. Total alternative fuel dispensed.

Plans and Projected Performance

LLNL plans to increase its overall electric vehicles fleet to sixty (60), in subsequent years.

SSPP Goal 5.4

75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2016 target: 75%)

Performance Status

In FY 2016, LLNL met and exceeded the required 75% replacement of fossil-fuel light-duty vehicles with AFVs. LLNL replaced over 77% of the light duty vehicles scheduled for exchange with AFVs. LLNL's current alternative-fuel fleet accounts for 97% of its total light-duty vehicles.

Plans and Projected Performance

LLNL will continue replacing its fleet with AFVs as manufacturers make them available and exploring different alternative fueled vehicle options. LLNL plans to replace ten (10) sedans with electric vehicles, and increase its overall electric vehicles fleet to sixty (60), in subsequent years. In the meantime, LLNL will continue with its primary E85 alternative fuel vehicle strategy.

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 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 station. Thirty seven (37) charging stations are available under the program and their use is allocated on a first-come, first-served basis. Thirty (37) employees are enrolled in the program.

This program is in response to employee requests and in support of NNSA and the Lab's site sustainability efforts.

DOE Fleet Management Information System (Fed FMS)

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 (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. (2016 target: 4%)

Performance Status

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

Plans and Projected Performance

FY 2017 goal is to evaluate the charging infrastructure required to support an electric vehicle fleet to meet the 2025 goal. Availability of electric vehicles will also be assessed. LLNL plans to replace ten (10) sedans with electric vehicles, and increase its overall electric vehicles fleet to sixty (60), in subsequent years. In the meantime, LLNL will continue with its primary E85 alternative fuel vehicle strategy. LLNL will 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.

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/recycled content have been incorporated into all LLNL General Provisions (GPs) for purchase orders and subcontracts making LLNL 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.

Sustainable Acquisition Highlights

- EPEAT: 90 % of all computers, monitors, imaging equipment, and televisions purchased during FY2016 successfully met the EPEAT criteria.
- LLNL continues to manage sustainable Integrated Contractor Purchasing Team (ICPT) agreements with Fisher Scientific, Grainger Industrial Supply, Holman's Inc., and VWR International Scientific Products. These agreements offer a range of special promotional pricing discounts from 15% off GSA Pricing up to 24% to the DOE Contractor Complex for environmentally preferable products.
- LLNL continues to award subcontracts to suppliers who offer DOT critical carbon steel drums made out of 15% recycled content material. During FY 2016, 9 Purchase Orders were awarded to Skolnik Industries totaling \$121,473.
- A subcontract with a contract value of \$3,950 was awarded to Stockton Tri-Industries, Inc. to manufacture 2 metal waste boxes containing 22% recycled content material.
- LLNL Computer subcontractors include 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

Administrator. 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 provides a punch-out list that identifies recycled content items to its customers. The catalog allows LLNL's Technical Release Representatives (TRRs) to see and search for recycled products.
- SCM continues to include quarterly EPEAT reporting requirements in its subcontract with Perfect Output for the purchase of multi-function devices (copiers/printers).
- The Controlled Items/Services List (CISL) identifies the items/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 Desktop, notebook workstations or computer monitor is 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 in order to ensure 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.

Monitoring and reporting EPEAT performance and raising overall awareness for sustainable acquisition requires EFA resources. As additional categories are added to EPEAT (such as imaging equipment, televisions, and servers) associated increases in tracking and informational outreach will be needed.

Recent Sustainability Awards

LLNL won a 2016 Environmental Stewardship Award from NNSA due to efforts of 21 employees who contributed to LLNL's Sustainability Performance Program (SP2).



A Plaque was presented by LFO to the awardees at the November Sustainability Summit meeting

SustainABLE Communications

The Laboratory was one of several sites across the nuclear security enterprise recognized with a 2016 Sustainability Award for innovation and excellence in environmental sustainability, by the Department of Energy's National Nuclear Security Administration (NNSA). LLNL's Sustainability Performance Program (SP2), in collaboration with many subject matter experts across the site, received an Environmental Stewardship Award in the Sustainable Communications category. This award category recognizes successful and innovative communication and marketing strategies that promote sustainability goals and best practices with a focus on effective and unique outreach programs that engage stakeholders and highlight the benefits of sustainability. Over the past few years SP2 has observed a shift in the conversation with employees concerning sustainability and pollution prevention issues and goals. Employees are reaching out more often, and not just with questions and concerns, but with valuable ideas, research and data, calculations, suggestions and solutions for a more sustainable campus. Because of employee input, LLNL has a growing personal electric vehicle charging program, greatly improved compost and recycling and has a path forward to refocus efforts on reuse. Employees have voiced their passion for sustainability through various feedback mechanisms and the SP2 program has stepped up to take advantage of this paradigm shift.

The four Laboratory SP2 initiatives recognized by NNSA during the past year are:

Green Hotline and *ES&H Newsletter*:

The lab's Green Hotline and *ES&H Newsletter* are valuable Labwide communication tools that provide employees with a direct connection to subject matter experts regarding environmental, wildlife and safety-related questions or concerns. The Green Hotline has been in place since 2008 with inquiries steadily

increasing over the years, which has helped the SP2 efforts on what matters to employees while also striving to meet sustainability goals.

Compost and recycling program in the cafeterias:

The Laboratory has a Composting and Comingled Recycling Program in both cafes and 13 buildings on the Livermore Site. Progress continues each year to expand the program in an effort to provide more recycling and composting opportunities and make separation less complicated for employees.

Employee electric vehicle program:

The Laboratory has a program for participating employees to charge their vehicles for a monthly fee. A long-term plan for government and employee vehicle charging is being developed to address the growing employee demand for additional charging stations and LLNL's fleet goals.

Bike to Work Day:

Bike to Work Day is an annual event that the Laboratory participates in and promotes to employees. The Laboratory partners with local organizations to coordinate activities and typically draws between 150 and 200 bicycle commuters.



LLNL was also awarded a Federal Green Challenge Achievement Certificate in 2016 for 2015 recycling program achievements. The Federal Green Challenge is sponsored annually by EPA to encourage organizations to set annual reduction goals of at least 5% in a variety of areas (such as waste, water use, sustainable purchases, transportation etc.) and strive to meet those goals over the year. Reporting is in December for the prior year (and as you can see, notification is almost 9 months later). LLNL has participated since inception in 2013.

Sustainable Materials Management

Federal Green Challenge



CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

Pacific Southwest Region

Lawrence Livermore National Laboratory 2015 Achievement

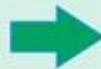
Region 9 EPA recognizes your 2015 Federal Green Challenge Achievement with this summary of progress and success in reducing your environmental impact. Your facility reduced its environmental footprint in the highlighted target area:



Waste & Materials

2015 Improvement:

Recycled	259 Tons
Improvement	14.4 %



Equivalent to avoiding annual GHG emissions from 156 passenger cars.

Note: improvement relative to FY14 data

SSPP Goals 7.1 and 7.2

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

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

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 2016.
LLNL status: LLNL consistently meets or exceeds this goal. In FY 2016, LLNL diverted 75%.
- Goal: Divert at least 50% of construction and demolition materials and debris by the end of FY 2016.
LLNL status: LLNL consistently meets or exceeds this goal. In FY 2016, LLNL diverted 57%.

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 13514 goals; Figure 7-1 highlights LLNL's progress in reducing paper usage. The Laboratory is identifying opportunities to go paperless where ever possible.

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 2016, the National Ignition Facility and Weapons and Complex Integration Directorates received briefings on the program and started the process of participating in the program.

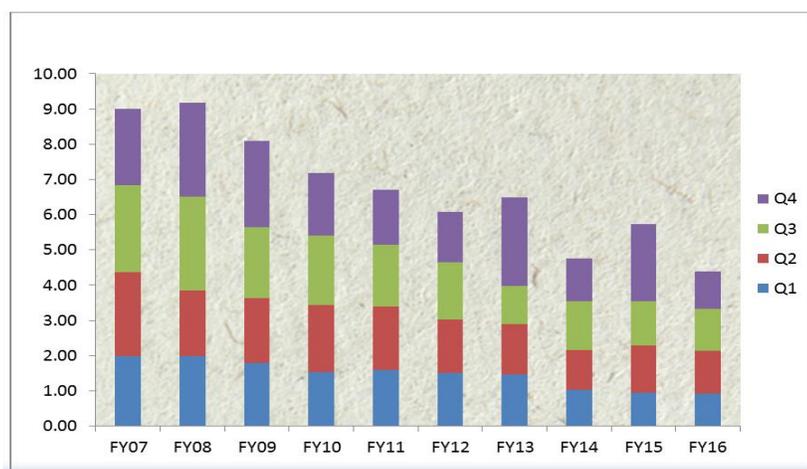


Figure 7-1 LLNL progress in reducing white office paper usage (reams per person purchased).

Waste Minimization and Recycling

LLNL regularly exceeds the EO 13514 goal that specifies that federal agencies divert at least 50% of routine non-hazardous solid waste, excluding construction and demolition debris, by the end of FY 2015. LLNL continues its comingled recycling and composting program in 13 buildings (about 30% of LLNL's population) and in both on-site cafeterias. During FY 2016, 65 metric tons of compostable waste and 43 metric tons of comingled recycling were collected under this program.

Waste collection areas in both LLNL on-site Cafeterias were revitalized in FY15 with new graphics, signs, and bins to encourage better separation of recyclable, compostable, and trash items into the correct bins. 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.

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

LLNL does not anticipate any changes in site population in FY 2017 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 7-2).

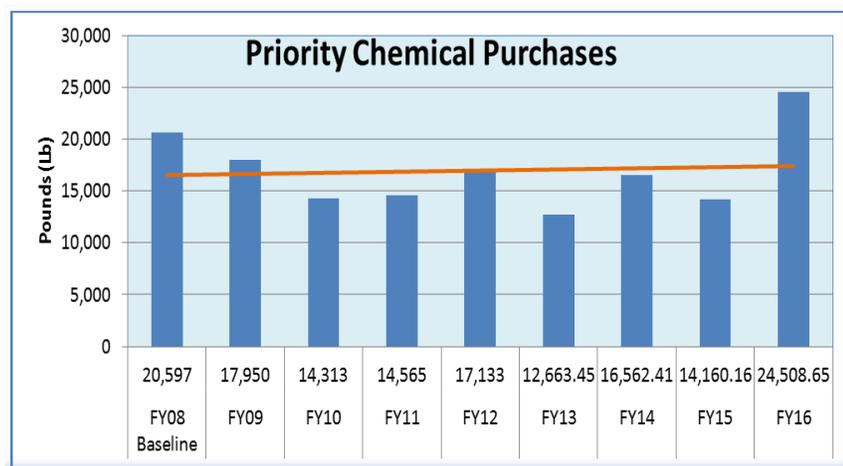


Figure 7-2. LLNL continues to track priority chemicals regularly.

During FY 2016, ChemTrack began converting from paper bar codes to Radio-Frequency Identification (RFID) technology to track hazardous materials at LLNL. The RFID conversion process provided an excellent opportunity to identify and reduce the number of legacy chemicals at LLNL. The reduction effort led to the disposal of approximately 10,500 hazardous materials and the recycling of almost 1,000 gallons of paint. The conversion effort was approximately 68% complete at the end of FY 2016. Full RFID implementation is anticipated by February 2017.



Integrated Pest Management and Landscaping Practices

An integrated pest management program has been developed, including sustainable landscaping practices.

Materials Not Cleared for Unrestricted Release

A Distinguishable from Background (DFB) Radioactivity Determination for Waste document was finalized in FY 2014 (LLNL-MI654907) to revise the process for certifying non-radioactive or radioactive waste. A DFB process for accelerator facilities has been implemented at most of LLNL's accelerator facilities.

Plans and Projected Performance

LLNL plans to continue to reduce pollution and increase recycling during FY 2017 by:

- Raising awareness through awards, outreach, and Laboratory events
- Expanding the compost and recycling program to more areas across the site
- 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. The increase observed in FY 2016 is due to a bulk purchase of a two year supply of sulfuric acid for wastewater treatment at the Waste Treatment Facility.

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 24 facilities as part of ECM3.1 and 79 advanced electric meters and Energy Management software called EEM Suite were installed as part of ECM3.2.

LLNL attempted a Utility Energy Services Contract (UESC) with the local utility, Pacific Gas and Electric (PG&E). An Investment Grade Audit (IGA) was completed and the proposal submitted in FY 2016. The final report proposed 4 energy conservation measures (ECMs) with an estimated cost of \$2M not including 3rd 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 also lack of resources. The ECMs will be prioritized in the master list for future projects as funding becomes available.

The 3.3MW photo voltaic 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 up-front can buy down the project and life cycle cost analysis can assist with improving the project's payback and will be applied as appropriate.

SSPP Goal 9.1

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

Performance Status

- Each fiscal year LLNL is tasked to meet the 95% goal 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 FY16 the overall percentage of EPEAT desktops electronics, imaging equipment, and television buys totaled 90 % for the year. LLNS did not meet the annual goal of 95% as 2 EPEAT Gold rated monitors that LLNL was purchasing during Quarters 1 and 2 were removed from the EPEAT list during Quarter 3. The monitor was the Dell 34-inch curved screen that LLNS was using to replace the use of 2, 24-inch monitors so employees could navigate across multiple applications. It should be noted that LLNL's purchases of desktop electronics during the first 2 quarters were at 100% then dropped to 97.8% and 80.7% in Quarters 3 and 4 when the curved screen monitor EPEAT rating changed. The chart below shows LLNL's achievements by quarter.

EPEAT Category	Q1			Q2			Q3			Q4			Total FY16		
	EPEAT	non-EPEAT	% EPEAT	EPEAT	non-EPEAT	% EPEAT	EPEAT	non-EPEAT	% EPEAT	EPEAT	non-EPEAT	% EPEAT	EPEAT	non-EPEAT	% EPEAT
Desktop Electronics	615	2	100%	1214	3	100%	1499	33	97.8%	1756	419	80.7%	5084	457	91.8%
Imaging Equipment	51	12	81%	68	4	94%	81	1	98.8%	66	1	98.5%	266	18	93.7%
Televisions	1	11	8%	0	15	0%	3	38	7%	3	35	7.9%	7	99	6.6%
Overall for all 3 Categories	667	25	96%	1282	22	98%	1583	72	96%	1825	455	80%	5357	574	90%

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 (TIG), 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 ensure the goal is met.

SSPP Goal 9.2

Power management – 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

Automatic duplexing – 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 Environmental Management System (EMS), the Directors Office made progress in migrating to the lab's Managed Print Services and eliminating desktop printing. Several other groups worked to eliminate all non-essential printers from individual offices and reduce paper use by distributing agendas and other media electronically.

Plans and Projected Performance

In FY 2017, Operations and Business has a plan to move forward on revising the laboratory's print management policy to increase toner and paper savings including an approach to evaluate the percent of printers set to default, which has not yet been fully evaluated.

SSPP Goal 9.4

End of Life – 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, 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, table top 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.



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

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

Performance Status

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 18 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 LLNL Data Center Master Plan of reducing data center inventories, 25% (1) of existing tiered data centers and 60% (7) non-tiered data centers will be closed and no longer used for data center operations before the end of fiscal year 2018. In addition, it is anticipated that through the DCWG LLNL will support the migration of inter-agency co-location data centers into the Enterprise Data Center currently located in B112.

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.

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 (see photo below).



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 high-performance computing (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 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 megawatts 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, 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.

SSPP Goal 10.1

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

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.



A parched landscape at LLNL's Site 300 in 2015; the years 2012 through 2016 were the driest in California's recorded history. (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.

LLNL water is supplied from Hetch Hetchy water system which relies primarily on Sierra Nevada snowmelt. The years 2012-2016 were the driest years in California's recorded history, and in April 2016, 74% of the state was in severe drought. Limited recharge due to the California drought and continued groundwater pumping from the Livermore Site aquifer for groundwater remediation has resulted in declining ground water levels observed and yields at many extraction wells, and expansion of pumping-induced ground water depressions across the site. Pumping-induced ground water depressions are documented in the most recent 2015 Annual Report for the Groundwater Project. 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.

Climate change may increase the number of extreme heat days and the number of cooling degree days experienced at LLNL. 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 on Site, and create a greater potential for black-outs or brown-outs of the electrical grid. In addition to redundant grid suppliers, LLNL has back-up diesel electricity generators for critical systems and facilities. In recent years, LLNL has replaced several conventional roofs with white-roofs which reduce heating gain to the building thus decreasing the cooling load. Because LLNL already experiences extreme heat days, we have already considered the potential for extreme heat to impact outdoor workers. LLNL currently conducts training for these workers that includes strategies for the prevention of heat illness including work-rest regimens (see photo below).



During an exercise, LLNL emergency responders practice lifting a worker who has suffered heat related illness (Photo Credit Paul Hara/LLNL)

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. The Lab may 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 climate 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 wild fires. As climate models predict more extreme droughts that persist for longer than normal periods of time, the risks from wild fires 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 Lab 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.



Hillsides near Site 300 burned by the Tesla wildfire. LLNL emergency responders practice their fire extinguisher skills on an HVAC unit during an exercise. (Photo Credits Lisa Paterson and Paul Hara/LLNL)

SSPP Goal 10.3

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

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.



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, and 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. As needed, LLNL management may consider issuing internal communications or updating policies relating to adaptation efforts.



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 climate change 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.



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 intercomparison 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 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 own climate scientists and experts in the field would advise on the use of the latest tools and science available for predicting and planning the effects of climate change as well as on the application of climate projections appropriate to Livermore's regional climate. LLNL will continue to apply the best available science in all decision making, including decisions relating to climate change adaptation and resilience.



Appendix

DOE Building Exclusion Self-Certification Form

Part G Exclusions Letter

Part J Exclusions

Part G Exclusions

DOE Sustainability Dashboard Data Self-Certification Form

DOE BUILDING EXCLUSION
SELF-CERTIFICATION FORM
FY 2016

FROM: Lawrence Livermore National Laboratory
Program Office Landlord: NNSA

TO: Sustainability Performance Office

DATE: November 8, 2016

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

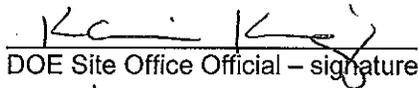
Each buildings or group of buildings that are to be excluded under the criteria for a Part G or Part H exclusion is/are metered for energy consumption and their consumption is reported annually.

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 Site Office Official - printed name


DOE Site Office Official - signature

11/16/16
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.

Part J

FIMS Site Number	Site Name	Prop Sequence	Property ID	Prop Name	EXCLUSION PART	PROPERTY TYPE	Comments
14002	Lawrence Livermore National Laboratory	200806	453	TERA SCALE FACILITY	G	B	Note 1
14002	Lawrence Livermore National Laboratory	200870	OS 454	TSF COOLING TOWERS	G	S	Note 1
14002	Lawrence Livermore National Laboratory	89922	451	COMPUTATION FACILITY BLDG	G	B	Note 2
14002	Lawrence Livermore National Laboratory	140320	581	LTAB	G	B	Note 3
14002	Lawrence Livermore National Laboratory	137350	681	OPTICS ASSMBY BLDG	G	B	Note 3
14002	Lawrence Livermore National Laboratory	140981	OS 682	NIF CENTRAL PLANT	G	S	Note 3
14002	Lawrence Livermore National Laboratory	140860	OS 683	NIF COOLING TOWER	G	S	Note 3

Note 1 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 data collection software. The Computations facility management team identified process and building related, non-process, meters. The computer floor (48,000-SF) will be reported as Metered Process per the Instructions for DOE Building Exclusions Self-Certification guidance, because lighting and HVAC electric power use for the computer floor are included, to some part, and are not totally metered separately. The remaining building area of 193,197-SF will be reported as Energy Consuming Buildings/Facilities. Process energy use by the TSF, B453 and the cooling tower, OS 454 will be reported under "Metered Process"; facility area is 0-SF, thus, the reporting category is moot.

Note 2 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-90 data collection software. The Computations facility management team identified process and building related, process & non-process, meters.
 Building 451 22,221 SF - to Metered Process Category = Computer Operations areas per LLNL data base
 Natural Gas Usage: Virtually no reheat is used for the (process) computer area, thus, natural gas usage is NOT excluded.

Note 3 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 separately metered.

581	693,002	SF - to Metered Process Category
681	46,819	SF - to Metered Process Category
OS 682	8,880	SF - to Metered Process Category
OS 683	2,104	SF - to Metered Process Category

B681 is the Optics Assembly Building and it directly supports B581 National Ignition Facility (NIF) that serves a national security mission. The high process energy used at B681 is primarily from the HVAC air handling equipment used for the clean-room environment (Class 10000) necessary for the operation of the optics plant. Lighting and HVAC are not separately metered at B681 and is placed under the Metered Process category per the Guidelines Establishing Criteria for Excluding Buildings published by FEMP on January 27, 2006. It is impractical to apply ordinary LCC ECMs to B681 based on its energy intensiveness in which, to quote the Guidelines, conventional performance measures are rendered meaningless by an overwhelming proportion of process dedicated energy. Facilities with energy-intensive processes where agencies can clearly demonstrate that process-dedicated energy overwhelms other building energy consumption, and the fluctuation in the operation of the process would significantly impact meeting the energy performance requirements, may be excluded.

TSF (B453) serves a national security mission. B453 houses the High Performance Computers that are all high energy intensive consumers. Cooling Tower (OS454) supports TSF by ultimately removing the heat load generated by the chillers. The high energy load at B453 comes from the chillers and air handling units that provide cooling for the high performance computers. It is impractical to apply ordinary LCC ECMs to B453 based on its energy intensiveness in which, to quote the Guidelines, conventional performance measures are rendered meaningless by an overwhelming proportion of process dedicated energy. Facilities with energy-intensive processes where agencies can clearly demonstrate that process-dedicated energy overwhelms other building energy consumption, and the fluctuation in the operation of the process would significantly impact meeting the energy performance requirements, may be excluded. However, a 'Free Cooling' energy saving project has been designed and estimated for B453 and needs funding to be implemented.

U.S. Department of Energy
Facilities Information Management System
Energy Consuming Excluded Buildings and Trailers List

09/22/2016

Program Office **NNSA**

Site **14002 Lawrence Livermore National Laboratory**

Property ID Justification Comments:	Real Property Unique ID	Property Name	Exclusion Part	Property Type	Gross SQFT	Excluded Facilities (GSF)
112	203771	Computer Center	G - Metered intensive loads	Building	45,512	45,511
The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy.						
U6042	136630	Mocho Potable Pumping Station (HH)	G - Metered intensive loads	Building	354	353
The building is a central pumping station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.						
117	89551	LLNL National Security Computing Center	G - Metered intensive loads	Building	11,370	11,369
The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy.						
133	89563	GS / Central Plant /DPRF/NTTC	G - Metered intensive loads	Building	5,631	5,630
The building is a central utility station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.						
256	89727	Telecom Node #1	G - Metered intensive loads	Building	5,937	5,936
The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.						
313	89770	Regional Dispatch Center	G - Metered intensive loads	Building	4,352	4,351
The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.						

This report qualifies DOE Owned, DOE Leased, Contractor Leased, Contractor License and Permit buildings and trailers where the Excluded Facilities (GSF) is greater than zero.

U.S. Department of Energy
Facilities Information Management System
Energy Consuming Excluded Buildings and Trailers List

09/22/2016

Program Office **NNSA**

Site **14002 Lawrence Livermore National Laboratory**

Property ID Justification Comments:	Real Property Unique ID	Property Name	Exclusion Part	Property Type	Gross SQFT	Excluded Facilities (GSF)
3304 the toilet trailer is shutdown pending D&D	143411	Restroom Trailer	H - Impracticability	Trailer	128	128
331 The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.	89801	Tritium Facility	G - Metered intensive loads	Building	30,484	30,483
332 The building's energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy conservation.	89802	Plutonium Facility	G - Metered intensive loads	Building	104,787	104,786
334 The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.	89803	HETB	G - Metered intensive loads	Building	10,668	10,667
335 The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.	89804	Support Facility	G - Metered intensive loads	Building	11,988	11,987
439 The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy.	89908	WCI Livermore Computing Facility	G - Metered intensive loads	Building	12,055	12,054

This report qualifies DOE Owned, DOE Leased, Contractor Leased, Contractor License and Permit buildings and trailers where the Excluded Facilities (GSF) is greater than zero.

U.S. Department of Energy
Facilities Information Management System
Energy Consuming Excluded Buildings and Trailers List

09/22/2016

Program Office **NNSA**

Site **14002 Lawrence Livermore National Laboratory**

Property ID Justification Comments:	Real Property Unique ID	Property Name	Exclusion Part	Property Type	Gross SQFT	Excluded Facilities (GSF)
451	89922	WCI Livermore Computing Facility G - Metered intensive loads		Building	51,398	22,221
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						
453	200806	WCI Livermore Computing Facility G - Metered intensive loads		Building	240,598	48,000
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						
581	140320	The National Ignition Facility	G - Metered intensive loads	Building	700,907	697,111
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 separately metered.						
681	137350	Optics Assembly Facility	G - Metered intensive loads	Building	46,818	46,818
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 separately metered.						
693	90044	EPD/RHWM Waste Storage	G - Metered intensive loads	Building	12,000	11,999
The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.						
695	140676	EPD/RHWM Liquid Waste Processing	G - Metered intensive loads	Building	46,504	46,503
The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.						

This report qualifies DOE Owned, DOE Leased, Contractor Leased, Contractor License and Permit buildings and trailers where the Excluded Facilities (GSF) is greater than zero.

U.S. Department of Energy
Facilities Information Management System
Energy Consuming Excluded Buildings and Trailers List

09/22/2016

Program Office **NNSA**

Site **14002** **Lawrence Livermore National Laboratory**

Property ID Justification Comments:	Real Property Unique ID	Property Name	Exclusion Part	Property Type	Gross SQFT	Excluded Facilities (GSF)
696 The building supports a Nuclear Facilities whose energy use is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional.	135831	EPD/RHWM Solid Waste Processing	G - Metered intensive loads	Building	21,381	21,380
U291 The building is a central utility station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.	90074	LCW Station	G - Metered intensive loads	Building	8,631	8,631
U325 The building is a central utility station that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building.	90078	LCW Control Support	G - Metered intensive loads	Building	5,072	5,071
115 The building is a computing facility that is driven by mission and operational requirements, not necessarily buildings and not influenced by conventional building energy	89549	Computer Center	G - Metered intensive loads	Building	17,140	17,140

This report qualifies DOE Owned, DOE Leased, Contractor Leased, Contractor License and Permit buildings and trailers where the Excluded Facilities (GSF) is greater than zero.

DOE SUSTAINABILITY DASHBOARD DATA
SELF-CERTIFICATION FORM
FY 2016

FROM: Lawrence Livermore National Laboratory
Program Office Landlord: NNSA

TO: Sustainability Performance Office

DATE: November 8, 2016

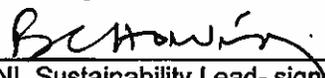
SUBJECT: SELF CERTIFICATION FORM FOR DASHBOARD DATA ACCURACY VERIFICATION

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*.

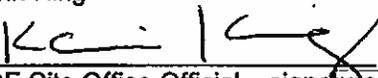
To fulfill the Department's sustainability reporting requirements, data was previously collected through the Consolidated Energy Data Report (CEDR) and verified by a Site's manager or Program Office through the SSP submission process. The CEDR has been retired and a new system for data collection, the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

I certify that the data submitted for FY 2016 through the Dashboard as of November 8, 2016 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

11/21/16
Date

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